

**Large Polities and Small Quarries: Local Resources and Imperial
Governance in Roman Asia Minor**

by
Bradley M. Sekedat

A Dissertation
Submitted in Partial Fulfillment of the Requirements for the Degree of
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This dissertation by Bradley M. Sekedat is accepted in its present form
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M.Phil. Thesis: *Cultural Identity, Settlement, and Land Use in Central Italy*.
Advisor: Damian Robinson.
- 2004 **Michigan State University** B.A.: Latin; B.A.: Anthropology; Cognate: History;
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RESEARCH INTERESTS

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 - Survey Methodology – pedestrian survey practices in Mediterranean contexts applied towards greater integration of human settlement and landscape features.
 - Ancient Quarrying Practices – tool use, industry organization and community formation. Developing notions of natural resources that incorporate social activities.
 - Remote Sensing applications in archaeology – satellite imaging and 3D laser scanning.
 - Archaeological Science – application of technologies to material remains
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TEACHING EXPERIENCE

- 2011 Teaching Assistant – Department of Anthropology: *Human Evolution* (Dr. Andrew Scherer)
- 2009 Teaching Assistant – Institute for Archaeology: *Introduction to Egyptian Archaeology and Art* (Dr. Laurel Bestock)
- 2008 Teaching Assistant – Institute for Archaeology: *The Archaeology of College Hill* (Dr. Krysta Ryzewski)
- 2008 Teaching Assistant – Institute for Archaeology: *Roman Archaeology and Art* (Dr. Susan E. Alcock)

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In Press	Carved in stone: long-term modification of the landscape as place-making practice at Fasillar, Turkey. In C. Fenwick, K. Lafrenz Samuels and D. Totten (eds.), <i>Roman Spaces, Heritage Traces: Past and Present Roman Place-making</i> . Journal of Roman Archaeology Supplementary Series: Portsmouth.
2010	No place like stone? Assessing social and material networks of place at quarries in Roman Anatolia. In A. Moore, G. Taylor, E. Harris, P. Girdwood and L. Shipley (eds.), <i>TRAC 2009: Proceedings of the Nineteenth Annual Theoretical Roman Archaeology Conference, Michigan and Southampton 2009</i> . Oxford and Oakville: Oxbow Books: 23-30.

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- 2011 O. Aldred and **B. Sekedat**. "Part Four of Moving on to Mobility: Archaeological Ambulations on the Mobile World," Posted on Archaeolog: archaeology blog – all things archaeological, April 9, 2011.
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- 2010 O. Aldred and **B. Sekedat**. "Part One of Moving on to Mobility: Archaeological Ambulations on the Mobile World," Posted on Archaeolog: archaeology blog – all things archaeological, November 29, 2010.
- 2009 Review of D. Hicks, L. McAtackney, and G. Fairclough, *Envisioning Landscape: Situations and Standpoints in Archaeology and Heritage*. (Walnut Creek: Left Coast, 2007). Posted on Archaeolog: archaeology blog – all things archaeological, February 20, 2009.
- 2008 "Landscape complexity and new media: a review of the Carrlands Project website (M. Pearson)," Posted on Archaeolog: archaeology blog - all things archaeological, April 27, 2008.
- 2007 L. Anderson, C. Mesick, C. Reiser, K. Rysewski and **B. Sekedat**. "Lessons from the Ethics Bowl, Lessons from a Collaborative Experience," Posted on Archaeolog: archaeology blog - all things archaeological, June 6, 2007
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- 2012 'Making more sense,' to be presented at the 77th Annual Meeting of the Society for American Archaeology, Memphis, Tennessee, April 2012.
- 2011 'The places Hadrian didn't go: rural quarries in western Asia Minor,' presented in the Brown Bag Series in Archaeology, Brown University. October 6, 2011.
- 2011 'Placing the quarries of Petra in their context,' presented at the 112th AIA and APA Joint Annual Meeting, San Antonio, Texas, January 2011.
- 2010 Member of organizing committee, Theoretical Archaeology Group (TAG) conference, Brown University, May 2010.
- 2010 Session co-organizer with Oscar Aldred; 'Archaeological Ambulations: Integrative Approaches to Movement' at the Theoretical Archaeology Group (TAG), Brown University, May 2010.

- 2010 'Mines without borders: movement, material and diffuse boundaries of place,' presented at the Theoretical Archaeology Group (TAG), Brown University, May 2010.
- 2009 'Making quarries move: the case of Fasillar,' presented at the Theoretical Archaeology Group (TAG), Stanford, May 2009.
- 2009 'No place like stone? Assessing social and material networks of place at quarries in Roman Anatolia,' presented at the Theoretical Roman Archaeology Conference/Roman Archaeology Conference, Ann Arbor, April 2009.
- 2008 Paper presented to the Brown Bag Series in Archaeology, Brown University. Discussed recent research on place-making practices in Turkey and Central Italy. April 3, 2008.
- 2008 'Carved in stone: long-term modification of the landscape as place-making practice at Fasillar, Turkey,' presented at the Critical Roman Archaeology Conference, Stanford University, March 1, 2008.
- 2006 'Small Finds and Settlement Organization: landscape and cultural identity in central Italy,' presented at the Classical Archaeology Graduate Work in Progress Seminar, University of Oxford, April 27, 2006.
- 2004 D. Gaff, J. Carroll, L. Goldstein, **B. Sekedat**, 'Painting the big picture with a fine brush: archaeological insights from the Aztalan GIS group,' presented at the 69th annual meeting of the Society for American Archaeology, Montreal, April 10, 2004.
- 2001 'Aztalan: Projectile Point Usage and Dispersal,' presented at the 47th annual meeting of the Midwest Archaeological Conference, La Crosse, October 13, 2001.
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- 2010 -2011 Central Lydia Archaeological Survey – Manisa province, Turkey.
Team member and team leader of pedestrian survey. Involved surface collection of artifacts, architectural survey of an abandoned village (Eskihaciveliler), and ceramic processing and recording. Conducted independent dissertation research, including survey, mapping and marble sampling of 11 quarries.
- 2010 Brown University Petra Archaeological Project – Petra, Jordan.
Team member and team leader of pedestrian survey around the city of Petra. Involved surface collection of artifacts, feature drawing and photography, and a small-scale survey of the quarries in the countryside surrounding the urban core.

- 2009 Southern Beyşehir Lake Basin Archaeological Research Project – Konya province, Turkey. Research Assistant to Professor Ömür Harmanşah, Brown University. Reconnaissance of Beyşehir Lake basin region in preparation for future archaeological fieldwork.
- 2008 Eastern Boeotia Archaeological Project – Boeotia, Greece. Team member and team leader of pedestrian survey for diachronic landscape archaeology project. Involved surface collection of artifacts.
- 2007-2008 Event Place Performance – Konya province, Turkey. Research Assistant to Professor Omur Harmansah, Brown University. Project addresses significance of Hittite period rock reliefs and spring sanctuaries in the central Anatolian landscape.
- 2007 Landscape Chorography – Argolid, Greece. Research Assistant to Dr. Christopher Witmore, Brown University. Project explores the complexity of landscape synthesis and the production of archaeological knowledge in southern Greece. Involved the re-visitation of published sites.
- 2003-2006 Sangro Valley Project – Tornareccio, Italy. Supervised Field School students in excavation, topographical survey and shovel-testing at and around a pre-Roman and Roman period mountain sanctuary in central Italy.
- 2001-2002 Aztalan Project – Aztalan State Park, Wisconsin, USA. Field School student. Project involved the excavation outside of the palisade wall of the northernmost Middle Mississippian village in North America as well as pedestrian survey of surrounding farmland.
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LANGUAGES

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A little more than four years ago, I received an unexpected email from Sue Alcock in response to some poorly formed thoughts about the site of Fasıllar, Turkey, which I had visited with Ömür Harmanşah the previous summer. The text of the email simply said, “How about the role of quarries in the landscape?”, and I have embraced it as my dissertation topic ever since. How I have come to think about “quarries in the landscape” has changed in numerous ways since 2008 through the contributions of many people, and I wish to thank them here.

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- Fig. 7.6 View of Petra city center with rock cut sandstone façades (photography by author).
- Fig. 7.7 Map of western and central Turkey showing the location of Fasıllar, Eflatunpınar, Karahisar, and Kibyra (ArcGIS basemap; created by author).

Chapter 1

Introduction

Producing a Polity

In the *Res Gestae Divi Augusti*, the first Roman emperor recounts his role in transforming the Roman state into the seat of *imperium*. Augustus boasts that what once was a city of brick is now a city of marble, an accomplishment he lists alongside numerous other enhancements to Roman power and prestige. Many of his deeds refer to the world abroad through battles and conquest; he lists territorial expansion on seemingly every front, including Spain, Gaul, Egypt and Armenia. His list of accomplishments is inscribed in marble in Ankara and in the *Campus Martius*.¹ Not far away, among the imperial fora, Trajan erects a column that depicts his conquests and his deeds in a visual series of historical depictions approximately 100 years after Augustus. Among Trajan's tales, as referents to the Roman world that few living in peninsular Italy ever saw, are personifications of landscapes and territories, such as the Danube River in the province of Dacia. Trajan, too, does this with marble. In Asia Minor, the provincial governor Plinius Secundus (Pliny the Younger) writes to Trajan requesting assessment of the terrain between Nicomedia and the Sea of Marmara for the construction of a canal to ease transport of marble and other goods that, he claims, boost impressions of the emperor's

¹ Monumentum Ancyranum, Temple of Augustus in Ankara. The version in Rome is presumed to have been marble initially, though replaced by a Bronze tablet at the entrance of Augustus' mausoleum.

magnanimity greatly. Somewhere in central Lydia, a farmer and several villagers strike iron pickaxes against the marble bedrock to extract modest amounts of stone for the construction of a dam wall.

In their own way, each of these vignettes provide some detail about the composition of the Roman empire, its relationship to natural resources, and the different ways this was experienced and expressed. All say something about Rome as a polity; Augustus and Trajan, for example, advance a view of empire through the rhetoric of power and expansion. Their role as the central figure of the state apparatus secures legitimacy for them at the same time that it situates authority in a central figure of governance. Pliny plays a part in this, as well, beseeching Trajan for permission to modify the landscape in order to move material more easily: material that Trajan, Pliny reminds us, both controls and from which he benefits. And yet, rhetoric is only a small portion of how the polity of Rome was constituted. The emperor's words must somehow translate to physical manifestations of authority. The big questions, then, are: How was this manifested on the scale of empire, and to what extent did it reach the farmer cutting marble in central Lydia (acts not clearly associated with any direct form of imperial oversight)?

Even within the propagandistic program of Roman imperial art and architecture, the message conveyed about how an empire should relate to its populace is rooted in places.² The Mausoleum of Augustus and the Column of Trajan are not located without consequence, and the rhetorical messages they convey about the relationship between the empire and its people leave room for alternative engagements. The recently conquered,

² See Khatchadourian (2008) for a discussion of this differentiation between what empires should be and what they are.

newly-made Romans, simultaneously express the empire's might and the pride of the rest of its people.

This dissertation presents a critical examination of how the Roman polity was constituted through the lens of marble quarrying in the rural landscapes of the Marmara Lake Basin in Roman Asia Minor. The region, comprising the hinterland of the city of Sardis, which was the seat of the Lydian Kingdom during the Iron Age, a Persian satrapy in the Achaemenid period, and a major Roman city during the empire, is in the Hermus (Gediz) river valley 15km north of the Tmolus mountains, retaining significance throughout time as fertile region with topographical advantages. I argue that polities, as spatial projects, exist somewhere outside of the political discourse promoted by state rhetoric. More critical in the context of expansive empire are the interventions in landscapes and places. Yet here, too, the techniques of governmentality have a ceiling because the landscapes and places in which such expressions of governance occur, push back, mediating the space of an imperial polity in forceful ways. It is this reason that makes the farmer, who does not see the words of Augustus or the depictions of Trajan, so critical to understand. His experiences, when combined with the project of governmentality undertaken by the Roman empire itself, provide a broader basis for the characterization of Rome as a spatial polity.

Because the Roman empire is so large, however, the analysis of it as a spatial polity is restricted here to one portion of its geographical extent (Fig. 1.1). The province of Asia Minor (later called Lydia) in the later imperial periods, was witness to a spectrum of governmental techniques and local responses that are, in many ways, indicative of the character of these landscapes and the deeply rooted aspects of place that adhere in them.

Falling under Roman sovereignty in the second century BCE (133 BCE), Asia Minor reveals that Roman policy entailed more than firm control over certain institutions and tolerance of other local practices. The penetrating projects of marble extraction in Anatolia's rich geological sources and the multiple local networks that develop in and around them speak instead to the inherent limits in imposing dislocated structures in located places. In other words, Asia Minor reveals that diversity is not a precondition of Roman governance, but a derived condition of the realities of governmental attempts. The landscapes of Anatolia inform the polity, and a look at the hinterland of Sardis reveals how this is so in one context.

Definition of Terms

Throughout the dissertation I refer to the extraction of marble as a place-based, landscape-based enterprise with ramifications for how we understand the spatial constitution of polities and their techniques of governmentality.³ This entire sentence is laden with terms that require definition before advancing any argument that could otherwise be lost in jargon. Rather than begin with strict definitions of terms that result in nuanced understandings of what I am trying to convey, I begin with what I want these words to do and explain why the term selected is appropriate for achieving this effect.

The idea of 'small quarries', which form the primary case study presented in this dissertation, requires explanation. The term itself focuses primarily on the difference between imperial and urban quarries that were extracting marble on the scale of

³ The terms place, space and landscape are the same defined by A. Smith (2003: 32). Our definitions, however, differ to some degree, though he builds on Tuan (1977) and Casey (2001).

exportation, and those that very likely did not. There is therefore a difference in scale as it relates to physical size and to patterns of distribution. Imperial and urban quarries are invariably larger in size than those in the Marmara Lake Basin, sometimes on the order of several hundred times. Thus, even though a quarry within the Marmara Lake Basin can be 40m x 15m at its largest extent, the volume of stone extracted from such a quarry, and its overall size, are comparably small. Small-scale quarries can also refer to the fact that material from a quarry was unlikely to have traveled very far. In most cases – and indeed in the case study presented here – both issues relating to scale overlap significantly. Physically small quarries do not tend to yield marble that is traded over great distances, and quarries used for local construction projects do not tend to be great in size. This pattern is not uniform through Anatolia or the Mediterranean, but this definition of a ‘small quarry’ adequately conveys the dominant behaviors associated with them: small-scale production of marble or other stones for local projects, with local ownership and oversight. This notion of shifting scales and the attendant issues of oversight and control provide a beneficial way to understand socio-political structures in antiquity, given the Roman empire’s notorious interest in high-grade stone. Since quarries exist everywhere, the practices undertaken in extracting marble from quarries of different scales offer a way to reevaluate the nature of the Roman polity.

The term polity was selected as the point of investigation because it is conveniently broad in its conceptual parameters. It includes some form of deliberate governmental control, and alludes to the “highest order socio-political unit in the region in question” (Renfrew 1986: 2), while dropping some of the baggage that assumes cultural homogeneity within those boundaries. Polity, as it appears in this dissertation,

has geographical parameters, but only insofar as it is used here to discuss the Roman empire. Renfrew and Cherry (1986) argue convincingly that the term polity best encapsulated the notion that socio-political units cannot function in isolation (see most pointedly Renfrew 1986: 1), and therefore the sole focus of scholarship cannot be a political entity without considering other factors that shape that entity. They rightly bring into play neighboring groups with their own hierarchies, suggesting that neighboring polities influence each other through clear forms of interaction. Whereas most instances of its use, however, refer to smaller socio-political units, my argument here is that the term polity should also attend to the internal parameters by which the dominant socio-political unit is shaped and reshaped over time. Here, in much the same way that an empire, for example, does not exist in isolation from competing political units such, it also does not exist outside of a multitude of internal stresses. For the Roman empire, the term polity would better enable a discussion of how local practices in distant provincial places have a bearing on the form and expression of the empire itself. This, in turn, would feed back into a discussion of how that unit governs and what influences its form of government.

Polity is therefore a powerful term that depends on social relationships, both internal and external, in supporting a governmental form, such as Foucault's term 'governmentality' (Foucault 2006a). This term, as applied here, refers more specifically to the nature of those social relationships as they produce both governing bodies and governed bodies – noting that the significance of both in determining the (malleable) form of that relationship is of utmost importance. Polities are constructed through practices of governmentality, which is itself derived from a combination of techniques

that attempt a specific form of governance, yet whose outcome is determined by the relationships in which such techniques play out. For the purposes of this dissertation, such approaches will be studied through the lens of quarries because they provide a glimpse into internal forms of governance in some places (imperial quarries) and internal stresses (local landscape contexts) in other places. Governmentality therefore encompasses the lived intersection between attempts at governance and on-the-ground experiences, and is crucial for understanding the role of place in spatial polities. It is the point of discursive intersection between governments and populations. Quarries matter in this regard because they provide evidence for how this varied across the Roman empire.

Smith (2003; 2011), following Lefebvre (1991), notes that polities are spatial, a term he uses to refer to the arena of relational encounters (2011: 32). Smith notes that space is where polities come to be, and so privileges this term. Place, although crucial in establishing the relational context, is to Smith more of a mediating entity. In the context of this dissertation, however, places are granted great significance, because of the importance they hold in the development of spatial policies and structures that characterize the polities under investigation. Since this project is about how polities are characterized, and what role rural landscapes play in forming the spatial polity, place, and in a closely related way, landscapes, become of great concern. In effect, the notion of place employed in this dissertation, which argues for the significance of place in the constructing of polities, depends upon the accumulation of material and cognitive associations that are flexibly applied, malleable, yet resolute. Places are subject to change because of the material and social conditions within which they exist are constantly

changing, yet they are able to retain great time depth as well for these very same reasons. Thus, monumentality can affirm social significance in some locations, yet the precise social conditions are subject to variation from moment to moment (Bradley 1991; 1998). Landscapes themselves have specific attributes that play into social relationships, but those social relationships, as they relate to landscapes, influence subsequent relationships in much the same way that the material aspects do. Landscapes are therefore both material and perceived (Johnson 2007: 2-4). The variability in both these cognitive associations, and the subtle changes that impact material aspects of the physical world also inform the definition of place used here, because it speaks to the fluidity of such associations and the fact that they are always becoming. Landscapes are therefore not backdrops that are limited to the realm of the environmental, because they are always part of the social relationships that mediate space, place and polity. These topics are tightly woven together and overlap in significant ways, making clear definitions difficult to achieve, as they are all necessary elements of the same project. It is through these terms, applied to the Roman Mediterranean, that the dissertation progresses.

Outline of the Dissertation

As spatial enterprises, polities are more than the successful implementation of state ideologies. Instead, polities are continuously created by differentially expressed interventions in landscapes and places. Some locations witness intensive alterations by state authorities while others continue to operate in more informal ways. To emphasize the significance of landscape in the constitution of the Roman polity, this dissertation

investigates one industry – marble extraction – exploring production undertaken in rural contexts before juxtaposing this to other forms of marble extraction during the Roman imperial period. Chapter 2, however, begins with the task of outlining a theory of place and governance that points out the multiplicity of imperial techniques of governmentality and what researchers in anthropology call “the informal economy”. This chapter navigates some of the different motivations underlying the social relationships that produce a system of imperial governance during the Roman empire. In particular, the coordination of labor at quarries owned by the empire is portrayed as an incomplete or inchoate form of governmentality employed by the state in expanding its spatial authority in the Mediterranean basin. After acknowledging that Rome applied the systematization of wages and labor practices to many marble quarries as a technique of governmentality, the abundance of instances in which such techniques were *not* applied are marshaled as evidence that the polity was diversely comprised. The chapter concludes with an introduction of the eleven marble quarries that form the primary case study.

While Chapter 2 tackles the theoretical underpinning of how to understand a polity through its diverse practices, chapter 3 places this case study in the context of existing scholarship on Roman marble quarries. Past attempts to associate patterns of tool-use to a culture-history model are critiqued, as are the efforts to calculate the significance of Roman marble extraction according to its volume and circulation within a market economy. Such studies overlook the numerous variants in quarry-type and quarry-size in such a way that the high-level imperial and urban quarries come to represent the norm. This scholarship is presented with increasing focus, moving from eastern Mediterranean studies, to those situated in Roman Asia Minor, to those with particular

significance for the Marmara Lake Basin. This discussion of past practices is concluded with a framework for answering new questions. Technological concerns and approaches to studying how the extracted material circulated are presented in the development of a new direction for quarry studies that emphasizes the characterization of regions instead of the sourcing of artifacts.

After situating this study in geographical and academic contexts, chapters 4, 5, and 6 develop the case study. Research on the specific quarries presented in this dissertation was carried out under the auspices of the Central Lydia Archaeological Survey (CLAS) during the 2011 season, following preliminary observations during the 2010 season. Chapter 4 presents the historical and geological background of the Marmara Lake Basin before outlining the methods used to study the quarries. The project itself combined intensive survey, mapping, photorectification and a marble sampling program to develop a contextual understanding of how these quarries related to the regional landscape. Chapter 5 presents the results from these analyses and chapter 6 steps outward to consider the implications of these results for how we understand the social, political, and economic networks that characterize the Marmara Lake Basin, and to which the region was connected. The chapter also explores how the region itself was connected to higher-level socio-economic structures that have characterized the Roman polity to this point.

Chapter 7, the final substantive chapter, expands the discussion to other types of quarries in other parts of the Roman empire. There, the application of detailed analysis to quarry landscapes serves as the basis for reexamining the role of extraction in the development of social practices throughout the empire. In this chapter, the case is made

for the significance of landscapes in shaping the outcome of governmental techniques, and variation in community formation and social practices is explored in the context of imperial, urban and rural quarries in the eastern Mediterranean. The cipollino marble quarries on Euboea, the granite quarries in the Eastern Desert of Egypt, the extra-urban marble quarries at Aphrodisias, the sandstone quarries at Petra, and several andesite quarries in central Anatolia are explored in detail.

The contributions of the study are, therefore, threefold. First, this dissertation incorporates many more quarries into a study of Roman industrial practices and Roman industrial landscapes. Second, the methodology employed combines existing archaeological strategies in novel ways, attending to a different set of research questions. Third, the results, and a comparative application of the results to other types of quarries, suggest that polities, and the Roman political administration in particular, can and should be understood as more diversely comprised than currently thought, and that this diversity is a product of the polity as an inherently spatial project that must engage with landscapes and places on the ground. In this way, the contributions reach scholars of Lydia, Asia Minor, the Roman provinces, Roman imperial administration, and landscape archaeology.

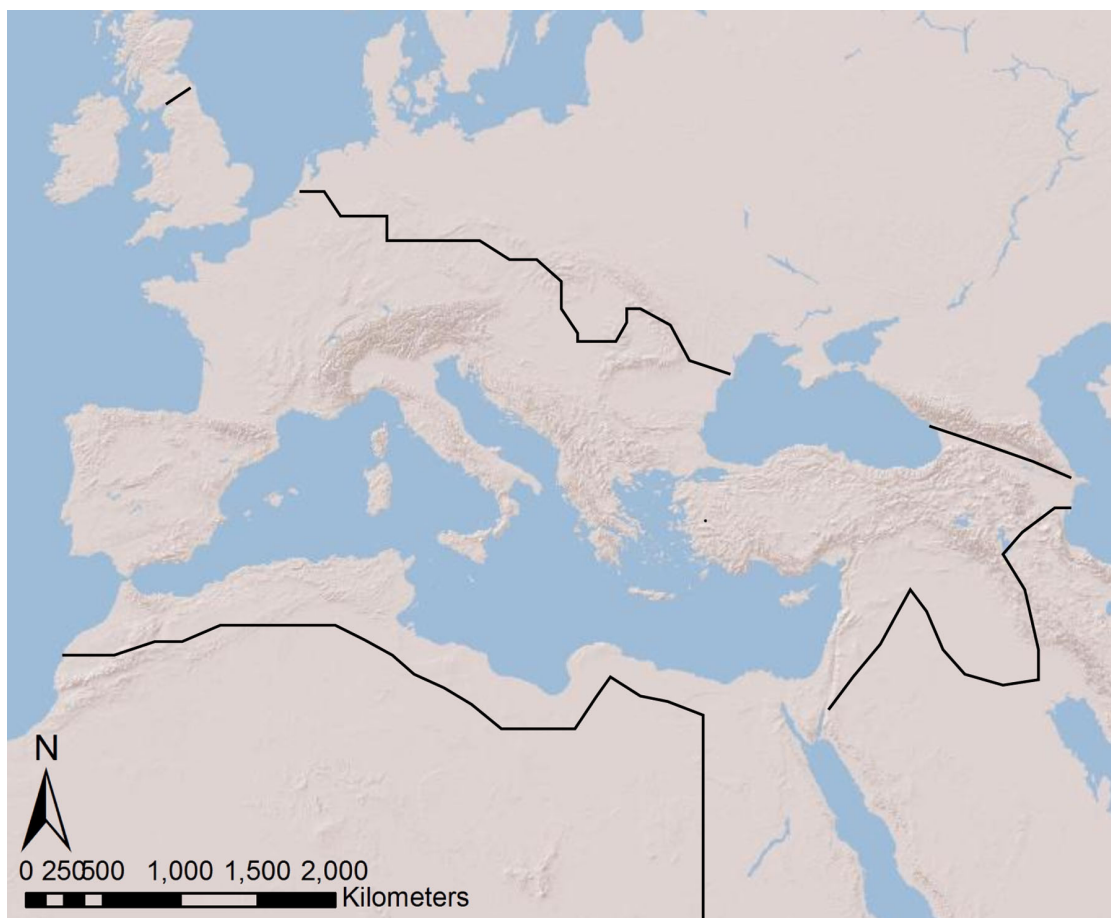


Figure 1.1: Map of the Roman empire in the early 2nd century CE.

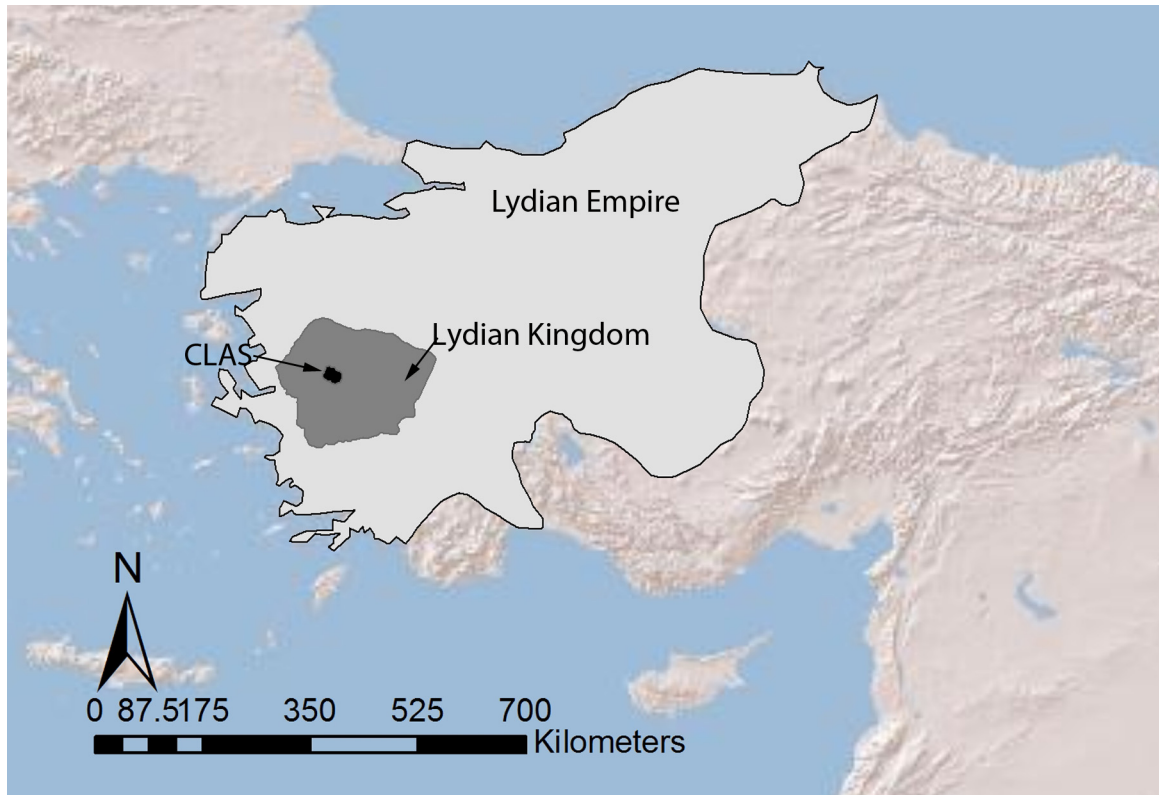


Figure 1.2: Map of Turkey showing probable boundaries of the Lydian Empire and the Lydian Kingdom, with the Central Lydia Archaeological Survey (ArcGIS basemap; after Roosevelt 2003).

Chapter 2

An Archaeology of Quarries

Introduction: Why Study Quarries?

This dissertation applies notions of governmentality to resource landscapes in the Roman province of Asia Minor. My argument is that Roman techniques of governmentality in the context of an expanding empire – coming to grips with a populace covering the entirety of the Mediterranean basin – worked fundamentally through places and landscapes in the creation of a spatial entity. My primary case study juxtaposes small-scale marble quarries in the Marmara Lake Basin of central Lydia, Turkey against other, larger and more structured forms of stone extraction, to demonstrate that the state's spatial parameters are inchoate because such attempts are inherently physical. That is, attempts to create the polity as a spatial entity must occur in real landscapes that have different physical properties, histories, contextual geographies, and established links to place. As such, Rome should be considered an incomplete project, or a polity continuously in the making and always heterogeneous, appropriating physical engagements between places and people in order to structure social life through technologies, buildings, sculptural programs, and, most importantly, infrastructures. My emphasis, however, is on the incompleteness of this project during the Roman period and that one can detect these elements through close examinations of quarries.

In this chapter, I explore the relationship between governmentality, landscape and place as explored through the lens of quarrying. I begin with a general discussion of how authority and governance have been discussed with respect to the Roman empire, situating political economy and authority in landscapes and places. I then review the literature on space, place and landscape before introducing my case study of eleven small-scale marble quarries in the Marmara Lake Basin of central Lydia in western Turkey. I conclude the chapter with an outline of how I propose to understand governmentality and landscapes through an archaeological investigation of quarries. This chapter, and the dissertation as a whole, present a method for linking daily practices in specific places to large-scale social, political and economic structures.

Governmentality

Foucault introduced the term governmentality to refer to the strategies employed by post-medieval states to turn a feudal system into an overarching system of government. In a general sense, governmentality refers to the techniques of the state in creating a relationship of authority over a populace. A considerable amount of Foucault's attention is given to specific power dynamics between the political authority and its subjects, investigating how actual encounters create a 'negotiated' sense of position (see also Smith 2011). The motivations of the state, then, are a mixture of intentions and realities, of possibilities and practicalities, derived from interaction in what Lefebvre (1991) would call the social space – the “vital, productive member of the cast” that is simultaneously produced through the discursive relationship between government and

people, and that influences the forms of possible social relationships therein (Merrifield 2000: 173). Space is therefore not a defined thing, but a created thing (cf. Casey 1993; 2001; Smith 2003). Foucault's emphasis on discursive relations of authority and Lefebvre's emphasis on space as the arena for these relations and the thing produced by it, lead to questions about how intentionality works in this process of creating the polity as a social and governmental space. It leads to the questions: through what mechanisms did Roman structures arise and how pervasive were they? What type of spatial polity was Rome?

For early states such as Rome, modes of governmentality have long been related to the ability to pull and control resources as the result of successfully implementing structures. Polities such as Rome arose because the conditions of the state were met through technological advancements made possible by the accrual of resources. Drawing from precursors established under evolutionary approaches to culture, Childe (1950) famously argued that specific organizational and institutional criteria needed to be in place to account for urbanization, pulling together examples from multiple regions of the world.⁴ In effect, these core attributes of cities – public architecture, etc. – stand in for governmentality, in the sense that these features result in a particular type of social unit. Across the Atlantic ocean, White embraced the evolutionary perspective with even more vigor, emphatically stating that better technology was the sole determining factor in social evolution (White 1959). This argument suggests that the Roman empire arose because it commanded enough labor and resources to meet the criteria for empires.

⁴ Criteria 8-10 deal specifically with craft specialization, construction and resource procurement. His criteria underwent extensive and repeated revision over time.

Enhanced technologies facilitated more efficient uses of human labor and energy, which led to greater social complexity.

From the perspective of comparative research on empires, Rome has been called an enigma of sorts, with little scholarly interest in the political economy approach so prevalent in more anthropological archaeology (Smith 2004). Studies in political economy have investigated the relationship between power and, in particular, craft production, from multiple perspectives, noting that different modes of production can coexist and result in similar types of governmental and social structures (equifinality). Roman studies, on the other hand, have regarded the economy as a distinct avenue of research.

The dependence that ruling classes have on the production of finely crafted goods for the establishment of authority is one of the main arguments behind this assertion (Brumfiel 1987; Helms 1993; DeMarrais *et al.* 1996), and the connections between social evolutionary perspectives, political economy and craft production are clear. Janusek (1999) moves beyond the dichotomy by advocating a third category, which he refers to as embedded specialization (see also Costin 1991; 2001). Drawing from his work in Peru, Janusek notes that, “Available evidence for Tiwanaku specialization points to a form of socially embedded household production, and it supports a model that shifts emphasis from external demand and political interest to the total social context of specialized production and distribution” (Janusek 1999: 126). More recent studies allow for individual input, or group feedback, in resulting social, political, and economic institutions, highlighting the significance of craft production for broader social organization. Morrison (2001) and Sinopoli (2003), for instance, argue that the

Vijayanagara empire in 2nd millennium CE India was characterized by complex negotiations, sometimes in the form of defiance, between the classes of craft producers and the state. They assert that political economy does not necessarily produce an easy correspondence between the forms of production and the mechanisms of state control (see Pauketat 2004, too). Instead, different forms of craft production can coexist within a single polity and the craft producers actively contribute to the shape of political structures through their very participation in them, pushing back in some places and acquiescing in others. This perspective can be compared with Marx's much earlier critique of the political economy, in which he states that, "The mode of production of material life conditions the general process of social, political and intellectual life" (Marx 1970: 20-21).

The legacy of this approach on subsequent archaeological interpretations of the Roman empire has been profound. The majority of scholars promote a view of governance over subjected peoples, forming a dichotomy between the ruling and the ruled. Although this played out historically under the rubric of changing social theory, with neo-evolutionism and systems-based theory the two most prominent, the formation of the Roman empire has largely been investigated in terms of transplanting structures into the empire's expanding territory.⁵ The relationship between the Roman polity and the people within its borders was assumed to be unidirectional. The intentions behind

⁵ Yoffee (2005), for example, reviews a number of neo-evolutionary approaches and is appropriately critical of the essentializing nature of many of the assumptions that this perspective created about past states. In particular he notes that history and archaeology have revealed greater diversity in their form and organization, challenging the notion that social evolution followed a precise linear trajectory (Yoffee 2005: 5). His approach is more flexible in its view of which social practices and patterns feasibly constitute complex societies with a particular emphasis on states and state formation. Marshalling stone for construction and elite display is, according to Yoffee's approach, part of state formation.

establishing a Roman form of imperial governance were characterized as Rome conveying its message to the people, primarily through visual culture.

In other words, what typically defined the Roman empire as an entity able to be studied are the structures that characterize its governance. And in Roman studies, economy takes pride of place in this discussion. In many senses, the monetary, market-based interests promoted by Rome are seen as the drivers behind Roman techniques of governance. The debate surrounding the degree to which the Roman economy could be called modern offers a window into why this is so. Greece and Rome have long been seen as the precursors to modern Western civilization, so much so that debates around Greek and Roman social institutions naturally revolve around questions important to modern populations, such as: Did Rome have a market economy?⁶ In many ways, the debate between substantivists and formalists has framed the discussion for Mediterranean trade and exchange in both historical and archaeological contexts. In these circumstances, the formal structures of the polity garner more interest than questions about how those structures are created in new social contexts. This emphasis on structures is particularly apparent when discussing empires and large states, where deliberate attempts at profit maximization more easily persuade scholars of delineated social spheres, such as the political, the economic, the religious and the domestic.⁷ Although a substantial amount of work has been undertaken to reveal the interconnectivity of these spheres, some archaeologists feel that the scale of certain polities requires an approach that heuristically apportions these component parts (see Finley 1973; Fitchen 1986; Greene 1986; D'Altroy

⁶ Kehoe (2007) takes issue with this question as well, seeking to understand how the parts of the economy worked together.

⁷ Though the formalization of economies itself has long been a topic of debate (Rostovzeff 1957a; 1957b; Polanyi 1966; Finley 1973; Greene 1986; Ward-Perkins 1973).

and Hastorf 2001). Thus we read about the political landscapes (Bender 1993; 1998; Smith 2003), the economic landscapes (Smith 2004) and the religious landscapes (de Polignac 1995; Connelly 2007) of antiquity, principally as mechanisms employed to comprehend complex scenarios. In such scenarios, particular types of resources become secondary in significance to the mechanisms employed to control them.

The close connection between the expansion of the Roman polity and economics can be seen, for instance, in the military garrisons that often accompanied quarries (Maxfield 2000 and 2002; Peacock and Maxfield 1997; Hirt 2010). Oversight, particularly in Egypt, accompanied the extraction and shipment processes in and through the Eastern Desert (Hirt 2010). Although there are clear implications for the methods of engaging with particular industrial landscapes, this evidence is largely used to argue for the coercive powers of the state and its wealthier citizens, for whom material from quarries and mines was extracted. Whereas research into non-state level societies showed how people were able to organize themselves to procure stone located in distant beds, an economic approach in state level societies looks for the extent of trade, the mechanisms of trade, notions of ownership and the organization of multiple intermediaries – that is, craft specialists and specific classes of distributors (Strong and Claridge 1976; Greene 1986). The approach is only subtly distinguishable from that undertaken under the banner of political economy, but there is the added notion of monetary value and demand in economic sectors beyond the ruling class. Rome, for instance, prefabricated marble blocks to suit the demand for relatively standardized construction projects (Ward-Perkins 1973; Fant 1985; Dodge 1991). Pay for quarry laborers in Egypt was also standardized, and appears consistent with pay in other parts of the empire (Cuvigny 1996). This

uniformity in the administrative aspects of resource control is, at times, equated with the state or the empire.

The imperative to move stone over great distances is seen in this instance as primarily economic in nature, a conclusion that sets the Roman Mediterranean apart from earlier time periods, such as the movement of obsidian from Melos, Sardinia, Lipari and Pantelleria in the Neolithic and Bronze Age (Torrence 1986; Tykot 1996; 2002) and the distribution of Aegean andesite as a grinding stone (Runnels 1985). Distance and trade are certainly at issue in these studies and for these time periods, but the lack of a centrally driven economic stimulus for those exchanges allows an expansion of the topic to other issues, such as local and multiple economies, the pervasive issues of value, and the persistence of existing social ties. Trigger's (1990) study of thermodynamics in monumental construction, for instance, argues that control of labor for specific projects and the advancement of social prestige is the primary motivating factor in Egyptian, Mycenaean, Mesopotamian, and Mesoamerican monumentality. Roman material, on the other hand, is viewed in terms of profit maximization. Infrastructure, which receives a significant amount of attention in the literature on Roman quarries, becomes a facilitator for other social motivations. Roads (Korres 1994; Vanhove 1996; Peacock and Maxfield 1997; Maxfield and Peacock 2001) and transport mechanisms (Asgari 1988; Russell 2009a; 2009b), whether by land or by sea, are products of this economically driven exchange.

Other recent scholarship, however, is developing a picture of the Roman economy with substantially more texture. McCormick (2001) writes of lateral expansion relating to production strategies, a model that is supported by the work of Parkins (1997), who, in

general terms, argues that elite competition leads to diversified production strategies. Mitchell and Katsari (2005) argued for the diversity and complexity of the Roman economy to suggest that religion, politics, and money overlap in multiple scales of trade, ranging from the regional to the imperial. Woolf (1998) goes so far as to suggest that all cities are more dependent on local and regional trade and production than they are on inter-regional trade and exchange, while Duncan-Jones (1982) identifies disparate spheres of trading activity in the empire. Each of these regional examples, however, yields evidence for long-distance trade, suggesting that multiple scales and multiple markets, and hence the impetus for diversification, likely existed in antiquity. The organization of pottery production workshops supports this model, but stone carving at the quarry has so far not lead to similar conclusions. As mentioned above, this has largely to do with the restricted interest scholars have had in imperial quarries at the expense of understanding stonecutting and quarrying practices in antiquity on a more holistic, level.

Space, Place, Landscape, and Authority

Although drawing attention to the significant issue of regional and scalar diversity in the Roman economy and in Roman social life, the studies cited above locate all explanations for variety in the act of permission granted by the governing polity, missing an opportunity to explore differences in polity construction in landscape contexts that vary dramatically. Such a perspective would, I argue, enable attempts to draw firmer connections between daily life and large-scale imperial structures that are not unidirectional, but dependent on located practices in the formation of social structures. In order for Rome to convey a coherent message about governmentality, there had to be a

spatial context in which the polity could be defined, and in which empire could mean and be something. As a spatial enterprise, the constitution of the Roman imperial polity necessarily had to engage with landscapes and with places, not just to reconfigure self-definition and cultural identity, but to impact the kinds of practices that connected people to their places; to create a political order (Smith 2003: 77). In other words, the enactment of Roman governmentality took place in landscapes, through which the necessary social relationships were formed for sustaining something like the Roman empire.

Smith's (2003) version of the state, or of the spatio-temporal polity, however, relies heavily on the discursive practices employed by the polity to influence the social relations that play out in landscapes.⁸ Here, Smith's emphasis on relational space allows for the landscape, and for place, to be manipulated by polities in sometimes dramatic ways that portray the authority as somehow already present, whether actualized or not. There is, therefore, some amount of tension between Smith's call for polities to be created by spatial relations and his suggestion that the polity exerts authority in space. In short, his argument depends heavily on highly visible instances of state intervention, such as fortresses, ritual complexes and cosmically aligned plazas. These are instances in which the state makes a clear mark on the landscape, in which the conditioning of bodies occurs through the manipulation of spatial relationships. Places, I argue, push back in ways that modify the spatial polity as well, such that the success of the state's attempts to shape social relations is rooted in specific places and landscapes.

Evidence from the Roman empire, however, supports an argument for a more punctuated version of state intervention in the relational construction of polities.

⁸ See also Khatchadourian (2008).

Instances of monumental construction, with sometimes overt attempts to control memory practices (Alcock 2001), were definitely part of Rome's governmental approach.

Abundant research into the Roman countryside, however, demonstrates that governance was less bluntly expressed in many situations. Rural farmsteads, villages and towns were connected to other levels of Roman social and legal operations through various mechanisms, such as market days, roads and aqueducts: all physical attestations to Rome's ubiquity either through participatory action (trade in markets) or through visual cues (infrastructure). But the specific role of local landscapes in mediating the relationship between the polity and its communities has not been explored in detail. In many cases it is quite difficult to define the presence of Rome beyond imported goods, which do not speak directly the physical nature of the polity or its spatial relationships. In light of recent research on 'discrepant experience' in the transmission of Roman material culture into new parts of the empire, a major question about the spatial constitution of this polity needs an answer: what are the spatial politics of imperial landscapes that do not witness direct imperial intervention?

Roman conceptions of space provide support for the need to include this as a major component in assessing the formation of the Roman empire. Whittaker (1994: 10) notes that Roman perceptions of space are caught somewhere between order and chaos. Cities and other entities – and here I would include imperial quarries – are ordered through the terminology of boundaries and hierarchies. The centuriation of some imperial farmland (Bradford 1957; Purcell 1990) speaks to this phenomenon as well. Specific landmarks delimit where certain actions can occur and specific titles provide order over social customs. And yet the landscapes of the Roman empire, as recounted by authors

such as Strabo and Pausanias, are not subject to the same empirical or cosmological ordering that govern urban boundaries or the division of practices in villas (Whittaker 1994; Purcell 1990; 1995). The litany of place names and landscape features in Strabo's *Geographia* are presented in a relational sense that favors the experience of one traveling in places and landscapes. Empirical geographies are, in these works, impossible to determine based on a chorographical account of the world, and the terminology used to reference the boundaries of empire are equally vague (Whittaker 1994). This tension between the boundaries of specific locations and the complications that arise when the same ordering processes are applied to landscapes writ large is represented in quarry administration as well. In this instance, however, the administration of resource control is neatly bounded by titles, prescribed wages and specialized labor practices. The tension manifests itself, however, when we look beyond the ordered hierarchies and begin to explore what was actually happening on the ground. This proves to be far more complicated.

Space, place and landscape are therefore critical elements in any attempt to relate the politics of daily life to the polity and its structures during the Roman imperial period. In the context of an expanding empire that encountered new environments with existing social practices and traditions, the polity as an encompassing space brought together imperial message and discrete places in a vibrant way. Comparison of different industrial resource landscapes, which scholarship regards as highly regulated by the Roman state (see Chapter 3), will accompany a close look at a specific, less regulated, landscape under empire.

Governmentality, marble, and the Marmara Lake Basin

Located in central Lydia in western Asia Minor, the Marmara Lake Basin offers an opportunity to explore Roman governance by looking at marble acquisition practices in the landscapes of a Roman province. My emphasis on small-scale marble quarries provides the lens through which I investigate Roman efforts at establishing authority in rural Asia Minor. The case study of marble production in Roman Lydia will shed valuable light on current understandings of how pervasive Roman intervention was in provincial landscapes. Do the strategies of the state, in the project of creating a spatial polity, necessarily require direct control of resource acquisition at all levels? And if not, in what ways do we account for the incorporation of rural landscapes into the Roman polity? In other words, I am investigating how a study of small-scale provincial marble quarries can inform our understanding of the constitution of the Roman empire.

Most famous for the Iron Age kingdom of Lydia, whose capital was at Sardis (15km south of the lake basin), central Lydia has deep roots that go back to the Paleolithic. Since 2005 the Marmara Lake basin has been the target of the Central Lydia Archaeological Survey (CLAS), directed by Christopher H. Roosevelt and Christina Luke. The survey explores the lake basin as the hinterland of Lydian Sardis, using the lake as its focal point for a diachronic investigation of settlement history and change. The region immediately south of the lake basin is called Bin Tepe (translated as ‘1000 mounds’). The mounds to which the region’s name eponymously refer are a dense cluster of tumuli built in commemoration of the dead, beginning with Lydian royalty and continuing for wealthy individuals in the Iron Age through the Achaemenid period. This particular landscape is therefore rich with archaeological evidence for cultural

engagements with specific places. Material culture in the region dates to all periods between the Paleolithic and the present day.⁹

Despite the diachronic scope adopted by CLAS, the Roman period in rural central Lydia is relatively poorly understood, having traditionally received less scholarly attention than the preceding Bronze and Iron Ages. This dissertation explores the material collected by survey that dates to the Roman period, with a sharp focus on landscape context and the proximity of the small-scale marble quarries to other features of the social landscape. The quarries themselves tend to be situated on the northern side of the lake, with the southern portion of the lake basin, including Bin Tepe, characterized by a prominent limestone ridge south of which the Hermus river (modern Gediz river) runs. The northern edges of the lake are more mountainous with intrusive veins of marble and schist.

Although evidence exists for the continued importance of Sardis in the Roman period, little research has been conducted on the relationship between the provincial capital and its hinterland. Major social and economic changes affected the city during the transition to Roman rule in Asia Minor, but the impact this had on rural settlement patterns and socio-economic networks has not yet been explored. The confluence of these factors allows for the close study of resource acquisition in Sardis to make a meaningful contribution to scholarship on the incorporation of new imperial landscapes. This can be accomplished through an examination of the changes in practices related to landscape interaction. The bulk of the dissertation presents and interprets data collected at the

⁹ See Roosevelt (2007) and Roosevelt and Luke (2008; 2009; 2010; forthcoming).

eleven marble quarries in the hinterland of Sardis with an eye towards questions of landscape, place and governmentality.

The following sections outline the process by which these issues are detected archaeologically and presented in this dissertation. With the goal of articulating connections between daily practices in quarries, the places in which these quarries are set and with which they interact, and Roman governmental practices, this dissertation outlines a close study of technological practices within the context of deep description of landscape, and an analysis of the networks through which quarries work by focusing on the distribution of material and the composition of local markets.

Technology

How do we see this archaeologically? The techniques applied to the production of stone artifacts and quarrying seldom receive enough attention to discern whether varied trade, exchange and production organization principles were accompanied by a multitude of procurement methods.¹⁰ Many of the detailed studies on production practices either focus on production with clear ties to the state or project non-state production practices onto society at large. Torrence (1984; 1986), for instance, situates a detailed analysis of obsidian mining/quarrying techniques against the evidence for workshops and labor specialization on the island of Melos. The work of Bessac (1996) in Roman France and the Roman East systematically explores the techniques and organizational principles there, but does so principally in the context of “economy”. The majority of reports that

¹⁰ Studies about changing ceramic technologies, on the other hand, are far more numerous (Costin and Hagstrum 1995; Sinopoli 1988; 2004; Shanks 1999).

include quarries within a political economy framework remain focused on the organizational level, which facilitates discussion of guilds and work groups. An abundance of data are present for the Medieval period (Harvey 1971; 1975), with perspectives also available from various contexts in the Roman Mediterranean (Burford 1972; Liu 2005; 2009). The emphasis is often, therefore, on the producers more so than on the complex interplay of producer, material, and organization, and it is increasingly apparent that multiple systems of organization can facilitate similar political and economic classifications.

The drawback to this approach, however, is that it limits the discussion of production to the commoditization of products in state-level societies, and fails to realize that commercialization itself is a political and economic strategy. In light of this observation, my dissertation argues that close examination of technological practices can provide details about the specific methods of material extraction in Roman-period quarries. Moreover, I argue that a comparison of techniques employed at quarries of different scales, both in terms of the volume of production and the uses of material, can provide data comparable to Leroi-Gourhan's (1993[1964]) *chaîne opératoire*. The utility of Leroi-Gourhan's work in this context lies in his reconstruction of the social dynamics of technological production through an examination of technology, technique, technical knowledge and skill (see also Lemmonier 1986; 1992; Pfaffenberger 1992; van der Leeuw 1994; Dobres and Hoffman 1999; Dobres 2000; Ingold 2000). Agency is afforded to the craftsman through improvisation and innovation, while technical knowledge must include local knowledge. Through such an analysis the *processes* of production enter into

dialogue with the organization of production by exploring specific engagements with the material world.

A well-known issue confronting quarries, however, is the seeming longevity that characterizes the standard tools of the trade – one of several issues that make quarries difficult to date. Extraction techniques, it would seem, do not vary greatly over time (Adam 1994; Rockwell 1993), even though architectural and artistic style might. While the ramifications of this observation are broad and will be explored more fully in other sections, it is important to note, in the current context of political economy, that changes in tool use do not necessarily offer direct reflections of broader socio-political changes, as one might expect in a cultural systems theory approach (Binford 1964). The enduring nature of certain technologies can challenge some of archaeology's basic assumptions about the relationship between tool, craft and social and political structures, opening the door for more subtle factors, with greater locational and culture specificity, to come into play.

Understanding political economy and economic practices specific to the Roman Mediterranean is, as has been established, dependent on the identification of technological interactions with resources and materials. For both approaches, detecting the relationship between craft producers, raw material procurers and official members of society requires an understanding of method, quantity, circulation, and technique. Scholarship on political economy has routinely emphasized the association between modes of production and society, with a general sense that society arises from practice. Above all else this calls for a close study of those practices, following Bourdieu's (1977) use of the term. In the case of the peculiarly Mediterranean study of commercialization,

monetization, and capitalism in antiquity, a close study of technological engagement with materials can generate a clearer picture of the relationship between imperial structures and daily life in the expanses of empire. To understand better the significance of production for generating social practices, it is appropriate to turn to technology.

As discussed above, most of the literature on the ancient Mediterranean that treats technology does so with a descriptive bent in an effort to understand how something was done and, often, whether it relates to trading practices. Other areas of technology studies offer alternative perspectives on the relationship between the body, society, and production, emphasizing the role of bodily action through engagement with material technologies in the production of objects and social identities. Mauss's (1973) discussion of bodily techniques demonstrates the significance of repeated action in the generation of social mores. His series of examples, including the ineptness of French naval cadets in the realm of swimming, is intended to demonstrate culturally specific traits through the identification of uniquely learned behaviors. In doing so, however, Mauss also paves the way to considering more generally how social practices are generated. Since different practices can lead to similar results, the identification of cultures through specific traits is no longer an objective. If bodily engagement with the world and routinized activity generate social understandings and customs, akin to Ingold's (2004) study relating how people walk to broader social values, then technological interaction, which mediates the body and the material, will also have a generative role in social production and reproduction.

Further work on technology drew on the connection between technique, tool, gesture, product and society to implicate production further into the constitution of social

structures. Science and technology studies, and proponents of an anthropology of technology, which grew out of Leroi-Gourhan's work specifically, take the notion that technology constitutes social practices and suggest that technology is therefore integrated into all phases of social life. Early proponents, such as Lemonnier (1986; 1992, drawing heavily upon Leroi-Gourhan), espoused links between technological choice and the reproduction of society (Dobres and Hoffman 1999: 2), an argument that is similar in many respects to those put forward by Giddens (1984) and Bourdieu (1977). While both Giddens and Bourdieu emphasized that action produces social structures, which in turn heavily influence subsequent action, Lemonnier (1986; 1992) applied a social constructivist model to his work on specific technologies. Many others follow the explicitly social constructivist approach to the relationship between technology and society (Lemonnier 1986; 1992; Pfaffenberger 1992; Dobres and Hoffman 1994; 1999), noting that society is never without the technical and technological.

Lemonnier (1986; 1992) principally states that within the framework of design, decision-making incorporates a complicated array of factors that influence the outcome, all of which are influenced by social constructs. The production of stone tools, the building of a wooden house, and the construction of an airplane all involve technologies derived from social customs, and the design of each is influenced by social constructs. The airplane, as discussed by both Lemonnier (1992) and Law (2002), is not the product of simply manifesting cultural values in material form, but derives from a combination of social factors that gradually influence the shape and outcome of it. Bijker (1995) conducts a similar study of the design of the bicycle. In his study, too, the specific needs of the bicycle in a social context determine its ultimate shape, and help to explain the

failure of innumerable attempts to redesign it. The bicycle was supposed to achieve certain things in a social context, and the design had to match these needs, forcing the bicycle, and the technologies involved in its production, to interact with other aspects of social discourse. In a sense, this perspective falls somewhere between DeMarrais *et al.*'s (1996) view of the material being a physical manifestation of the ideational and approaches that emphasize relational ontologies, as outlined below.¹¹ In such a view, technology is nothing more than technique in the sense of a means to an end. Lemonnier, Bijker, and Law, however, develop the elaborate social connections at play in the implementation of technologies in the processes of production.

It was not until later, however, that the potentially generative nature of production practices addressed by Leroi-Gourhan was reintroduced in anthropological and archaeological literature. Ingold (2000), in particular, develops this perspective by emphasizing the significance of human observation on the formation of perceptive understandings of the world. In short, he articulates an alternative perspective on the issue of production through his depiction of a basket weaver. Here, Ingold is basically translating ideas about human perception of the physical environment to human perception in the production of craft. The main thesis suggests that each instance of creating a woven basket requires the producer to apply learned skills and techniques in a responsive way to the particularities of each new basket.¹² Skill, Ingold suggests, requires

¹¹ Alfred Gell (1998) also inseparably links technology and society, arguing additionally that the appearance of reality created by artifacts and objects has a more mystic origin in which the tangible nature of things compels us to think they reflect reality – a process that renders the social-technical link nearly invisible.

¹² Ingold defines skill as “the capabilities of particular human subjects,” such that techniques are the particular applications of human interaction. Technology is defined as a “corpus of generalised, objective knowledge, insofar as it is capable of practical application” (Ingold 2000: 315).

“a mixture of improvisation and imitation in the settings of practice” (Ingold 2000: 401).

Technological systems, then, arise from accumulated responses in a mechanical interaction between person and object. Technology is accumulated knowledge about practice (and about the way to engage with material): in other words, technology is akin to local knowledge and local ideas about production and method. Importantly, though, technology (social know how) derives from, rather than dictates, material interaction. The sequence of operations for the basket weaver, then, moves from innovative interaction with wicker, resulting in techniques pertinent to manipulating the material (a human relationship with the material), resulting in skill sets that are learned and modified based on renewed or subsequent innovative interactions with wicker. A technology or technological system emerges when attempts are made to routinize or mechanize this process, removing the worker from individual variability and reducing the worker’s responsiveness to the manufacturing process.

Latour (2005), Shanks (1999), Witmore (2004; 2007) and Webmoor (2007) develop a similar argument in looking predominantly at the relationship between ‘things’ and humans, concluding that too much credence is giving to human agency over material agency in the development of social systems.¹³ Just as Ingold described production as a generative process, Latour (2005), in particular, views the material world in its entirety as generative of social life. To simplify a complex series of positions, this approach (variably called Actor-Network Theory and Symmetrical Archaeology, depending on the context of its use), offers three main tenets. Things are critical aspects of social life. We

¹³ This work draws heavily on the philosophical work of Heidegger (1977), who advocates a definition of ‘things’ as a gathering together based on German etymology, and who emphasizes the thing ‘being in the world’, that is, the thing dependent on its context for it to become what it does. See especially Witmore (2007) for a definition of what ‘things’ are.

are not what we are unless we pull together specific items in association with each other and with ourselves. Similar to arguments put forward by Foucault, encounters between bodies depends on the material circumstances of the context and those material circumstances are products of an infinite array of existing associations and shared bodies of knowledge. Ultimately, this infinity of material relationships gives pause to those who encounter ANT, because it severely limits the degree to which we can come to grips with the material and social world. Nevertheless, the contextual understanding of social engagements, the necessity of material presence in those relationships, and the contribution that material interactions make on the outcome of social practices is an important step towards understanding the nature of human social groups, economies, politics, and relationships.

Regrettably little has been pursued in this fashion for quarries, with the notable exception of a series of attempts to incorporate the *chaîne opératoire* into archaeological contexts, particularly with respect to flintknapping.¹⁴ Rather than resulting in exploration of the connection between stone cutting gestures and socio-technical behavior, work on the sequence of operations in quarries has produced catalogues of quarrying methodologies, with an assumed linkage to political and economic structuring principles.¹⁵ At least for the Greco-Roman world, broad economic factors are privileged over focused studies of specific quarries for evidence of varying technical applications.

¹⁴ Stone tool production was, indeed, one of the first applications employed by Leroi-Gourhan and Lemmonier respectively.

¹⁵ Technical reports on quarrying practices on the culture-wide level include Adam (1994) for Roman quarries, Korres (1994) for Greek Quarries, Arnold (1991) in Egypt, Bessac (1988) for a general discussion of techniques, (1996) for Roman Gaul and (2007) for the city of Petra, and Protzen (1993) for the Inca.

Where these studies hold potential for quarrying practices in antiquity is in the way they develop the relationship between human action, response to material, and social efficacy. From an archaeological perspective, demonstrating change in practices, variation in practices, and associated political and economic markets for goods distribution and exchange presents a strong way forward in developing a sense of how relational practices create relational structures, better linking the actions of daily life and the constitution and perpetuation of political units.

Although it is clear that different strategies of procurement support what are nominally similar social categories, Yoffee (2005) and others have argued for more generalized patterns that emerge in less rigid frameworks that give more agency to those involved in the actual processes of production (see, for example, Stein 1998). This turn in scholarship addresses two important things. In recognizing the interconnections of different social institutions, it introduces a closer examination of the composition of those institutions and, subsequently, it advocates an emphasis on the modes of production, being concerned with how modes of production and various social institutions interact in landscapes. Understanding the relationship between practices, structures, and the social and physical contexts in which this plays out will help reveal the role played by places and landscapes in the constitution of the Roman empire.

Archaeological Science

Since the early 1980s, archaeological science techniques have been applied to questions about the movement of stone, metals and ceramics in antiquity, attempting to

identify where different material originated. Materials Science techniques, with the primary objective of locating specific stone sources in order to determine the nature of long distance and local trade networks in antiquity, fall primarily into two categories: physical and chemical composition.¹⁶ Physical techniques, including petrographic analysis, identify the dominant mineral structure of stone, including the type, size and orientation of the mineralogical matrix and any inclusions (Rapp and Hill 2006; Pollard and Herron 2008). Petrography is a widely used technique in all parts of the world (Pike 2004; Hayward 2009). Archaeological applications of these techniques, however, have a decided interest in sourcing material to specific locations to better understand trade patterns in past societies.

The chemical techniques employed in archaeological science vary in nature, though some have had more profound impacts in the study of Roman marble sourcing than others. The implementation of stable isotope analysis in the 1980s as a technique to source white marble established chemical signatures for some of the major Mediterranean marble quarries (Herz 1987; 1988). Similar techniques have yielded useful results in the Americas as well (Luke *et al.* 2006). The technique irradiates molecules in order to detect which chemicals are present in a sample of stone and in what quantity, provides a broad array analysis of a stone's geochemical composition. Other techniques, including XRF (X-Ray Fluorescence) and XRD (X-Ray Diffraction) are appearing more regularly in recent academic publications. In part this is related to cost, as ICP-MS is generally more expensive than XRF and XRD. XRF, however, can sometimes be performed in a manner not destructive to the sample through the recent advent of portable hand-held devices.

¹⁶ Signatures are now established for Naxos, Paros, Docimium, Aphrodisias, Mount Pentelion, Ephesos, Sardis, Carrara, Sicily, etc. (Attonasio 2003). Other marbles are still identified by color alone, and very few studies have attempted to isolate the chemical signatures of other stones such as tufa and limestone.

XRD is considered useful because of its ability to detect a range of phase changes in addition to geochemical results. Multifaceted approaches are considered best, because they enable the comparison of complementary methods to refine results (Pollard and Herron 2008).

While these studies have succeeded in establishing the extent of trade in a variety of stones and in a variety of locations, they have encountered pitfalls in identifying specific quarry signatures. Pike's (2004) work in the Pentelic quarries outside of Athens, Greece, for instance, reveals that mineralogical signatures are variable even with a single quarry system, and there are substantial overlaps in the results of isotopic analysis between quarries as well (Knapp 2006; Pollard and Herron 2008). Thus, although XRF does not encompass the same breadth of chemical attributes for a given stone sample as is available from ICP-MS, it has proven to be an effective technique for identifying the region of origin more generally. And the current difficulty in identifying precise points of origin might suggest that a change in research question is in order.

Where the application of archaeological science can prove of greater utility is in regional studies that emphasize the social and political context of quarry extraction. Although this approach still incorporates the same analytical techniques, it shifts the focus from the artifact as the subject of examination to the region as the subject of examination. It emphasizes the characterization of the region's material composition over the characterization of the economic conditions that facilitated the procurement of material from distant sources. From the perspective of a social archaeology, material characterization can inform a discussion of the nature of resource acquisition, looking at the extent of material distribution, the scale of material distribution and, in conjunction

with regional settlement data, the intersection between industrial activity and social life in a region. Sourcing is therefore not an end point, but the beginning of a discussion about regional characterization, and forms the dataset around which place/space and governance occurs.

Comparative Studies Within the Empire

Lastly, an investigation of how polities and rural landscapes intersect through industrial activity requires a comparative approach. Beginning with the supposition that the Roman empire cannot exercise power uniformly in all portions of the empire at the same time or in the same fashion, and arguing that landscape interactions provide the best means to observe this phenomenon, a full consideration for how a polity establishes authority – or attempts to establish authority in a perpetually incomplete project – can only be understood by exploring multiple examples of how landscapes factor into the creation of political spaces. The well-developed knowledge we have about the structure of industrial administration in the Roman period provides useful data for a comparative endeavor, facilitating as it does a comparison of how labor was organized in different landscape contexts.

Roman quarrying has been, as Chapter 2 will discuss more fully, regarded as a set of highly regular and standardized practices. Although clearly part of the process of defining the empire as a distinctly Roman space, quarrying does not ever happen in the absence of other social practices, or in the vicinity of other landscape features that are, as Bradley (1991; 1993) suggests, always already socialized. Understanding the contribution

of quarrying in the production of Roman space requires coming to grips with how prescribed (and non-prescribed) industrial practices intersect with existing historical and social conditions to create something new. In Lydia, this will be demonstrated by placing the quarries in the context of the deep histories made present by the monumental tumuli and Bronze Age fortresses that are visible from many Roman period sites. It will also take into account historical attestations of how the Iron Age past was perceived during the Roman period. Necessarily, though, these data will be compared to known imperial quarries (literally owned by the emperor) and large-scale quarries in the immediate vicinity of urban centers.

What is a (Roman) Quarry?

Part of the discrepancy in quarry research agendas is that people do not share the same concept of what a quarry is. Many of the examples drawn from in the previous section refer to structurally different features, though all of them call their sites ‘quarries’. Only in rare circumstances, however, do authors attempt to explicitly define a quarry.¹⁷ We would do well, however, to consider the significance of this, since what we are studying – or what we think we are studying – will have a bearing on what analytical approaches we employ. And while categories such as ‘island’ (Braudel 1995[1966]a and b; Broodbank 2000), ‘landscape’ (Witmore 2004) and ‘site’ (Alcock and Rempel 2008) have all been criticized and defended with varying degrees of sincerity and zeal, ‘quarry’ has not received the same treatment even though this concept arguably stands on looser

¹⁷ Some examples are offered by Rockwell (1993) and Waelkens (1992).

footing than those listed above. A review of what constitutes a quarry may have implications for future research directions.

In part, what this study reveals is that Rome, too, was actively trying to define certain types of quarries. In the creation of a Roman space, as attempts were made to establish authority through specific interventions in the landscape, the administrative component of these interventions helped to redefine different landscapes and places as well. In support of my argument that quarrying was, in fact, more diverse than Roman authorities indicate, there appear to be differences between official quarries and unofficial quarries, both in terms of the practices within them and in terms of the utility of material extracted from them. Furthermore, while the polity as a whole encompasses all of the forms of industrial activity, both formal and informal, the attempts at regulating certain practices in landscapes served to reinforce a tiered system of networks between the governing body and the communities in its physical limits.

The most basic definition of a quarry is that quarries are sources of stone that are used for a variety of purposes by the people who collected the material. Often appended to this definition, particularly in studies of industrial societies, is the notion that quarries are places where stone is physically extracted from the bedded rock. This is the definition favored by Rockwell (1993), and the definition that fits most of the literature on Roman stone procurement. In such settings, vertical rock faces are either systematically reduced in a horizontal progression, or the rock face is stepped. There are, however, numerous possibilities for removing stone from the surface, and the application of techniques is often geographically and culturally differentiated. Roman quarrying is often characterized as having a stepped appearance, while the Inca frequently used fallen rock, such as at the

red granite quarries of Kachiqhata (Protzen 1993). In Egypt, granite was quarried by repeatedly dropping balls of dolerite onto the rock face until trenches were created around a well-defined block (Arnold 1991).

In the examples of the preceding section, numerous strategies were incorporated into the discussion of what questions archaeologists answer with quarry data. Several examples of stone acquisition can interchangeably be referred to as mining activity and quarry activity, as the distinction between the two is not clear-cut. Mines, it seems, apply to both stone and metal, while quarries apply only to stone (Healy 1978; Hirt 2010). Mining operations involving stone do tend to cohere around the more ‘opportunistic’ efforts of acquiring material below the surface. Standardized block size is less relevant, because such efforts are typically involved in the production of tools, which inherently require less material than blocks of stone for monumental construction. The material can thus be broken up into smaller chunks with less regular shapes before refinement techniques like knapping are applied to them. Mining operations would therefore seem to lack any systematized pattern of extraction, preferring to follow natural fissures and breaks in the bedrock which are naturally points of weakness. Nevertheless, this literature falls comfortably into the same scope as that of more systematic cutting practices. After all, standard blocks of stone cut to fit construction plans can come from underground sources, blurring the distinction were it to be based on association with the ground surface alone.

Agreeing on divisions between quarries and mines, however, precludes potential that discussions of stone sources will cover a massive range of issues. In the Eastern Mediterranean, for instance, although some have advocated that quarrying originated in

Egypt, spreading to the Near East and Greece only later (Bessac 1988; Waelkens 1992), distinct stonecutting traditions are observable in these different regions. These range between what Waelkens calls ‘opportunistic’ quarrying of surface outcrops and prospective efforts to locate stone beneath the surface. Sometimes these varied practices relate to the tendencies of particular types of stone. Obsidian, for instance, is generally not quarried in the same manner as marble or limestone because the physical properties of this volcanic material are not amenable to stepped or trench fracturing. Conversely, the crystalline structure of marble, travertine and limestone leads to more regular and controllable fracturing of the stone, which is further helped by the relative toughness of these calcareous stones (presented in order of hardest to softest here). Thus, obsidian quarries are often surficial, whereas marble, travertine and limestone are more frequently stepped with vertical and horizontal faces, suggestive of patterned block removal.

Still, the opportunity to follow veins of stone was not mandated. Egyptian granite at Aswan was extracted from the surface, while Inca granite was refined from rock spill. Granite in Egypt was too hard to be cut by the copper tools available to Egyptian craftsmen, so an alternative method had to be introduced in order to extract the available stone. Basalt in Turkey could be extracted from deep veins or extracted from surface outcrops only. The varied application of technological choice led to clear overlaps and clear divergences about what form the acquisition of stone took, distinctions that are not represented in scholarship on quarrying activity. This is particularly evident when the overarching question is not rooted in activity at the quarry, but rather in activity at a construction site removed from the resource location.

This raises the question of whether quarries are, by definition, removed from the final destination of the stone. Many instances of quarrying discussed so far are concerned with the infrastructure of moving stone, but there are a number of instances in which the quarry is also the site of construction. The site of Belevi, in Turkey, is one such example, wherein the stone quarried to build to monument comes from the stone removed from the site to create the platform on which the monument sits. The T-shaped pillars of Göbekli Tepe offer another instance of immediately local stone in eastern Turkey. Parallels in the Inca world demonstrate a similar overlap of building site and resource location (Dean 2010). Although the technological choices may not have been altered to construct these monuments, they do speak to the simultaneous presence of multiple social functions in industrial and monumental settings. Quarries as a class of site are therefore not definable by their industrial function alone, nor are they reducible to distant and valued materials that travel great distances. Distance is, of course, dependent to a large extent on the context of the people involved (Ingold 2007a).

In addition to quarries that *are* the site of the monument, there are a number of examples of quarries where social life and industrial life occupy the same physical space. Such examples merge the lived environment and the industrial environment to a greater degree than even the well-known worker villages at sites like Amarna or Deir el-Bahri in Egypt and the mining towns in the Laurion region of Attica (Hopper 1968). At Timna, in Egypt, a religious shrine is located within the quarry (Rothenberg 1988). Sicilian quarries were host to burials and houses, similar to the post-extraction inhabitation of the quarries at Dura Europos in Syria (Baird 2008). Even the military garrisons at Mons Porphyrites and Mons Claudianus in Egypt offer examples of overlapping sectors of social and

economic life. Fifty-three quarries at Mons Claudianus, for example, had huts located in the immediate vicinity of the quarry boundary (Peacock and Maxfield 1997: 233).

These last two Egyptian examples, which yielded clearly organized labor and spatial divisions at the quarry, raise yet another issue confronting how we define quarries. What activities actually constitute quarrying? At these large, imperial quarries in Upper Egypt, Peacock and Maxfield have surveyed and mapped major processing components of the site. There are thus living barracks, military observation towers, baths, a road network, and a temple in the proximity of what Peacock and Maxfield (1997) calls a quarry field – that is, there are numerous small quarries dotting the landscape near the Roman fort. There are, however, no workshops within the *hydreuma* or the fort. Instead, the evidence from the ‘opportunistic’ quarry faces in the landscape indicates that a great deal of finishing for specific objects occurred in the field – at the quarry site. Partially finished columns and building stones are still visible in the quarry walls. Although this pattern is widely attested elsewhere in the world, such as the Bronze Age quarries at Yesemek and Karakız Kasabası in Turkey, there are equal numbers of quarries where the stages of production – extraction, refinement, finishing – occur in separate spaces. This situation prevailed in Honduras, where vases were created from the Ulua Valley marbles (Luke *et al.* 2006). It also describes a great deal of modern stonework, where mechanization and standardization of block cutting for industrial use in Turkey, Italy and the United States spatially differentiates different stages of production. Spatial differentiation can be located in the immediate proximity of the quarry, at great distances from the quarry, or both, leaving open the issue of whether we define the quarry as the location of the desired rock, or whether we define it as the technologies used to cut stone.

If the latter, the physical extent of any given quarry is greatly expanded. And considering the specialized skill attributed to Egyptian stonemasons, it would be presumptuous to assume a one-to-one connection between social complexity and spatial differentiation.

While Given and Knapp (2003) and Knapp (2003) have performed studies in the vain of a social archaeology of copper production sites on Cyprus, similar efforts to situate all of the aspects of extraction and other non-industrial elements have not been undertaken for quarries. In this literature, there is an either-or mentality to what is being studied, certainly as a measure to correct what appear to be lacunae in the literature. Torrence (1986: 10) noted the limitations of inferring exchange from resource use alone, arguing acquisition and production as integral to any understanding of exchange systems and strategies. We might expand on this as well, noting that the particularities of resource use, acquisition, production, and even exchange, are quite limited means for understanding the full significance of resources in a social world. Whether the quarry is located near a settlement, at a settlement, or at a great distance from a settlement, the resource is never a completely separate entity from practices meaningful in the construction of social norms. Resource acquisition and production are actively integrated into other aspects of social life. It is for this reason that so many possible definitions, or at least implicit understandings, of ‘quarry’ exist.

Lastly, and perhaps with greatest significance for understanding the enduring traces of features and landscapes beyond the period of extraction and construction, is the notion of buildings as quarries. Scholarship on the Late Antique and Medieval periods of western Anatolia has addressed the significance of the appropriation of iconographic content in new contexts through the examination of ‘spolia’. The study of the reuse of

worked marble demonstrates, however, that representational systems are conditional and dependent on specific social and landscape contexts, and numerous regional survey and landscape projects in Anatolia are demonstrating that quarrying in post-Classical periods was more common than originally thought, even if the source was not bedrock.

Greenhalgh (2009), for instance, speaks of post-Classical quarries *as* buildings and monuments. Indeed, there are several instances of this known from Sardis, with evidence coming from sculptural fragments associated with a Late Roman-Byzantine lime kiln in the Bath-Gymnasium complex (Hanfmann and Ramage 1978). What is clear from studies of ‘spolia’ and reuse, however, is that such practices are not limited to economic efficiency, but speak to a broader social context (Elsner 2000; Kinney 2011; Redford 1993).¹⁸

Archaeology of Quarries

From an analytical perspective, the variability in quarrying poses some serious challenges. Yet an opportunity presents itself to create a composite mode of studying quarries that more fully accesses the range of activities and implications present in them, rather than arriving at a new or more precise definition of what a quarry is, and without advocating a completely relativistic approach to defining a quarry. Any attempt to reassess the significance of quarries needs to fully engage with the existing avenues

¹⁸ Papalexandrou (2003) outlines a position that suggests that only locally available stones were used on account of economic concerns. Stone, when quarried anew from the ground, is regarded as implicitly local, while spoliated stone is more easily accessed and potential of a better quality. Such a position is argued against by the other authors cited here.

already being pursued. The difficulty is teasing apart which aspects offer useful points of departure for a coherent approach.

Two primary methods of archaeological research have been carried out for the study of stone in past societies. The first has typically viewed stone as a proxy for measuring specific social behaviors. Many scholars have investigated the extent and nature of trade and exchange networks by turning to models that closely approximate the patterns of material distribution evident in the archaeological record. Such approaches attempt to characterize one element of a social system in an effort to comment on the system as a whole. The second approach, which lies on the opposite extreme of the spectrum of approaches to stone, views material interaction as a component of the making of cultural meaning and ideology. Social theory, performance theory and thing theory are often applied to such studies that overtly emphasize the role stone acquisition can play in cultural reproduction. By no means do all studies fall into these two disparate intellectual camps, but particular leanings are present in more middle range works as well.

Moving forward with quarry archaeology, however, prompts consideration of how different strains of thinking about past social practices might converge to construct a more holistic picture. Similar modes of thinking have been applied, in limited ways, to landscape archaeology more generally. The publication of *Sandy Pylos* (Davis 1998), for instance, attempts to situate the archaeological material located by intensive pedestrian survey within past and present stories and accounts of the region, providing a narrative to what can otherwise feel like cold descriptions of sites, counts and measures. The Sydney Cyprus Survey Project (Given and Knapp 2003) also successfully pulls together data

from survey, excavation and social theory to more fully characterize the local and global characteristics of copper production and its association to urban and rural settlement patterns on the island. This project is successful in its conceptualization of one example of an industrial practice as integrated with other aspects of Cypriot island society. A new approach to studying quarries in the ancient world cannot mimic these studies directly, given the different nature of the evidence, but a more inclusive study can incorporate the social and political context of the landscapes in which they are situated. Three research questions in particular adequately cover the range of issues present in a new approach to studying quarries.

Spatial Resolution

An issue that is seemingly lost in many of the more recent debates about how to understand the distribution of resources is how and where to define the limits of research. This applies to both geographical extent and to methodological extent. The example of how to explain the social implications of stone tool distribution serves to demonstrate both points. The issue of geographical extent deals principally with where we delimit our target of analysis, which depends on what questions we are asking. Torrence (1986: 11-12) discusses the validity of studying the entirety of a known resource distribution map versus selecting to study how material moved through a confined region. This enduring dilemma recalls Plog *et al.*'s (1978) discussion about whether to define the boundary of a survey based on ecological or cultural factors, challenging existing definitions of 'region'. Complicating issues, however, include secondary and post-depositional movement of material that has nothing to do with the distribution of stone during the time

when it was procured (cf. Schiffer 2004; Knapp 2003). Basing an exchange model on where material ends up potentially creates a self-fulfilling explanation, unless the context of movement is also known. For this reason, beginning with a small spatial resolution before expanding to cover known regional extents is preferable than beginning with the fullest distributional extent of a material with a known source.

Research should therefore begin with the quarry and its immediate landscape, regional and settlement context, including the documentation of technological means, routes through the regional landscape, and the characterization of a quarry's geochemical and geophysical fingerprint. Eventually, and with an understanding of local mechanical operations and movement infrastructure, assessment should include where the material ended up, what additional means facilitated this movement and what overlapping social groups were involved. This methodology recognizes that most locations are both locally and regionally relevant, particularly when resource trade is involved. Because of this, the spatial resolution necessary for a more holistic study of resource sites should be flexible enough to move between scales, recognizing that different resolutions are often present at the same time.

Moving Forward with the Text

The remainder of the dissertation is designed to be an undertaking of the positions outlined in the previous section. The following chapter begins the process of narrowing in on the specific region of interest. By discussing quarrying traditions in the eastern Mediterranean, and in the Roman period as a point of comparison, the diversity of scales

of resource interaction will be demonstrated to argue for the utility of a focused study. Chapter 3 will present Central Lydia and its historical and cultural background before exploring the specific field and laboratory methodologies employed to conduct the study. This includes intensive surface collection and mapping, photographic rendering, integration into the CLAS project GIS, and the systematic sampling of the quarry stone for the performance of X-Ray Fluorescence, X-Ray Diffraction (XRD) and petrology in order to determine the precise character of the stone as well as to gain an understanding of whence the stone objects in circulation in this region were coming. Chapters 4, 5 and 6 present the data and results from these studies, synthesizing them for a discussion of the specific significance of quarries and quarried stone for the region of central Lydia. This begins the process of gradually expanding the study so that its results may fruitfully interact with the series of overlapping data for social organization in the Roman world by establishing what scales of exchange, politics, economics, and technological interaction were occurring in Lydia first. Chapter 7 applies these synthetic results to the eastern Mediterranean during the Roman period, such that a clearer picture of social complexity can begin to emerge – one that is rooted in noted variability. Other quarries in other parts of the eastern Mediterranean will be discussed to support these claims. Finally, Chapter 8 concludes the dissertation with general comments about archaeological research of this nature.

Chapter 3

Quarrying in the Eastern Mediterranean

Mediterraneanist approaches

The same tension highlighted in Chapter 1, between highly local landscape contexts and large-scale social structures, characterizes much of the previous scholarship on Mediterranean quarries. The caveat, however, is that previous scholarship has left unresolved the simultaneity of quarries as both place-specific and distributed. Instead of explorations of how resource sites linked disparate classes of people and their locally derived customs with larger networks, including polities, the scholarship cited in this chapter demonstrates that concerns for located traditions are taken up in one type of scholarship, while patterns of distribution are taken up in quite another. The implications of resource sites participating in both – the interest of this dissertation – are not addressed in any explicit sense, with scholars preferring to divide both landscapes and societies into component parts. When technological concerns are mentioned, the trend has been to discuss the matter in a teleological fashion – as progress from early to secondary states in the Mediterranean, or transmission of knowledge down-the-line. This trend regards technology as local traditions that migrate through culture contact, resulting in the loss of landscape specificity along the way. Conversely, the other extreme is promoted, with special emphasis afforded to long-distance trade of highly valued material. On the one

hand, there are studies discussing the generation of regionally specific practices, and on the other are studies of practices that are altogether dislocated. If quarries are simultaneously place-specific and implicated in the construction of the Roman polity as a negotiated space, then local practices and local significance must run concurrently to interregional contact and exchange.

This chapter explores this tension by outlining how quarries have been regarded as local phenomena and non-local phenomena, but rarely as both. Through an analysis of existing scholarship on Mediterranean quarries, I articulate an argument of polities as contested spaces and practiced places. The first section therefore looks at the development of regional archaeologies that emphasize monolithic cultural perspectives. Second, I discuss how current research trajectories privilege large-scale quarries and long-distance trade in highly valued stone at the expense of understanding quarrying techniques in a regional context. Third, I address scholarship specific to Asia Minor and Lydia in order to situate my own research. Each section ends with a critique of the scholarly trajectories outlined within, to demonstrate where productive avenues of research remain. Whereas cross-communication appears to be lacking when considering stone resource studies in a global perspective, the opposite is argued for Mediterranean studies, where quarries are selectively studied because they offer insight into well-established research programs.

Scholarship in the Mediterranean, in several areas and across multiple time periods, has advanced archaeological understandings of landscapes and their social, ecological, political, economic, religious and, at times, esoteric contexts.¹⁹ Landscapes

¹⁹ See in particular Cherry (1983) who outlines what archaeological survey can address; Renfrew and Cherry (1986) who develop peer polity interaction based on changing settlement data relating centers to

are, as is commonly accepted, attuned to social vagaries and interconnected with many different rhythms of action and social meaning (cf. Ingold 1993). In short, archaeological understandings of landscape now incorporate something akin to Edward Casey's (2001) notion of 'constitutive co-ingredience': landscapes and people reciprocally shape each other. Moreover, landscapes are complicated, lived spaces (Thomas 2001).²⁰ As Alcock and Rempel (2008) note, however, archaeologists still sometimes struggle to merge their theoretical intentions with the products of their scholarship. While Given and Knapp (2003 – see footnote 1 for further references) go some way toward achieving this with their study of copper production sites within the landscape of Cyprus, resource and production sites still tend to be dealt with only superficially or in ways that fail to address their underlying complexity and their contribution to broader social patterns. The study of quarries is no exception, and the dearth of research into the extensive number and type of quarries utilized during antiquity presents a problem for understanding archaeological landscapes. I argue, in part, that the high degree of specialization in how quarries are studied in the Mediterranean leads to this disharmony between Mediterranean landscape studies generally and industrial and production sites more specifically. If prevailing theory suggests that all phases of landscapes are social, then so too are resource locations.

rural sites; Alcock, Cherry and Davis (1994) who articulate some of the justifications for how ceramic sherds appear in the landscape at all; Alcock (1994) who synthesizes survey evidence from the entire Hellenistic world to portray broad social changes; Alcock and Rempel (2008) who address how to incorporate special-purpose sites more completely into regional studies; Alcock (1993) who addresses broad social change in the Greek landscape through landscape archaeology; Alcock (2002) who inserts social memory into the discussion of Greek landscapes; Knapp (2003) who discusses social archaeology in the context of Bronze Age Cyprus; Given and Knapp (2003) who publish the same; Given (2004) who attempts to portray the lives of colonized individuals; Attema (2002) who discusses the perception of landscapes in a regional survey context; Witmore (2007) who develops the depth of time and mediated, experiential notion of landscape; Mattingly (1997) who discusses the 'discrepant experience' of individuals in 'Romanized' landscapes.

²⁰ See also Bender (1993; 1998) and Hamilton *et al.* (2008) for this perspective in other regional settings.

Teasing out why this is so involves contextualizing stone-use patterns in the Mediterranean against dominant research patterns in the region, while acknowledging the strides that have been made in this regard already.

Locating Quarry Practices in the Eastern Mediterranean

As many scholars have pointed out, stonecutting practices have varied only a little over the course of several thousand years in terms of both technology and basic modes of extraction.²¹ Nevertheless, careful research in recent years has produced a clearer understanding of the different practices employed at different times, in different places, and according to the demands of different materials. Although several attempts have already been made to characterize ancient quarrying in the Mediterranean, Dworakowska's (1983) ambitious survey of many quarries is not grounded in field research, as pointed out by Waelkens *et al.* (1989), who conduct the most thorough synthesis of quarry research at this point in time in their treatment of "history, present problems, and prospects", yet who restrict their scope principally to white marble.²² The quantity of new research conducted since 1989, including new quarry discoveries, advances in material studies and new geochemical methods, however, makes a more up-to-date appraisal of the field worthwhile.²³ What follows explores the general

²¹ On this, see Waelkens *et al.* (1989: 93); Waelkens (1992); Ward Perkins (1973); Fant (1988; 2008); Rockwell (1993) for classical antiquity. See Harvey (1971 and 1975) for the Medieval period.

²² Dworakowska (1975) is a similar examination of Greek quarries.

²³ Waelkens (1992) and Fant (1992; 2008) both offer general overviews of quarrying in specific periods – the Bronze Age and Roman periods respectively – but neither goes into very great depth. Arnold (1991)

developments in quarry activity throughout the eastern Mediterranean with an emphasis on the methodologies employed to arrive at these conclusions. As Dolci (1980) argues, the regional differences over space and time result in a greater diversity of practice than is usually attributed to stone working before mechanization. Awareness of the relationship between tool-type and cut-mark pattern is the most effective way to provide a general date for the quarry face under study.²⁴

Quarries and dates? Trends and Problems, Tool marks and Time

The earliest evidence of quarrying is found in Egypt.²⁵ The tools employed in extraction in Egypt, Greece and Anatolia are never, it seems, consistent until the Roman period, suggesting that direct transference of quarry technologies did not occur as previously believed (cf. Waelkens *et al.* 1989).

Indeed one of the major advances in studying stone resource sites over the past few decades has been the increase in the number of projects aimed at identifying the correlation between tool marks, tools, and technique. Rather than revealing that Egyptian practices were repeated elsewhere in the Mediterranean – which appears to be an assumption based on a sequential reading of when civilizations arose in the region – these data, beginning with the efforts to document production activity made by Röder (1965),

and Aston *et al.* (1999) provide the most in-depth studies of Egyptian practices. Each of these studies deals with only one region, and none address the trends in research strategy.

²⁴ See Ratté (2011) for a discussion of how tool marks assist in dating Lydian masonry practices. See Bessac (1988) for a discussion of problems relating to tool identification.

²⁵ A frequently repeated, yet inaccurate, factoid is that quarrying proper – that is, the removal of blocks of stone from a bedrock surface – began in Egypt, spreading to the Mediterranean and Anatolian civilizations from this singular point of origin. So intrusive was this belief that those who argue against it rarely, if ever, provide a citation for its source. Notable exceptions are Waelkens *et al.* (1989) and Fant (2008: 121). In these instances, Ward-Perkins (1973) is the most commonly cited proponent of the direct transfer from Egypt hypothesis, though its veracity is surely unfounded.

suggest that Egyptian tools were, in the earliest instances, made of both copper and other types of stone. Subsequent work by Klemm and Klemm (1981), Arnold (1991) and Aston *et al.* (1999) corroborates this claim, though with some differences of opinion. Klemm and Klemm (1981) and Arnold (1991) argue that soft copper tools were used in the Old and Middle Kingdoms for the majority of soft-stone quarrying, likely in the form of pointed picks. Others, however, suggest that the use of soft copper is unlikely, due the presence of harder copper industries available at this time (Aston *et al.* 1999: 7).

Although the presence of new materials does not mean that they replaced older technologies, the evidence of extant copper tools supports this scenario, and adequately fits the description of combined fine-lined cut marks on vertical quarry-faces alongside pointed chisel marks.²⁶ Bronze was used later, possibly during the late Middle Kingdom (Klemm and Klemm 1981; 1993), while iron tools may not have been in use until the Ptolemaic period (Aston *et al.* 1999: 7).²⁷ These softer tools were able to cut the softer limestone and sandstone, popular during the Old Kingdom (Arnold 1991; Aston *et al.* 1999).

Procurement of granite sources, such as the quarries near Aswan, was aided by the use of dolerite hammer-stones, examples of which survive to this day (Aston *et al.* 1999). The specific method for removing granite from its source, however, has not been settled. Clarke and Engelbach (1930) and Röder (1965) initially suggested that wooden

²⁶ Aston *et al.* (1999: 7) note, too, that experimental archaeology has revealed in all but one instance the near impossibility of breaking granite with soaked wooden wedges.

²⁷ Note, however, that Waelkens *et al.* (1988: 95) suggest that iron was used as early as the 6th century BCE in Egypt.

wedges were used to crack the stone, yet most recent research refutes this claim.²⁸ The total lack of evidence for the use of any wedges prior to the Ptolemaic period, when iron was readily available, cautions against acceptance of Röder's speculation. Undercutting stone by nearly half a meter, as occurred at the limestone quarries near Cephron's pyramid (Aston *et al.* 1999), however, might offer a parallel method of extraction with respect to granite. The relatively wide breadth of trenching in granite provided enough space to undercut the desired block and apply sufficient leverage to break it free of the bedrock beneath.

Subtle alternatives in stonecutting technique are detectable in the numerous other types of stone available in Egypt, many of which were extracted for non-architectural or monumental purposes. The sandstone quarries in the Wadi Hammamat, for instance, provide an example of soft stone quarried with harder stone tools. And as the taste in stone changed over time, the application of different techniques to facilitate the procurement of different block types developed. In general, however, it is clear that most archaeological knowledge about Egyptian quarrying practices comes from a relatively few examples that are typically associated with monumental construction. Examples are the granite quarries near Aswan, the Wadi Hammamat, due to its curious location in the eastern desert and its associated graffiti, and the limestone and sandstone quarries associated with royal construction projects such as tombs, mastabas, and pyramids. Setting the amount of research on quarrying techniques against the 156 known quarries

²⁸ See Waelkens *et al.* (1989), Klemm and Klemm (1981), Aston (1994), Arnold (1991) and Aston *et al.* (1999) for arguments against the use of wooden wedges. Note, too, that this suggestions has filtered into stonecutting literature in other parts of the world as well. Nylander (1970), assumes soaked wooden wedges to be the principal means by which stone was freed from outcrops in the Achaemenid period, for instance.

throughout Egypt portrays a stark picture of just how raw our data still are.²⁹ We may know more about cutting and construction practices in Egypt based on more extensive research at well-documented sites, but efforts to determine how extensively these practices characterize the entire region remain to be undertaken.

Whereas quarrying is thought to have ceased in the post-Mycenaean period in Greece (Waelkens *et al.* 1989), no such similar lacuna is evident in Egypt. Here, instead, bronze and iron replace copper as the preferred metal used in tool production, and the preference for stone shifts from limestone in the Old Kingdom to sandstone in the Middle and New Kingdoms (Aston *et al.* 1999). (Sandstone has the distinct advantage of breaking more easily along horizontal layers.) Statuary, vessels and finer crafts continue to utilize a variety of stone types, including granite, basalt, porphyry, soapstone, and gypsum. The techniques of removing stone from a source remain rather consistent over time, although, as Bloxam (2008) notes, the evidence varies depending on tool use and stone type. Channeling in Egypt appeared in both hard and soft stones, using a combination of stone hammers and bronze tools (Bloxam 2008). Some stones, like basalt, were quarried by the levering method, which advantageously exploited existing fissures in the rock by inserting either crowbars or large cobbles (Harrell and Brown 2005; Bloxam 2008).

Early Anatolian Stonecutting

Anatolia offers a similar set of problems regarding the identification of tool development, in part because of the dearth of publications relating to stone-working

²⁹ See Aston *et al.* 1999 for the location and material of each quarry.

technique or to the stone sources themselves.³⁰ Waelkens (1990a; 1992:11) suggests that Hittite quarrying in the Late Bronze Age was the first systematic effort to remove blocks of stone for large-scale building and artistic programs in Anatolia. He also notes that most Hittite quarrying, which utilized basalt, limestone, granite, andesite, and sandstone, was conducted in an opportunistic fashion, in which natural fissures were accompanied by occasional signs of undercutting stone for removal (Waelkens 1992). This technique, as mentioned above for several Egyptian quarries, is difficult to see at times, as it does not offer easy differentiation between natural outcrops and natural breakage (cf. Bloxam 2008). Basalt also appears to be the preferred stone for monumental stelae distributed throughout Anatolia, with known sources at Fasıllar, Karahisar, Yesemek, Tilmen Hüyük, and Zincirli.

Nevertheless, the use of bronze picks and chisels during the Anatolian Bronze Age is evident based on the finds at an expanding number of quarries. The aforementioned pick-marks indicating the combination of levering and undercutting at basalt quarries such as Fasıllar, Karahisar, and Yesemek (Waelkens 1992; Sekedat 2010) could only be achieved with bronze during this time. The famous Yesemek quarry in southeastern Turkey reveals a useful series of partial and complete Hittite stone figures with evidence for the use of point chisels, which likely also were used in the creation of the many Hittite rock reliefs dotting the Anatolian landscape (Bahadır Alkım 1974;

³⁰ Some new work is being undertaken to rectify this lack of publication, particularly under the guise of the Quarryscapes project and because of accidental discovery in the process of completing regional survey. This issue will be taken up more directly below.

Seeher 2011).³¹ Karakız Kasabası, a new imperial Hittite quarry located in the northern portions of the Central Anatolian Plateau, reveals a similar stonecutting program with the same bronze tool assemblage (Summers and Å-zen 2007).³² This evidence, along with the consistent monumental program that spans the entirety of the Hittite empire/kingdom, has been used to argue for an organized imperial quarrying program (Waelkens 1990a; 1992). The Yesemek material in particular suggests that stone was extracted in excess of the amount needed for immediate use, and that workshop spaces overlapped with quarry locations.

This evidence, however, confronts the otherwise locally derived pattern of stone use throughout the Anatolian region. The majority of stone used in the construction of the lower courses at the Hittite capital of Hattusa, for instance, comes from immediately proximate sources, or those located within 30km of the site, at the Shapinurva, Kızlar Kayası, Kesik Kaya, and Ortaköy limestone quarries (Akoğlu *et al.* 2007; Waelkens 1992: 11). Although 30-40km is still a great distance to cover, materials are not arriving at the capital from distant sources for monumental display.³³ Waelkens (1992) notes that local limestone and granite was used at Hattuşa, local andesites at Kültepe, local porphyry at Alaca Hüyük, and local limestone at Carchemish. These quarries, however, do not offer the same temporal evidence for when they were in use, and their association

³¹ On rock reliefs and their meaning, see Schaffer (1998), Ehringhaus (2005), and Stokkel (2005). For meaning and text see Hawkins (1998) and Bonatz (2007). Geopolitics, religion and place are all aspects of rock-relief positioning.

³² Note that the map provided by Waelkens (1992) is incomplete, even for quarries known at the time of publication.

³³ In this instance, it is possible that the meaning of resource location retained significance where it was, such that transplanting stone from important places did not result in transferring the significance of that stone as well. Something that might set the Hittite belief system apart from other Mediterranean cultures. Contrast this to, for instance, the Neo-Assyrian penchant for bringing landscape features back to Nineveh after campaigns to the northwestern reaches of their domain (Thomason 2001).

with the imperial Hittite period of the Late Bronze Age is speculative at best (Akoğlu *et al.* 2007), and appears rooted in the absence of any known and datable cut-mark styles.

Iron Age quarrying, particularly that of the Phrygians, seems more securely identifiable due in large part to an apparent shift in technique and tool use. Late Iron Age Lydian stone-working and quarrying techniques are assumed to follow established Greek practices (Ratté 2011), but the opposite pattern of transference is perhaps more plausible, based on current knowledge about when specific tools appeared in each region. Rockwell (1993) notes stylistic similarities between earlier Anatolian workmanship and later Greek practices, while Waelkens (1992: 12) suggests that Neo-Hittite practices migrated west, ultimately influencing Greek stonecutting techniques. The entire debate, as much as there is one, seems implicated in the ongoing debate on whether to call western Anatolia culturally Greek or culturally eastern (see *Anatolian Studies* 57 for different perspectives), an either/or situation that has been refuted by Roosevelt (2009) among others. Incorporation of iron tools into the stonecutting repertoire is visible here, as elsewhere, by a widening, deepening and curving series of parallel striations running roughly diagonally down the quarry wall. Most of the research conducted in both Phrygian and Lydian stonecutting technology, however, has emphasized the production of architecture and monumental tombs (Ratté 2011), with particular attention paid to artisanship (Kurban 2002; see also Nylander 1970 on Achaemenid architecture).

Greek Stonecutting

Quarrying in the Greek east tends to receive short shrift, at least in comparison to Roman techniques. Fant notes that, “research on Greek quarrying has generally been

piecemeal, with studies often linked to investigation of entire sites...” (Fant 2008: 126).³⁴

Nevertheless, considerable work has been conducted on Minoan and Mycenaean masonry techniques (Waelkens *et al.* 1990a; 1990b; Papageorgakis *et al.* 1992; Waelkens 1992; Fant 2008; Shaw 2009), although Fant’s (2008) synthesis of Archaic and Classical Greek stonecutting is, for instance, comparatively brief. The Bronze Age provides a wealth of information, however. Extensive studies of the distribution of obsidian have been conducted for a range of sources in the Mediterranean, including Melos (see especially Torrence 1986), and central Anatolian sources (Tykot 2002). Less transportable stones, such as steatite, limestone and marble, were also procured during the Bronze Age using the familiar trenching and levering techniques that characterize stone acquisition efforts for much of this region. While sandstones, schists and chlorite stones were used in construction from the late 3rd millennium, it is not until around 1900 BCE, the Old Palace phase, that quarrying begins, coincident to the advent of bronze quarrying tools (Waelkens 1992: 8). After this time, the Skaria, Pelekita and Malmoures sandstone quarries near Zakros, Crete were opened and worked in the trenching manner, as were several quarries near the island of Mochlos (Papageorgakis *et al.* 1992; Shaw 2009). These quarries are dated almost entirely according the appearance of this particular type of stone in monumental architecture nearby and by the associated stratified ceramic finds.³⁵ Quarrying thus appears to be tied to specific acts of building in the Late Bronze Age.

³⁴ Note, however, the useful ‘Corpus of Ancient Greek Quarries’ compiled by Kokkorou-Alevras (2003).

³⁵ Waelkens *et al.* (1989) are somewhat dismissive of using ceramic finds to date quarries, yet such finds have proven useful in dating single-period operations such as those on Crete. In mining contexts, ceramic finds have proven useful in developing a sense of what supplementary activities might have occurred

Waelkens *et al.* (1989: 92; 1990) suggest that strong ties between construction projects and stone extraction existed in the Archaic and Classical periods as well. It does appear, however, that after a significant gap in stone construction following the Mycenaean Late Helladic period, which is the primary evidence for the lack of quarrying practices, efforts to extract stone begin again with the late Geometric and early Archaic periods (Waelkens *et al.* 1989; Fant 2008), and extant finds dating to these periods are generally limited to pieces that failed to meet construction specifications (Korres 1994).³⁶ Soft poros stones in the Corinthia were some of the earliest extracted stones, while harder stones like marble are not definitively used for construction until the 7th century BCE.³⁷ The Classical period marks the first strong evidence for the exportation of marble and other stones (Fant 2008).

The 7th century BCE, in addition to marking the construction of marble structures, also witnessed the first confirmed use of iron wedges (Chiotis and Papadimitriou 1995). Iron wedging appears to date to the 6th century BCE on Naxos (Waelkens *et al.* 1989), and numerous wedges and iron tools have been found in quarry contexts of similar date. The Hellenistic ignimbrite quarries at Kefalos Bay on Kos, for instance, yielded an iron chisel in addition to the surprising find of a wooden wedge, the veracity of which had

alongside the industrial activity (Knapp 2003). Similar results have arisen in Chalcolithic marble quarries (Takaoğlu 2005). Shaw notes that the Pelekita quarry had MMII sherds in the quarry channels.

³⁶ Korres's fictional story about the making and transportation of a broken column capital from the Pentelic quarries to the Athenian acropolis depends entirely on the mandates of specific volumes and designs in marble.

³⁷ This appears to be based in large part on the presence of iron wedges, epigraphy, and the first marble temple construction at this time. See Fant (2008), Korres (1995), and Waelkens *et al.* (1989), who note that the first marble temples were built in the Cyclades in the 6th century BCE and spreading from there. Use in figurines and other objects is well attested throughout the Bronze and Iron Ages. For early marble use tied to local construction, Parian, Pentelic, Naxian, Thasian, Samian, Hymettian, Dolianan in Greece, and Belevi, Miletus, Heracleia and Proconessus in Ionian Anatolia (Waelkens *et al.* 1989: 89-90).

been in doubt for Egyptian quarries (Chiotis and Papadimitriou 1995), while iron picks have been found in quarries of different stone types including marble, limestone and sandstone (Waelkens *et al.* 1989: 97).

Ownership of most Greek quarries is thought to have been private, not state (Waelkens *et al.* 1988), with a few exceptions. One possibility is that private ownership of quarries in Greece (Hopper 1968 and Healy 1978 mention ownership of mineral resources for metallurgy) was facilitated by the extraction system based on contracts for specific architectural projects. Supply, in other words, was met by specific demand, not by the prefabrication of blocks of stone. Hayward (2003) demonstrates how the limited evidence for quarrying stone around Corinth was in all probability dependent on the rhythms of the agricultural season, which might indicate seasons appropriate for quarrying and construction as well.

In principal, these dates are arrived at through the combination of stylistic similarities between unfinished products and the quarry's marble, epigraphic data, surrounding ceramic evidence, the tools in use, and the marks these tools leave behind. In very few instances are the findings reported above corroborated by detailed study of the tool marks, however. The rare examples are Röder (1965; 1971), Klemm and Klemm (1983; 1991), Bessac (1988; 1996; 2007), Waelkens (1985; 1990a; 1990b; 1992), Waelkens *et al.* (1989), Arnold (1991), Adam (1994) and, more recently, Bloxam (2008, who creates a 'how-to' manual), and Gaied *et al.* (2010), who relate the measurement of cut blocks to standard units of measurement in antiquity to approximate the age during which blocks of stone were cut. Much of this work, however, dates best to the Roman period, where by far the most effort has been put into understanding the development of

cut-stone industries – methodologically, economically, and scientifically. While Waelkens *et al.* (1989) do not provide the kind of multi-stone coverage desired in this project, they do demonstrate how careful observation of the quarry face and the surfaces of cut stone can contribute to a better understanding of technological change over time.

Roman Quarrying

Although interest in the volume of different marble types distributed throughout the Roman empire dates to the 19th century with the publication of Bruzza's catalogue of marble colors in Rome, subsequent work has largely focused on scale and administration. Dubois (1908) surveyed Latin literature, official documents and epigraphic evidence to develop the basic administrative structure of stone-working and stone trade in the Roman empire (Fig. 3.1). Forays into what this structure meant in terms of physical production and the economy at large can principally be attributed to the work of Ward-Perkins in the 1970s and following, when he observed that marble for long-distance trade was cut in a prefabricated fashion.³⁸ That is, stone blocks of regular size were distributed to ports throughout the Roman empire, where the process of refining the stone for local flavor and local projects would be undertaken. This recognition enabled Ward-Perkins to posit that the Roman economy at large was invested in surplus production (1973 - see note 24).

Fant's (1988) study of the epigraphic evidence for administration at the quarry districts at Dokimeion, Dodge's (1991) overall study of the marble supply, Fant's (1992) study of the marble yard at Portus, and Russell's (2009a) examination of the stone transportation network in the Roman empire all support Ward Perkins's notion that such

³⁸ See in particular the series of lectures delivered in 1971, where he considers a "highly sophisticated commercial organization" and "mass-production, standardization, and even a certain measure of prefabrication" (1973: 145).

a system did exist during this time. R.R.R. Smith's study of production based on the demands of specific consumers also lends credence to the viability of prefabricated stone to be worked at a later time. Fant (1985; 1988; 1989a), Waelkens (1985) and Sekedat (2010; in press) have also observed mass-production of partially finished sarcophagi, including nearly complete decorative schemes of these objects where they rest still in the quarry.³⁹ Extensive distribution and demand for material clearly speaks to the scale of an overarching administrative, or at least cooperative, production of stone, which is consistent with similar evidence for mass production in the brick and timber industries (Meiggs 1978; Bodel 1983; Graham 2006). Waelkens *et al.* note that, "On the whole, the production process in or near the quarries of the Roman Empire thus was organized along identical lines, the only difference being the kind of artifact that was produced locally and the range of its market" (Waelkens *et al.* 1989: 114), for which some of the evidence lends support. The primary issue confronting this claim is the expanding awareness of how many quarries were actually open during the Roman period, suggesting that the similarities between quarry practices might be more variable than the limited study presented in the 1980s permitted.

Technological Change and Dating

As mentioned above, the critical observation made by Waelkens *et al.* (1989) relates to changing tool material and size. Early stonecutting practices, they suggest, are represented by narrow, horizontal and vertical cut marks, likely produced by light-weight

³⁹ Sarcophagi, of course, are not the only prefabricated form. Asgari (1978; see also 1977) noted the prefabrication of wash basins at the Marmaris quarries. Prefabrication on this scale should not be confused with pre-forming such objects as columns and capitals, which likely were produced for specific building programs.

picks or points. Later cut marks were produced by heavier, harder tools that fundamentally altered the motion of the stone worker's arm, forcing it to carry beyond either a vertical or horizontal line. The result is a concentric series of curved markings on the rock face. In rare cases, there is evidence for a quarrying activity that spans the entirety of time between the earliest periods of stone working (i.e., the Old Kingdom) and the Roman period.⁴⁰ The granite quarries at Aswan West Bank (Heldal and Bloxam 2008) and Aswan East Bank (Bloxam 2008), as well as the sandstone quarry at Gebel el-Silsila (Bloxam and Heldal 2008), all preserve evidence for stonecutting activity spanning several millennia. Less expansive time scales are also observed, such as at Proconnesus, Dokimeion, and Fasıllar in Turkey, where similar changes in pick technology are apparent. Observations about stone removal techniques follow the series of observations made in Waelkens *et al.* (1989), in which the wider, heavier tools of the Roman period leave more substantial marks in the rock face, with a resultant overlapping curvature visible.⁴¹ Such marks are not observed in Egypt prior to the Roman period (Dworakowska 1983: 147), though Dworakowska and Dolci (1980) suggest that a variety of tools and techniques were in contemporary use at many quarries in the eastern Mediterranean. In Egypt, they appear to be primarily dolerite hammers and slender copper, bronze, and possibly iron picks and points prior to the Roman period.⁴²

Other changes include the wedge, as discussed above, and the use of ancillary materials, like rope, in innovative ways. Rhodes (1987) shows how quarrying practices in

⁴⁰ Shaw (1994: 110) presents some of this evidence in a brief survey of Egyptian quarrying in marginal desert locations.

⁴¹ Reiterated by Klemm and Klemm (1993).

⁴² See, in particular, Röder (1965), who also mentions the discovery of a narrow pick at the Anatolian quarry of Dokimeion. Bloxam *et al.* (2003) discuss Old Kingdom cutting techniques specifically.

the Roman period of the Corinthia yield highly consistent channels for ropes that would have facilitated the movement of stone blocks within the quarry itself. Other tools, such as the claw chisel, were not in use widely in the Mediterranean prior to the imperial Roman period, with Lydian masonry an exception.⁴³ The basic method for extraction of stone blocks in the Roman period, as Ward-Perkins (1973) suggests, does stay remarkably similar to the practices described above.⁴⁴ What sets Roman quarrying apart, Fant (2008) argues, is the scale and standardization according to which Roman stonecutting was undertaken.⁴⁵

Critique of Regional/Cultural Characterizations

The focus on when quarrying developed in specific regions, and within specific cultural contexts, offers several important observations about the history of stone-working in the Mediterranean. Knowledge about early markers of tool use, for example, is critical in any understanding of quarrying, and it is natural to assume that these marks will vary between regions. The studies cited above, therefore, have contributed greatly by establishing a base of knowledge about temporal trajectories for the introduction of quarry technologies throughout the region, as well as a base of knowledge about tool marks and their appearance. Although of great significance, this body of literature is open to several critiques. First, the majority of these data are based on large-scale construction

⁴³ Note, however, that the claw pick was in use in Achaemenid Iran (Nylander 1970), though this may have been influenced by Lydian masonry, which saw the introduction of the claw chisel by the mid to late 6th century BCE.

⁴⁴ For detailed discussion of Roman quarrying, including descriptive diagrams of the each phase of the process, see Kozelj (1988) and Bessac (1996; 2007).

⁴⁵ Research on this topic is dominated by the marble industry. Examinations of other stones have been undertaken most vigorously in Egypt, which lacks marble (Peacock and Maxfield 1997; Maxfield 2000; Maxfield and Peacock 2001; Bloxam 2008; Storemyr *et al.* 2003; Hirt 2010).

programs with associated large-scale quarries. Only rarely are smaller quarries mentioned, with Egypt providing most of the examples. While this trend clearly results from research emphasizing the most prolifically quarried areas that yield the most abundant evidence, it reinforces a problematic understanding of stone extraction as initially and, at times, exclusively linked to the rise of specific types of political authority, or it assumes cultural and technological homogeneity in defined spaces.

In this way, the regional approach to quarries has also advanced a notion of technological uniformity with strong temporal and political components. When technological variability is accounted for, it often appears as an indication of change over time, leaving intact a sense of cultural and political homogeneity within ancient regional boundaries. Recent emphasis on more diverse quarrying practices in Egypt, Greece and Anatolia, however, pose a substantial problem for this understanding of the association between quarries and regional polities. There is a disparity between the number of quarries found archaeologically, the number of quarries published openly, and the ability for archaeological synthesis – archaeometric and otherwise – to address the role of stone in past landscapes. For example, there are a finite number of quarries definitively owned and operated by Roman imperial authorities.⁴⁶ These quarries do not, however, offer anywhere close to a representative sample of the scale, quality, quantity, material, and organizational practices that existed during this period of history. Both survey and excavation projects throughout Anatolia, for instance, have located an ever-increasing

⁴⁶ Hence Hirt's (2010) defined scope. He outlines his field of research as encompassing imperially operated mines and quarries to understand broad scale economic organization and control of particular resources within the empire. Pliny, however, suggests that even in antiquity, marble quarries were considerably more numerous than the list of famous quarries would suggest: "It is not important to mention the colours and species of marbles when they are so well known, nor is it easy to list them when they are so numerous. For there are few places for which a characteristic marble is not found to exist" (Pliny Natural History 36.9.53-36.11.55).

number of stone quarries that could potentially change archaeological understandings of resource management, location, and procurement strategies for all periods. Review of 30 archaeological regional survey publications that present at least partial site gazetteers is revealing in this regard. Of the 30 surveys in Turkey, all but 3 have reported finding local quarries, the vast majority of which are unaccounted for in the list of imperially owned and operated stone sources in antiquity. Still others were found during excavation, though an exhaustive discussion of each project and each quarry is not provided here. Even well known quarries, such as those around Ephesos, are relatively numerous, though this fact often goes unreported in favor of characterizing a particular city's available resources.⁴⁷ Aphrodisias is now known to have had nine quarries, while the region north of Sardis has at least eleven quarries. Often, the only settlements in close proximity to these quarries are small rural sites such as farmsteads. Western Anatolia alone, therefore, has yielded an abundance of new quarries that have received cursory attention in the scholarship at best, and in most instances, have only been mentioned as existing, with no follow-up analysis conducted to attempt to date or further synthesize the quarry into the developing social landscape. There is clearly a need for research into what the number of local-level resource sites means for the local, regional, and imperial landscapes under investigation.

The preponderance of evidence for diverse stone-working practices indicates the need for research that is more attenuated to a specific landscape context. By generalizing quarry practices as the products of cultural norms, much of the scholarship cited previously limits the role of landscapes and places to backdrops for cultural activity, rather than acknowledging them as active participants in the production of social

⁴⁷ There are, for example, some 40 quarries around the city of Ephesos, the vast majority of which have never been sampled in order to contribute to the expanding stable isotope database. See Prochaska and Grillo (2010).

practices. Since, as Chapter 1 argued, polities attempt to define themselves through spatial practices, then all of the practices occurring within the spatial limits of a polity should factor into its characterization. As Smith (2003) argues, discerning the intersection between place, space and landscape allows for analysis of social units that is not devoid of location-specific attributes, which has the added benefit of addressing the factors responsible for intra-regional variability as well as inter-regional variability. Thus, although local concerns are a major component of existing scholarship on quarries, the lack of emphasis on the role of landscapes and places in the composition of varied practices over space and time leaves significant room for development.

Distance, Distribution, and Organization

The other prevailing trend in existing scholarship on Mediterranean quarries has to do with the distribution of stone over long distances. This is particularly true of the scholarship on Roman-period marble extraction and on archaeological science applications to quarried stone.

Archaeometry in the Eastern Mediterranean

One area for which the growing corpus of known quarries could have a major impact is materials science. Beginning in the 1960s with trace element and geophysical analysis, and the initial collaboration between Herz and the British Museum to develop the method for stable isotope analysis, efforts turned towards understanding the primacy of certain sources of stone (principally marble) and the extent to which it was traded. This

research is partly driven by the same questions that were prevalent in Roman archaeology from the 18th century: where does much of the building material for elite construction come from?⁴⁸ The added, more recent, interest in how this impacts discussions of economy provided additional motivation, contributing directly to the discussion of the scale of production and the scale of economic connectivity across the Mediterranean. Since the 1980s, however, the application of archaeological science to provenance studies has vacillated between excitement over its potential, the tempering of this excitement, the persistent search for newer and more refined techniques, and the reappraisal of appropriate questions to ask of such methods.⁴⁹ While the ultimate goal is to isolate one mineral source from any other possible sources, doing so has proven to be a challenge, made increasingly difficult by newer studies at more quarries, which have served to blur the distinctions between stone sources.⁵⁰ Nevertheless, there are three primary questions currently applied to material sourcing that characterizes eastern Mediterranean research. These are: sourcing to a specific location, sourcing to reassemble/disassemble objects, and sourcing to understand broad economic trends. These aims are covered by a variety of different techniques.

⁴⁸ Waelkens *et al.* (1989: 83-84) comment on the same issue, drawing out more fully the scholarly trajectory behind it.

⁴⁹ Herz, for example, published a graphic display of quarries sampled for isotopic signature, against which most subsequent studies have been plotted. The result is an increasingly large number of stone sources with overlapping chemical signatures. Some success has been made, such as the proof that stone comes not from one region, but more likely from another (Walker 1988), and that material used inland in Turkey was distributed overland rather than from immediately local sources (Walker 1988), but Knapp (2003) has voiced concerns pertinent to all archaeological science studies. Of significance is how Knapp suggests that an alternative set of questions might be more appropriate given current limitations on the ability of archaeological science to answer very narrowly defined inquiries. Knowing a material's origin, for instance, does not convey information about how that material arrived and what intermediate stops might have occurred during its journey.

⁵⁰ Waelkens *et al.*: "Yet it seems very likely that with the development of ancillary methods of analysis and with the establishment of more data bases unambiguous provenance determination for all classical marble artifacts eventually may become possible" (1989: 84-85).

As mentioned above, sourcing to a specific location is perhaps the driving force behind materials science approaches to marble, as it is the foundation upon which the other two research questions rest.⁵¹ The general process by which provenance studies are conducted requires the development of a source characterization study, during which the rock faces from a known quarry are analyzed for their geochemical or geophysical signature. Samples from the quarry are analyzed according to the specifications of different methods. In petrography, for example, a polarizing microscope is used to describe the physical attributes of the mineralogical inclusions in a thin section of stone, including the orientation and size of grain types (Rapp and Hill 2006). When successful, this technique enables visual observation of the different mineralogical attributes present in a stone source. As with all sampling strategies, multiple samples are taken from each source to confirm the fingerprint's spatial consistency across the mine or quarry.

Although examples of the use of petrography are numerous, two cases demonstrate both its utility and the problems confronting it.⁵² Antonelli *et al.* (2010) have recently published a report comparing the granite from Mons Claudianus in Egypt and visually identical sources of granite in Calabria, Italy. Their study reveals that the differential composition of stone can result in strikingly similar outward appearances that are nonetheless differentiable through microstructural and geochemical analysis. The microstructural study (petrography) revealed that the Egyptian granite had high levels of hornblende, while the Calabrian granite yielded high levels of muscovite, sillimanite and

⁵¹ And especially to white marble, the ubiquity of which makes visual identification more difficult than for varicolored stone.

⁵² For petrographic analysis in the eastern Mediterranean, see Germann *et al.* 1988; Roos *et al.* 1988; Gorgoni *et al.* 1992; Lazzarini *et al.* 1995; Brown and Harrell 1995; Hayward 1996; Barbieri *et al.* 1999; Lazzarini *et al.* 1999; Gorgoni *et al.* 2002; Cramer *et al.* 2002; Attanasio *et al.* 2002; Pike 2004; Attanasio *et al.* 2009; Gaied *et al.* 2010; Ebert *et al.* 2010; Antonelli *et al.* 2010; Serra *et al.* 2010.

allanite (Antonelli *et al.* 2010: 932), revealing that stone sources can be differentiated from each other in certain circumstances, particularly when the sources are geographically disparate.

Pike's (2004) study of the Pentelic marble quarries, however, reveals that internal variability causes challenges for precise petrographic identification. In his petrographic study of the Pentelic marble quarries outside of Athens, he demonstrates that a high degree of variability can exist within the limits of a single quarry system and between different *brachia* (branches) of extraction, while developing a database for mineralogical attributes present within this extensive system of quarry faces. Thus, spatial resolution has important consequences and potential limitations for petrography, serving to distinguish between two distinct sources quite successfully, while raising doubts about the precision of provenance studies that aim to locate the source of a specific artifact.

Trace element analysis and isotopic signature analysis have also been employed commonly in the effort to determine provenance. Numerous different techniques can be applied to stone to determine the quantity and kind of trace elements present in a given sample, with the primary differences lying in the type of elements detected and the resolution of the particular instrument – whether it detects elements in the parts per million range or the parts per billion range. Commonly applied techniques include Neutron Activation Analysis (NAA) and X-Ray Fluorescence (XRF), both of which irradiate the sample to detect the emissions of unstable elements.⁵³ X-Ray Diffraction (XRD) is used to determine the lattice-work of mineral elements physically present in the specimen, though its utility in archaeology has not been widely practiced (see, however,

⁵³ Other, less common, techniques include atomic absorption. XRF is commonly used with obsidian. See Tykot 1996; 2002; 2006; Tykot *et al.* 2009.

Williams-Thorpe *et al.* 2004). Inductively Coupled Plasma Mass Spectrometry (ICP-MS) and ICP Atomic Emission Spectroscopy (ICP-AES) determine, with a high degree of precision (parts per billion rather than parts per million) the presence of isotope ratios in a sample, usually of carbon, oxygen or strontium.

The initial success mentioned for Herz (1987; 1988) and Walker (1988), which helped to expand notions of trade and economy to the Mediterranean-wide scale, have since been tempered by the awareness that chemical attributes are often subject to the same heterogeneity that afflicts petrography. In particular, this realization has been arrived at in tandem with the growing efforts to find and study quarries. Thus, Rapp and Hill's (2006) comment that the Greeks and Romans only used the purist white marble in sculpture and construction programs has emerged as quite profoundly wrong.⁵⁴ The initial hope, as Rapp and Hill (2006 – see note 37) note, for isotopic signature analysis and other trace element analyses, was that formation processes would lead to a high degree of homogeneity in a stone source. The purest (in this sense, that with the most consistent color) stones were assumed to be more uniform due in part to the metamorphosing processes that created marble, and to the mistaken observation that consistent color and texture should yield uniformity in interior structure as well. As the number of known quarries of varied color and composition expands, and as studies such as Pike's (2004) are demonstrating the amount of variability present within single sources, we are increasingly aware of the problems facing source characterization.

This does not mean that chemical analysis has proved ineffective.

Characterization of one source can provide very precise signatures or fingerprints that

⁵⁴ This comment, and the following, appeared in the first edition of their book. The removal of such statements in the second edition (2006) is a testament to the growing awareness of widespread stone use throughout antiquity and the implications that this has for the utility and sensitivity of archaeometric study.

have helped in very practical ways. Walker (1988) successfully combined the results of elemental analysis with inscription fragments to form complete documents. The same has been applied to sculptural fragments (Tykot *et al.* 2009). And in confined areas with no evidence for large-scale trade in stone, regional studies have offered a clearer glimpse at where resources were coming from for a particular urban zone. The quarry survey around Aphrodisias, for instance, has yielded strong evidence that construction during the imperial period at this city was augmented by stone production in approximately nine quarry sites throughout the countryside (Long, personal communication; Attanasio *et al.* 2009). Thorough studies on Naxos and Thasos have yielded strong evidence for changes in production over time (Ebert *et al.* 2010). Each of these studies reflects a shift in research questions from one that tries to isolate a quarry's chemical signature to one that tries to enhance research into regional characterization.

Current trends, however, favor what is called the “multi-method” approach to source characterization (Moens *et al.* 1992; cf. Grillo 2010: 60). Put simply, the multi-method approach combines several techniques in order to better define the source. Usually this involves both petrographic analysis and some form of geochemical study, such as stable isotope or XRF. The reason behind combining different strategies is due to the recognition that each technique has its own strengths and weaknesses, some of which can be offset or clarified by comparing the results of two methods that attack sourcing from different perspectives. Reflecting on the sourcing techniques, their promise, and their limitations suggests that archaeometric studies of stone samples in the eastern Mediterranean have fundamentally altered archaeological knowledge of stone production and distribution, but perhaps not in the way initially envisioned by early proponents. This

addresses the third aspect of materials science approaches, which has to do with the addition of questions concerning broad social trends and whether the distribution of stone can address changes in the patterns of regional connectivity. Walker (1989), as a clear example of this, noted that geochemical signatures reveal a shift in preference from Italian to eastern Mediterranean stone during the 2nd century CE. And in a general way, the byproduct of archaeometric research, which shows above all that many more stone sources were active during the Classical and Imperial periods, has altered expectations about distribution models in antiquity.

Quarry administration: epigraphy, military involvement and spatial organization

Associated with the scale of production and distribution in the literature on Roman quarrying is the issue of labor standardization and administration, the evidence for which derives from documentation either in texts or on the quarry faces themselves. This evidence attests to individuals, offices, titles, accounting systems, and ownership, giving valuable insight into the organization of state-operated, and in some cases, private quarries. These data are limited in most cases to the Roman period, contributing to the notion that Roman-era labor and economy are fundamentally different from preceding practices. Other textual evidence does exist for pharaonic Egypt, which exhibited a corvée style of labor control, and Greece, where private ownership prevailed. Rome, on the other hand, employed a complicated mixture of administrators, wage laborers, slaves, and seasonal workers.

Fant (1989a), for instance, uses inscriptions located in Bacakale (part of the Dokimeion quarries) to demonstrate the participation of officials who governed two

stages of quarrying, as well as some of the individual letter-cutters. The process of *caesura*⁵⁵ was undertaken by groups of quarrymen with overseers with the same title, while the *officinae* oversaw the reduction of stone blocks to their appropriate size (Fant 1989a; Hirt 2010). Fant uses this material to develop a picture of hierarchical labor practices, with clear divisions in activity performed by individuals with different skill sets, using different production techniques. Hirt's (2010) comparison of the Dokimeion epigraphic formula to those at Mons Claudianus, Chemtou, and Karystos shows, however, that although quarry marks are common occurrences in imperial contexts, a high degree of regional variability exists. In some cases, titles are represented, such as at Dokimeion, whereas Mons Claudianus reveals only numerical values inscribed on blocks of granite and with uncertain meaning. Hirt (2010) notes the possibility that numbers refer to brachia (here, the origin of the stone within the quarry system), the team that cut the stone, the destination, or an unknown alternative. That some blocks at Mons Claudianus have different numbers inscribed on multiple surfaces further complicates the issue.

Inscriptions from quarries and ostraca have enabled scholars to determine the basic administrative structures employed in imperial mines and quarries. The overall structure for imperially operated mines and quarries begins with procuratorial (*procurator metallorum* – with metallorum here referring to mineralogical resources generally – cf. Hirt 2010) oversight of an entire region's resources. These individuals,

⁵⁵ In this case, *caesura* refers to the creation of an empty space around each block of stone to facilitate extraction, relating to the more commonly used poetic meaning of a break or stop in the middle of a line of verse. Trenching creates a physical stop or break in the otherwise continuous rock formation. The office holder is called the caesura-holder by Hirt (2010: 294). Hirt, however, suggests that *officinae* refers to the physical location of the workshop, and the individual in charge would have been in charge of reduction practices undertaken in that specific location.

from the *familia Caesaris* (equestrians who served the emperor – Hirt 2010: 107), are sometimes known to us. In Egypt, the procurator for Mons Claudianus, Mons Porphyrites and Mons Ophiates was one Marcus Ulpius Chresimus during the reign of Hadrian (Hirt 2010: 107). A *procurator marmorum* existed in Roman Asia Minor and in Achaia who held a similar position to his Egyptian counterpart. These procurators were in charge of the accountants and other administrators, who worked more directly with the quarrying practices (Hirt 2010: 155). The procurator's office, however, was responsible for provisioning the necessary labor and equipment, including food and supplies, for the active functioning of the imperial quarry. Other administrative titles include *caesura* and *officinae*, mentioned above. The specific labels applied to quarry workers is unattested by the epigraphic evidence, which favors imperial title-holders.

Evidence for stone and metal production in Egypt, Spain, and the Balkans additionally suggests that the wages paid to similar classes of laborers was consistent across the empire as well (Cuvigny 1996). The full hierarchical structure is exhaustively treated by Hirt (2010), who carries his study of labor division and labor policy, including all known titles and their corresponding duties, from the quarrymen to the provincial governor. Much of Hirt's evidence comes from Egyptian contexts, however, raising the possibility that such divisions were particular to newly opened quarries, of which there were many in Egypt, rather than comprehensively covering all Roman quarries.⁵⁶

Although labor practices were governed by an overarching administrative unit, the standardization of titles did not translate to the standardization of spatial organization. Local context mattered a great deal to the operation of stone-working sites. In such cases,

⁵⁶ The fact that Fant's research at Dokimeion, a major imperial quarry, does not reveal the same degree of hierarchical structure, is a case in point. Structural differentiation seems more likely than simply differential preservation of evidence between the two regions.

associated industries, structures, complexes, and institutions create the backdrop into which the quarry is set. Mostly this is achieved through the survey and documentation of the quarry and its periphery, though usually not with the same intensity as called for by Mediterranean-style pedestrian survey.⁵⁷ As we have seen, however, the spatial separation of extraction and reduction is not always clearly defined. Nor is the division between quarry and settlement structures. While Fant (1989a) suggests that laborers would walk between the town of Dokimeion and the quarries, a distance of approximately 2km, and Korres (1994) finds a similar separation of quarry and household for Pentelic marble, other locations, such as Mons Claudianus and Mons Porphyritis in Egypt (Peacock and Maxfield 1997; Maxfield and Peacock 2001) and Dura Europos in Syria (Baird 2008), witnessed industry and home occupying the same space.

Nevertheless, evidence from a number of stone sites suggests the desire to control the stonecutting industry. Usually this comes in the form of military installations either in the quarry or along the roads leading into and out of the extraction district. The Karystian quarries of southern Euboea are well known, for instance, for their ‘dragon houses’, which are likely to represent official outposts for the protection of valuable marble resources. These structures are unusual because of their short stature (c. 1-2m high), leading Kojelz and Wurch-Kozelj (1992; 1995) to suggest that they were short-term lookout posts, situated with better views of different access routes to the quarries, but serving only for temporary occupation by soldiers. In southern Euboea, these were located closer to a central military barracks, and they owe their creation and position to

⁵⁷ Takoğlu’s (2008) survey of a Chalcolithic marble workshop in western Turkey is a notable exception. Collection of ceramic material at quarries does happen in the course of conducting regional survey (Broodbank personal communication), but usually not with an accompanying interest in documenting the quarry wall. Alternatively, the quarries at Aphrodisias were surveyed, but lack associated ceramic collection (Rockwell 1996).

the undulating nature of Karystian slopes, which prevented any centralized surveillance of all active quarries from any single position (Kozelj and Wurch-Kozelj 1995: 20). An organized system of road networks and quarry slip-roads near Karystos was also constructed, facilitating the movement of marble from the quarries to points of export along the Euboean coast (Vanhove 1996), which were also protected by these military garrisons.

The clearest evidence of such military oversight of quarry operations comes from the detailed survey of Roman quarries in Egypt, where road and slip-road networks were critical to the stone transport. These, however, represent an altogether different sequence of operations, both in terms of initial use of stone and in terms of spatial layout. The late 1980s and early 1990s saw a growth in the number of systematically surveyed quarries in Roman Egypt that endeavored to define site layout, quarry location, building identification, and stonecutting technique. The most comprehensively published survey reports, from Mons Claudianus and Mons Porphyrites, respectively, provide detailed studies of two important granitose quarry systems in Roman Egypt.⁵⁸ Their remit is to document quarrying activity as it relates to the sudden exploitation of new sources of stone throughout the empire. Located near to each other in the Eastern Desert of Upper Egypt, these two quarry systems were part of a deliberate effort to locate new stone sources. Such measures required prospecting for stone, an effort that, in the Eastern Desert, was not without precedent. Similar prospecting campaigns were used to locate the *giallo antico* quarries at Chemtou (ancient Simmithus) in modern Tunisia, again with

⁵⁸ Recent surveys conducted by Storemyr and Bloxam have been partially published, principally in the online Quarryscape publications, which are somewhat lacking in detail due to the limited space available in each 'deliverable'. Tiberiane and Mons Ophiates are also representative of quarrying districts in Egypt that have been documented and published thoroughly (Hirt 2010).

earlier stone-working precedence and knowledge available to the local and military populations.

Regardless of what motivated prospection for new stone, the infrastructure that accompanied these new quarry foundations is substantial. Road systems connecting the Eastern Desert to the Nile and Red Sea are still visible in parts today, as are a series of interconnected slip roads near the rock outcrops, meeting up with the main road system (Peacock and Maxfield 1997; Maxfield and Peacock 2001). At Mons Claudianus, the use of scree slopes appears universal, simplifying the mechanism by which difficult-to-move blocks of stone would reach the lower levels of the surrounding terrain. Additionally, the quarries, due to their marginal location, had associated military barracks and camps for laborers, some of whom were certainly slaves.⁵⁹ The evidence from Egypt would seem to point clearly towards strict oversight of spatial layout and labor organization, and the marginal location of many of Egypt's quarries has facilitated the preservation of many architectural and technological details that are considerably less visible in other regions of the eastern Mediterranean, where continued quarrying has led to the obliteration of ancient quarry marks.⁶⁰ For this reason, Hirt (2010) uses Egypt as his model for quarrying and mining activity throughout the empire, depicting an industry with clear rules, hierarchies and methods that were transferable across the Roman empire.

⁵⁹ St. Cyprian (Letter 77.2.4) discusses the act of binding Christian slaves in shackles at the quarries in Numidia, for instance. Material evidence of this practice has been found in Spanish mines as well (Healy 1978).

⁶⁰ Such destruction is the motivation behind the Quarryscapes group. There are even documented examples of modern quarry prospection following and expanding upon the ancient stone sources in a deliberate fashion (Long, personal communication). Hirt (2010) states that this is the main reason for his decision to examine primarily Egyptian mines and quarries in his study.

The predictable problem with Hirt's (2010) decision to model Roman quarrying and mining based on evidence from just one region is that as soon as one leaves the confines of Egypt, the pattern becomes significantly murkier. The consistent naming in offices and titles for laborers, and in wages paid to laborers throughout the empire, is strong evidence for some form of shared institutional oversight of quarries and quarrying in the Roman empire. These titles, however, have not been proven to account for the range of quarrying present in the empire during this time.⁶¹ Beginning with a similar type of elite production of stone, we can contrast the evidence from Egypt to the evidence from Aphrodisias, Dokimeion, Proconnesus, and even Petra. In Egypt, the spatial proximity of the quarry to other settlements is a salient feature that speaks to its peculiar nature, even within a regimented system of production that touches all corners of the empire. Against the backdrop of similar quarry themes, such as surveillance and standardization of labor, is the fact that masons had to be transported to live at the quarry sites (Peacock and Maxfield 1997; Maxfield 2002). Karystian marble sources, by contrast, were worked by a combination of local residents trained in marble cutting and slaves (Vanhove 1996).⁶² Dokimeia (the town) was located approximately 2km west of the ancient quarries at Bacakale, which were presumably worked by local residents (Fant 1989a). The *africano* marble quarries near the town of Teos, 40km south of modern

⁶¹ On wage standardization between mines in Egypt and Dacia, see Cuvigny (1996) and Edmonson (1989).

⁶² Burford (1972), however, notes that slaves were at best minimally involved in the actual cutting and reduction of stone, processes which requires high degrees of skill and craft knowledge – yet this is an observation that does not allow for slaves to develop skill sets over time, as other scholars have noted.

Izmir, Turkey, were apparently worked seasonally by local inhabitants (Fant 1989b).⁶³ And there is growing evidence that the cities of western Anatolia procured most of their construction material from the immediately proximate stone sources, such as the case at Hierapolis (Bruno 2002), Aphrodisias (Ponti 1996; Rockwell 1993), Ephesos (Attanasio *et al.* 2006) and Pergamon (Attanasio 2003). At Petra in Jordan, the quarry and the urban core quite literally occupy the same space, suggesting that the landscape was not divided between urban life and resource locations (Rababeh 2005; Bessac 2007). Prospection for new stone was not the same throughout the Roman empire, and the associated infrastructure and spatial patterning belie this claim.

Instead, it appears that some manifestation of indigenous stonecutting processes persisted into the Roman period, and many spatial decisions relating to quarries were derived from local geological constraints (Hirt 2010). Egypt, for instance, was long accustomed to locating quarry villages close to the source, as was the case during the 18th-Dynasty settlement at Amarna, the New Kingdom village of Deir el Medina, and in the Old Kingdom quarries in the Wadi Hammamat (Shaw 1994). The development of encampments to serve the extraction of a particular resource does not characterize activity in other regions of the Mediterranean, however. The close association between site and quarry in Greece, Turkey and Jordan is attested over great spans of time, wherein immediately available resources were coupled with long-distance trade and exchange to procure necessary materials. The prevailing view of Roman quarrying, then, developed from specific patterning that piqued interest in large-scale trade and large-scale organizational economics, at the expense of a more comprehensive treatment of the range

⁶³ The seasonal nature of stonecutting is an issue brought up all too infrequently. Notable exceptions are Fant's work on Teos, cited above, and the recent work on oolitic limestone quarries outside of Corinth (Hayward 1996; 2003).

of practices. It is in rare instances that specific stone types were distributed on the scale of international trade that has dominated the scholarship of stone production in archaeology to this point, and it is imperative to introduce the vast majority of sources, which worked within small communities, back into the fold if we are to arrive at a better understanding of how resource sites including stone fit within the landscapes of the Roman empire. Whereas Broodbank (2000: 7) comments regarding the dangers of plurality for the sake of plurality, I argue here that the lack of a pluralistic understanding of quarrying does a great disservice to our understanding of past landscapes.

Past Perceptions of Stone?

The persistence of some techniques and some spatial patterns into the Roman imperial period, and the diversity of these practices, raise the question of how stone was understood. In Chapter 1, the groundwork was laid for connecting technique, technology and social life, of which perception is a major component. Much of what we know concerning how stone was understood comes from the Greek and Latin literary sources, with the well-tread cautions regarding bias and skewed presentation applicable in this instance as well. The surviving texts are typically from writers of the upper classes expounding on moralistic responsibility, or they were written by powerful architects and engineers writing for a specific audience and including what are, for the most part, idealized descriptions of how things should work, rather than careful documentation of what actually happened on the ground. Nevertheless, several interesting trends emerge from a study of descriptions of quarries, quarrying, stone working, and ownership in antiquity. Some of the sources refer to labor, some to attitudes towards the profitability of

stone, and some to curious conjectures about the natural processes at work in the geological formation of architectural stone. Notably, the sources offer competing and conflicting views of how stone was understood, ranging from that of a resource used for profit and display, to that of a natural wonder, to the familiar and mundane projected into the rock itself.

Perhaps the best place to begin is with stone as a market commodity. We have already seen how, in specific cases, blocks of stone were prefabricated and shipped to warehouses in Roman port towns, suggesting diverse practices of consumption (Russell 2009a). As a commodity, stone (again, with special reference to marble) has been viewed as a medium of cultural expression. Some recent debate has centered on the degree to which individual patrons influenced artistic style and taste in the Roman period, deviating from the existing belief that cultural mores dictated the production of stylistic tendencies. Smith and Russell, for example, view consumption as the driving motive behind style and trade, while others, such as Zanker (1988), note how style is largely driven by cultural patterns. Of special significance is the role played by the emperor, who is noted in certain instances for having affinity to particular stones. Hadrian, for example, is regarded as favoring cipollino from Karystos, explaining a surge in its presence in imperial monumental construction through the empire. In less emperor-driven contexts, examples exist of the deliberate use of specific stones in specific contexts because of the semantic content associated with each material type (Molholt 2008). This perceived large-scale trade, dependence on specific tastes of individual patrons, and the rise in the number of stone sources utilized in the Roman empire suggest that stone was, to some portion of the population, a marketable commodity.

Nevertheless, stigmas surrounded such market-based practices, implicating marble and other stones into broader social discourses about appropriate means of economic participation. Varro, although writing in the 1st century BCE, notably discusses quarries alongside clay beds, mines, and agricultural pursuits. Senators were not permitted to profit from specific economic practices such as mining for precious metals, and quarrying, which often provided necessary building materials. Landholders, naturally, found a way around such prohibitions.⁶⁴ Several pertinent issues derive from this passage. First, debate surrounded the degree of commoditization in antiquity. Second, the nature of this debate forced resource management and procurement to engage with a range of other social practices and perceptions. Resources in antiquity were not isolated elements of the Roman world, able to be exploited without concern for how this impacted other, established, customs such as land tenure systems, senatorial privileges and prohibitions, and the interrelationship between stone, metals, timber, clay, crops, labor, and markets.

Within a discourse on whether it was appropriate to profit from stone are expressions of appreciation for materials such as marble as distinct from, and some would say of higher intrinsic value than, other materials.⁶⁵ In addition to the late imperial tax and sales laws (Cuvigny 1996),⁶⁶ which are more stringent for some stone types than they are for others, are comments showing the awareness that stones such as marble were

⁶⁴ See Humphrey *et al.* (1998: 195) for this particular passage of Varro, set in the context of primary source commentary on other agricultural and technological practices.

⁶⁵ Note, however, that ‘marble’ as a category was more widely defined in antiquity than it is today (Attanasio 2003), meaning the notion of value that encompassed this material incorporated a wider range of materials as well.

⁶⁶ Both Diocletian and Theodosius passed edicts with direct relevance to the sale and taxation of marble, setting the price and standardizing the wages paid to stonecutters.

considered a luxury. In his *Natural History*, Pliny notes that, “whoever first discovered how to cut marble and split luxury into sheets showed harmful ingenuity” (36.51). Elsewhere, Pliny laments that the life of luxury represented by “varicolored stones” (*Natural History* 36.1-36.3), wishing that his contemporaries would not concern themselves with luxurious constructions and instead disavow this life for a simpler one.⁶⁷ To Pliny, marble represents excess, itself a topic of great interest to scholars of classical discourse. Pliny addresses other stones, such as limestone, hematite, sandstone, and tuff with respect to their suitability in specific architectural and artistic contexts, such as wall construction (36.51.171-36.53.174). In other contexts, such as the *Res Gestae Divi Augusti*, and even later in Pliny’s *Natural History*, such a Spartan attitude towards material consumption is not at all reflected in the growth of the stone industry, but was instead regarded as indicative of imperial splendor and might.⁶⁸

In some cases, the Romans appear to have developed a peculiar understanding of the depletion of a resource that symbolized the wealth and prosperity of the empire. At least two accounts survive of stone that regrows in certain locations. Here again, Pliny has something to say, noting as he does that Italian marble quarries are known to recover

⁶⁷ “Nature made mountains for herself as a type of bond for compressing the bowels of the earth and at the same time for holding in check the rushing strength of rivers and breaking the waves of the sea and to restrain with her hardest substance her least quiet parts. We quarry these mountains and drag them away for no other reason than that our pleasure dictates it – mountains which it was once astonishing even to cross. Our ancestors considered it almost a portent that the Alps were climbed by Hannibal and later by the Cimbri: now these very peaks are quarried into a thousand types of marble. Promontories are laid open to the sea, and nature is made flat. We carry away features which were meant to serve as barriers for keeping nations apart. Ships are built for the sake of transporting marble, and so here and there over the waves, the wildest portion of nature, are carried mountain peaks.... Each of us who hears the price of these items and sees the massive quantities which are being dragged around should meditate on how much better life would be without them. Oh that men should do these things – or rather, endure them – on account of no other purpose or pleasure than to recline surrounded by varicolored stones...!” (Translation from Humphrey *et al.* 1998: 195).

⁶⁸ Pliny notes that the construction material used in the city of Rome show how it had “vanquished the world” (Pliny, *Natural History* 36.14.101-103 – translation by Eichholz 1962).

from the wounds inflicted upon them through the process of quarrying, a metaphor that speaks both to the healing properties of nature and to the violence of human acts of extraction. A much later (6th century CE) account reports a similar regrowth of stone in Greek quarries, but lacks the violent, judgmental, tone employed by Pliny. Curiously, Strabo notes similar fantastical occurrences for metal sources in the central Mediterranean. Whether this reveals a general attitude towards the environment, to an awareness that resources can be depleted, or to the justification of extravagance provided by the earth is a matter for debate.⁶⁹ But here again, the production of stone is entwined with social significance that transcends the economy behind stone extraction itself. Construction with marble confronted concerns about resource supply, value, and whether human agency was actively destroying the landscape through acts of physical violence.

A final element of how stone was understood in antiquity deals with the words used to describe the material and the names given to specific types of marble. The well-known examples of cipollino, which means ‘little onion’, is one example of many in which stones were given familiar, descriptive names. Cipollino effectively describes both the green hue to the marble from Karystos while also attending to the many folds and veins present throughout its matrix. In other examples, the color of the stone is directly reflected in its name, such as red granite and red porphyry. But descriptive names were not limited to visual identification of observable traits. Marble in particular was also afforded varying degrees of warmth and coolness, hardness and softness (Barry 2007).

⁶⁹ In the present day, marble-producing companies apply the metaphor of mother earth providing material for the consumer with great regularity. The Faber marble company in Denizli, Turkey, for example, suggests that marble is created by the earth specifically for human use in elaborate display programs. Compare this to Pliny’s comment that stone is made by the earth for functional reasons relating to controlling the earth’s various component parts, such as water, rivers, and even states – mountains serve a natural purpose, in other words (Pliny, *Natural History* 36.1.2-11).

Thus, cool stones and cool colors can be expected as display elements in cool rooms, such as in baths and pool complexes (Barry 2007; Molholt 2008). Poros limestone and sandstone were described according to their generally softer texture, compared to granite, basalt, andesite, and even marble. And stone was written about as the ideal method of demonstrating durability, longevity, and lasting memory. Witmore (2007) argues that the erection of codes in stone acted to materially affirm the fixity of the law, while monuments to the dead, which frequently ask the passerby to stop and remember the deceased, employ stone as a means to preserve this memory in as enduring a fashion as possible.⁷⁰

The material, social cues, social outcomes, and economic practices surrounding stone are all interrelated in the Roman Mediterranean, suggesting that a more comprehensive understanding of the role quarries and quarried stone played in social life must go beyond the confines of economic studies. Value is certainly an important portion of the distribution of stone for building and sculpture, but never is this notion of value divorced from the rest of society in a way that justifies isolating economic measures from the social practices surrounding stone production and use.

A Critique of Distribution-based Research

Many advances in our state of knowledge concerning Roman administrative and exchange systems have been made through research on the distribution of marble and other stones throughout the Mediterranean. The names of officials, the locations of quarries and the extent of the trade in valuable stones during the Roman imperial period

⁷⁰ Note that in Egypt Old and Middle kingdom palaces were still constructed with the prevailing domestic architectural material – mudbrick. Only funerary elements, such as chamber tombs, were built in stone (Laurel Bestock, personal communication).

are all better understood because of the combined efforts of archaeological science and epigraphic evidence about the nature of trade and organization. Nevertheless, a variety of questions are left unanswered by this research. Landscapes and places, again, are the major elements missing from these discussions. The emphasis on titles and administrative units divorces the geological and social conditions of a given landscape from political and cultural expressions of control, treating the environment as a backdrop for action, rather than as a critical component in how authority is constituted (Smith 2003). In order for Rome to assert authority in a quarry, however, the policies and practices must intersect with the landscape itself, particularly when the very practice being governed involves extraction of its material, more appropriately characterizes a political and administrative ideal, glossing over as it does the success of different administrative models in the face of different environments. We must ask whether the data exhibit a Roman model superimposed onto new and varied landscapes, or whether the model represented by administrative titles masks the variability imposed by the landscape.

Furthermore, the spatial component of Rome's imperial policy is two-fold, whereas the emphasis on distributed goods only looks at one aspect: expanse. In much the same way that the material traded and controlled by Rome, through its materiality – a term that encompasses the material and associated attributes such as perceived temperature and other cognitive associations (Barry 2007; Ingold 2000) – conveyed something about the spatial extent of the empire's authoritative control in the Mediterranean, imposition of controlled labor practices in newly conquered environments serves to alter the political nature of these places. While Rome must respond to the specific landscapes in which it interferes, the places in those landscapes enter into new

networks of interaction as well. Rather than settling on this as a newly Roman network, however, it is important to recognize that Rome's interference is neither wholesale nor uniform. The specifics of places matter in the outcome of this interaction.

Lastly, this emphasis on long-distance trade and overarching mechanisms of control falters in the same way as the regional/cultural approach faltered. It only engages with quarries of a specific nature, neglecting those that were not part of large-scale system of trade, exchange, or political control.

Places in the Constitution of Authority

The review of literature on stone-working in the eastern Mediterranean presented in this chapter has revealed two foci for this tension. First, the models for Roman administrative practices are supported by evidence from large-scale quarries, to the exclusion of the far more numerous small-scale quarries in the Mediterranean region. Second, the places and landscapes in which the quarries are situated are largely missing, privileging idealized notions of political norms over practice-based outcomes of spatial politics. That is, landscapes are treated as backdrops onto which a-spatial structures are placed. But the growing evidence for different quarrying practices throughout the eastern empire suggests that the political and administrative policies advocated by the Roman polity did in fact engage with landscapes – and adapted to them as well.

The intersection of politics and places in Roman industrial landscapes should therefore be explored to determine how the places themselves figure into the constitution of Rome as a spatial polity. By studying the previously neglected small-scale quarries as

places, the scope of Roman spatial politics can be more completely fleshed out as a whole with variable parts that intersect with each in diverse ways.

This survey of work on quarries in the eastern Mediterranean, beginning with current understandings of how it developed over time and concluding with understanding how resources enter into broad social discourse, demonstrates a number of strengths and weaknesses that help point to better practices and research trajectories in the future. In general, local circumstance matters a great deal in the nature of quarrying activity that occurred in each of the regions surveyed in this chapter. This applies to stonecutting technique, the association between quarries and settlements, perceptions of stone to those who used it in antiquity, and the integration of stone into broader social trends, such as public display and monumentality. The development of stonecutting in Egypt exhibited a high degree of interdependence between available technology, natural features and the material composition of the stone. Overall, the dependence on stone for a wide variety of uses was accompanied by an initial diversification in technique. The application of wedging from the Hellenistic period onwards culminated in the standardization of practices, as they related to a number of different stone types. In many ways, recent research in quarrying, sporadic as it often is, has yielded considerably more variation in stonecutting practices than previously recognized. In part this is due to another trend in Egyptian stone studies, wherein a number of new sources have been not only discovered, but systematically surveyed as well. Following the discovery of the quarries in the Wadi Hammamat in the 1980s (Shaw 1994), further study in marginal Egyptian landscapes has revealed even more previously undiscovered sources. Examples include Harrell and Lazzarini (2002), who published a new granite source at Wadi Barud, Egypt, and

Storemyr *et al.* (2003), who note new evidence for Roman period basalt quarrying on a small scale in Egypt. Thus, regionalism in resource use and management was alive and well in Egypt, even coexisting alongside more concerted efforts to obtain specific stones on the margins.

But the relationship between tool marks and quarry organization is only beginning to emerge. As noted above, the tally of known quarries in the eastern Mediterranean, as elsewhere, is dramatically higher than is often noted in the scholarship. The search for a clearly observable trend in technological changes over time has, in most circumstances, led to a hyper-focused examination of official state quarries and mines, which obfuscates the full view of stone-working technologies and techniques running concurrently in antiquity. While some examples of recent work in Egypt, as elsewhere in the eastern Mediterranean region, has profoundly expanded on Waelkens *et al.*'s (1989) observation that quarry studies revolve around two practices (technique and sourcing), much scholarship is still concerned with what tool marks can tell us about economic practices specifically. Adding more data from previously unstudied quarries will enhance the big picture perspective on this by placing imperial practices within the context of a great many other, non-imperial quarries and workshops present in each region.

As already discussed in Chapter 1, my work fits within a growing body of literature that reassesses the Roman economy not according to state-sanctioned practices, but according to the full – or at least a fuller – range of practices that overlap, intermix, and reveal tensions and flexibility within the empire. The opportunity exists to test current chronological knowledge of stonecutting in a cross-referential way, comparing the well-understood paradigms of imperial quarry practices with those at smaller quarries

where the rhythms of the seasons and the demands of consumers would have acted upon the modes of production in different ways. Part of this change will certainly include the refinement of archaeometric techniques designed to address broader social questions in addition to the specific provenance studies that dominate current research. Just as new quarries can and should offer the opportunity to explore stonecutting technologies and techniques in a greater range of locations, expanding materials science approaches to include new quarries can clarify the provenance picture while giving greater refinement to questions concerning regional use and the movement of stone through social landscapes.

That stone and other resources were incorporated into Roman social life in meaningful ways is clear from the analysis of perceptive understandings of stone in antiquity. While the examples provided in this chapter are far from comprehensive in their coverage of different perspectives on stone, they do demonstrate that such things as profit, quarrying, market sale, and even the names of stones were grouped together with other social concerns. Thus, the sale of marble also dealt with land tenure systems, the social status of the quarry owner, the status of the material, whether the stone was perceived to be in short supply, the value of the material, and human agency in modifying the landscape. The stone itself was felt to have agency as well, as it inherently contained qualities such as warmth, coolness, flavor, odor, and familiarity to other, non-stone entities. Often these characteristics were played with and juxtaposed in antiquity, adding to the perceptive experience of a building and its material constitution (Barry 2007), indicating that marble at least offered much more than merely a way to make money.

Put together, all of this suggests that combining technological, social and economic studies can fruitfully push quarry studies in the eastern Mediterranean into novel and advantageous directions. Egyptian quarrying of stone blocks, for instance, was intimately connected with the development of a state-level polity covering both upper and lower Egypt, when elite display was manifested in monumental form, both architecturally and sculpturally. While there is a tendency to focus on the connection between monumental display and kingship, a more compelling story to tell would consider how new technologies and interactions with stone helped to shape and frame the social world of Egypt. Expanding this approach to Rome, where imperial display and the imperial prerogative have received significant attention, could show how the shape of the empire, its social composition, and the very nature of political and economic practices throughout the Mediterranean were derived from action. The most recent research on quarries in the eastern Mediterranean, pointing as it does to great diversity across the region, suggests that local context, local practices, and the engagement with the regional landscape can go a long way towards informing a stronger perspective on the creation and maintenance of imperial Rome.

To do so requires a modified approach that draws from previous scholarship while attending to the new avenues of research that have opened recently. The tool marks in use at smaller, more regionally directed quarries (that is, quarries with stone that was not part of a long-distance trade system) will help clarify the extent to which stonecutting practices in the Roman period truly were universal in character. Exploration of the quarry floor and surrounding environment through intensive survey and surface collection will clarify the extent to which spatial layout of stonecutting sites was consistent in the

Roman period. Characterizing the quarries in Lydia petrographically and geochemically will enable a more thorough understanding of how stone in this region moved – in other words, were the quarries primarily cut for local consumption? Integrating the quarries into the surrounding settlement pattern is also a great importance. Spatial comparison of the quarries in Lydia will be compared to quarries in other portions of the eastern Mediterranean to determine variability in settlement proximity, with the understanding that proximity to sites impacts who works there, where they live, and how they interact with the resource site itself. Finally, these patterns will be looked at for long-term trajectories, to see how the role of stone resource sites in the landscape did or did not change over time. This approach adequately accounts for the potential for small quarries with limited scope to alter our understanding of the marble trade in antiquity, while emphasizing that quarries are never limited in impact to their economic attributes, engaging as they do with the formation of social practices in a variety of ways.

Moving forward

Quarry research in the eastern Mediterranean – particularly that of the last half century – has facilitated the exploration of a range of connections that point to complex and diverse practices during the Roman period. Although these connections are evident through the accumulation of disparately located sources, putting it all together to demonstrate the progression from specific analyses of tool marks, petrography and geochemical signatures, to spatial patterns, and then to a meaningful conclusion about the role of quarries in a truly social landscape, is yet to be achieved. Chapter 4 will begin the process of making these connections evident through the introduction of the case study,

set within the Central Lydia region of western Turkey. The specific geology of the region will be set against the cultural developments that occurred in pre-Roman, Roman, and post-Roman Lydia, while laying out the methodological parameters used to arrive at the conclusions about the significance of stone production in the social world of this part of Turkey. Subsequent chapters will explore these issues further afield, by comparing the Lydian data to those from other regions of the eastern Mediterranean, before ultimately attempting a contribution to current approaches to the Roman economy.

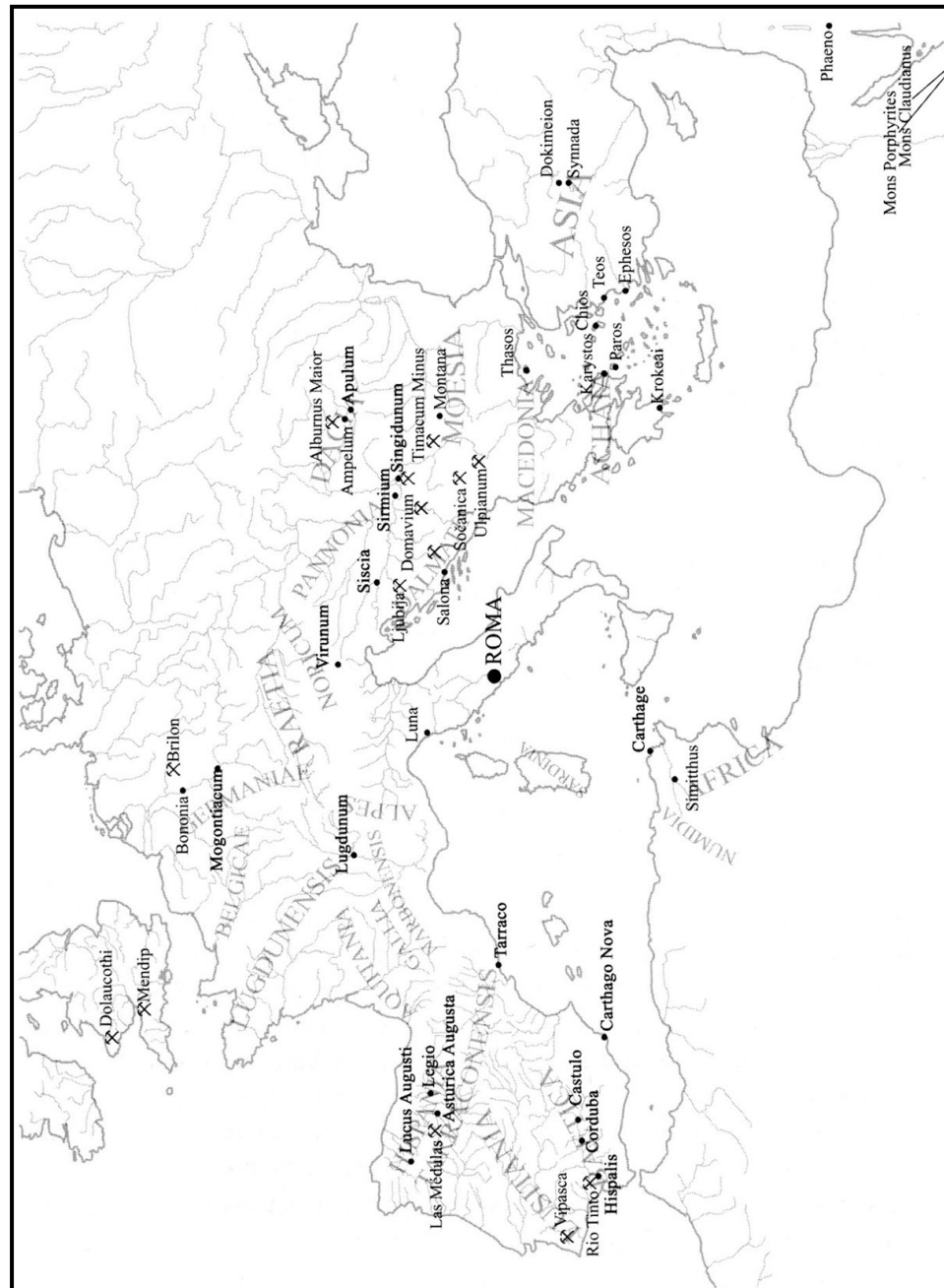


Figure 3.1: Map of known imperially owned quarries (from Hirt 2010: 11).

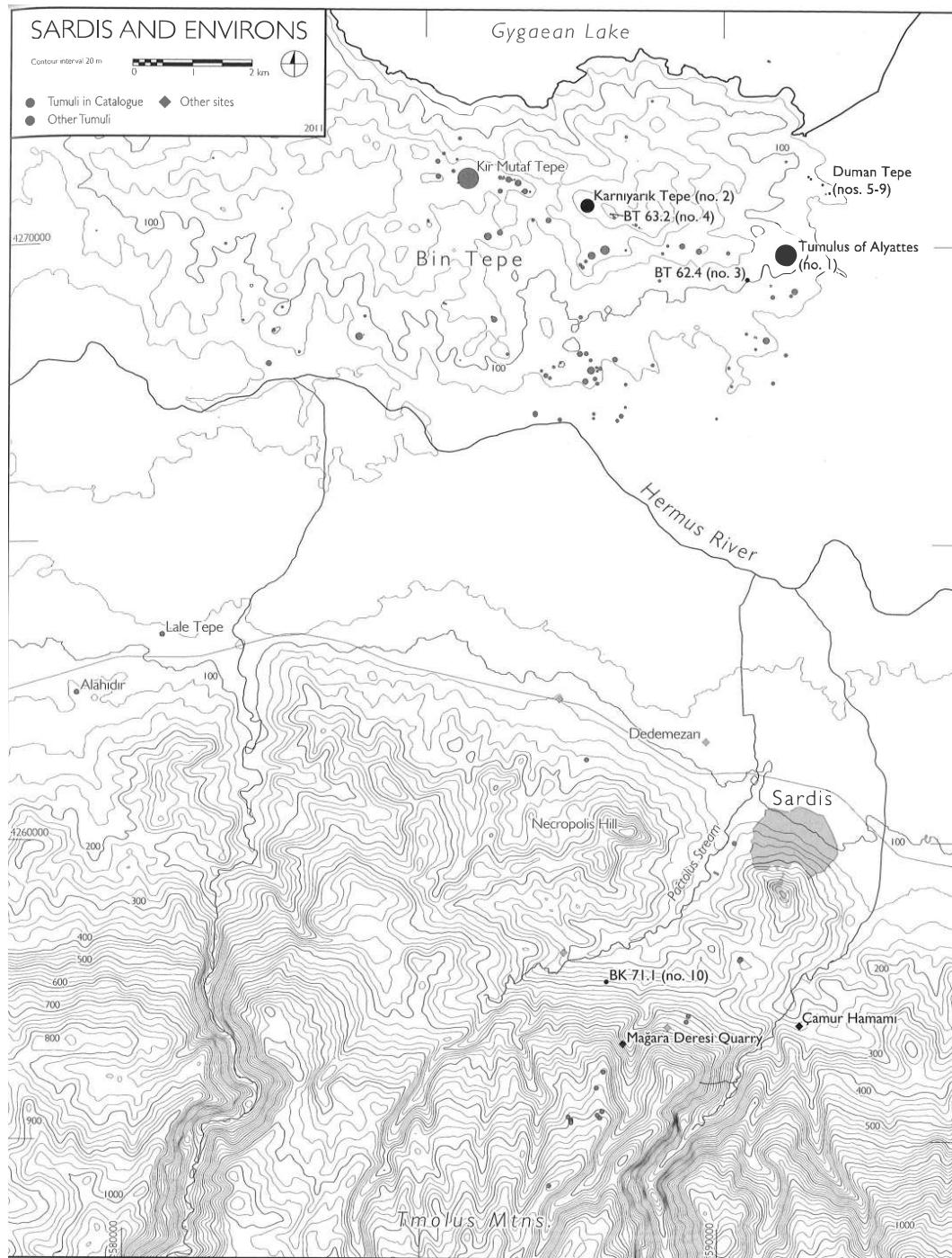


Figure 3.2: Map of Sardis and environs (Ratté 2011: 137 – image includes detail provided by CLAS).

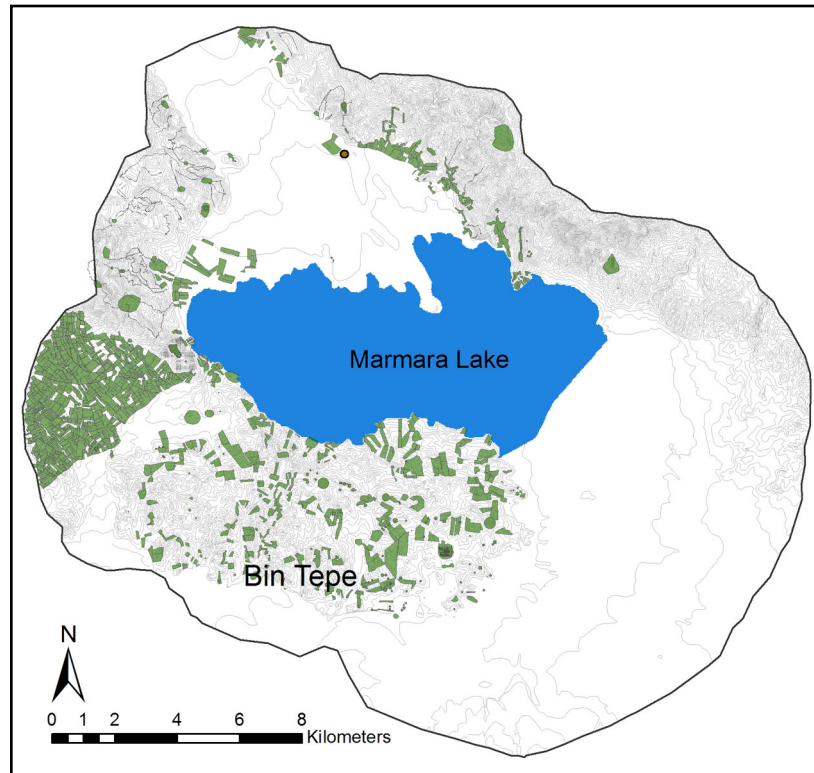


Figure 3.3: Map of CLAS boundaries (Image created by author, courtesy of the Central Lydia Archaeological Survey).



Figure 3.4: Bin Tepe, looking south (photograph by author; courtesy of the Central Lydia Archaeological Survey).

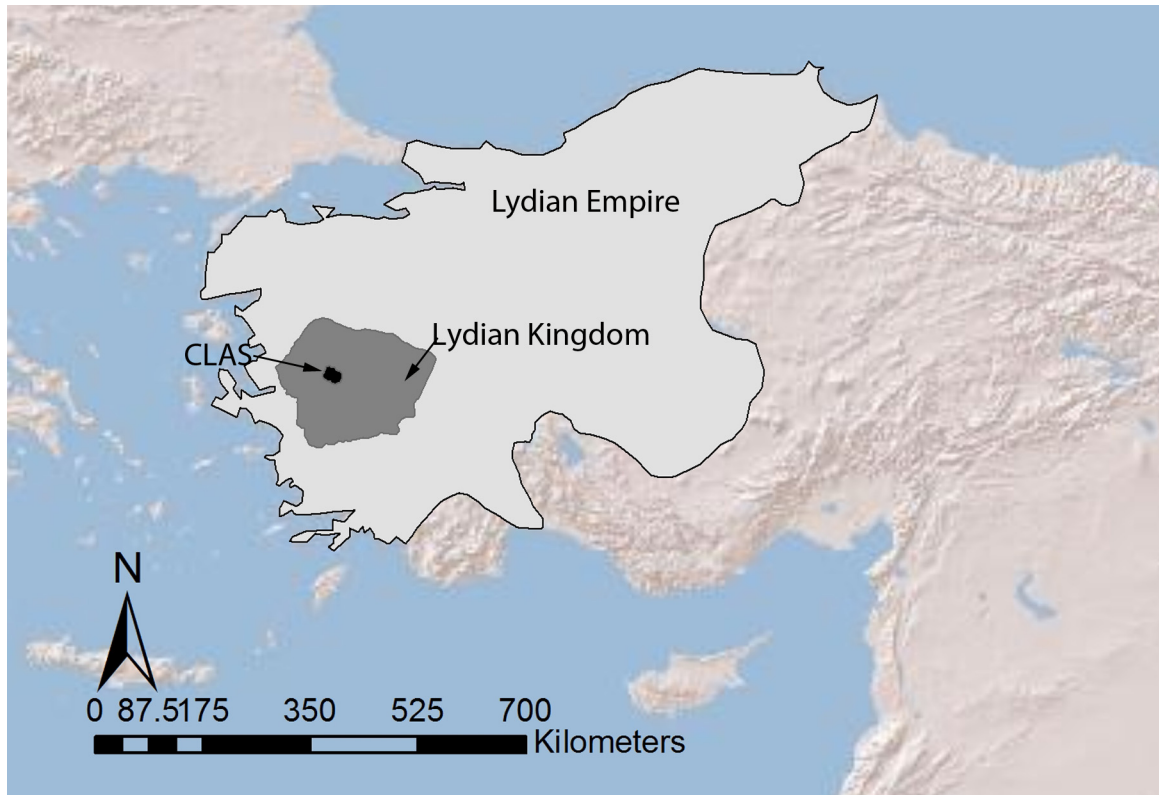


Figure 3.5: Map of Turkey showing probable boundaries of the Lydian Empire and the Lydian Kingdom, with the Central Lydia Archaeological Survey (ArcGIS basemap; after Roosevelt 2003).

Chapter 4

The Marmara Lake Basin Quarries: Survey Methodology and Implementation

Introduction

Quarry studies in Asia Minor generally and central Lydia in particular have to this point emphasized sourcing as it relates to marble as a finished product or in terms of quarry administration. Having outlined an argument in favor of polities in the making whose spatial and governmental elements are mediated in the places where the techniques of governmentality intersect with the landscape, current applications of quarry technology and archaeological science should be expanded to answer questions about regions and about the diversity of practices in the past (or lack thereof), rather than beginning with assumptions about Roman hierarchical systems being transplanted to new, provincial, territories. The study of marble quarries should contribute to discussions about the creation of whole (and always changing) polities through contested techniques of governmentality. The methodology outlined here, and implemented by CLAS in the Marmara Lake Basin in 2011, attempts to achieve this by utilizing existing archaeological techniques to address a new set of questions.

Each phase of the research design was intended to address one or more of five guiding questions relating to quarries in the central Lydian landscape. The five questions are:

- What technologies were used in stonecutting at each quarry?
- What relationships existed between quarries and other forms of site?
- What material evidence exists to help date the period of extraction at each quarry?
- What are the specific geological attributes of the region and each quarry?
- What evidence exists for detecting the movement of stone to other sites and throughout the central Lydian landscape?

The ultimate objective in providing answers to these questions is to develop a richer, more textured, picture of not just a diachronic and dynamic landscape, but of the intersection between human-landscape interaction and the maintenance and development of social and political/economic institutions.

The methodology devised therefore includes three primary techniques: detailed quarry-mapping; intensive pedestrian survey; and marble sampling and materials science. Detailed mapping of each quarry's vertical and horizontal surfaces provides evidence for the spatial layout of stonecutting operations and the tools used in the process of stone extraction. The intensive survey component of the project, which took place both within six of the eleven quarries and in all agricultural fields surrounding the quarries provides data about the spatial proximity of sites to quarries as well as chronological ranges for land use in the immediate vicinity of each extraction site. Attention to ceramic vessel form and type also provides some indication of the nature of settlement activity. The sampling of marble from all eleven quarries relates directly to the issues of sourcing and movement. Sourcing is an important aspect of assessing how these particular quarries fit within the pattern of broader social structures at play in Lydia. An emphasis on movement draws attention to the obvious, but often overlooked, importance of what is

entailed in moving heavy blocks of marble through a landscape. Finally, the materials science techniques provide the data necessary to characterize the type of marble available in this region. Of significance are the consistency of the material and the mineral inclusions that might be present within each sample and within each quarry. Together these methods, both field and laboratory, create a complementary series of datasets that will be used in Chapters 5 and 6 to develop a narrative of what stone extraction was like in Lydia during the pre-Roman, Roman and post-Roman periods.

Geographical and Historical Setting of the Marmara Lake Basin

Previous research on marble in Asia Minor fits generally within the trend described for eastern Mediterranean marble studies in the previous chapter (Hanfmann 1975; 1983). Western Asia Minor sits on a large massif of metamorphics (the geological processes are described below), facilitating the production of large quantities of the marble traded during imperial Roman period. Ward-Perkins's early work on the marble at Proconessus, along with his work at Nicomedia (Ward-Perkins 1980) and work by Asgari and Drew-Bear (2002) and Drew-Bear (1994) at Dokimeion reveal a substantial amount about imperial quarry administration. Even before this, however, art-historical studies associated specific forms of sarcophagi to quarries from Asia Minor (Waelkens 1985). Meanwhile, the abundance of urban sites on the Aegean coast of modern Turkey yielded tremendous amounts of marble architectural and sculptural fragments, which drew the attention of scholars interested in such things as elite benefaction and civic identity. Aphrodisias, for instance, has long been associated with a marble workshop school.

As part of the discourse on civic and imperial identity formation in the Roman provinces, marble studies in Asia Minor have dealt with both artistic style and visual message. Mythological figures and foundation stories have a long history of appearance in the sculptural programs developed in Asia Minor. Specific visual programs were employed to legitimate a city and its urban elite during a period when cities competed for provincial titles and the imperial benefactions that accompanied it. Mythological figures, this argument goes, spoke to a city's long-term significance, materially rooted it to a deep and revered past (see Heres 1996; Howgego 2004). Moreover, as part of elite and civic competition, such programs also factored into arguments about governmentality and control, speaking as they do to Rome's rewarding cities for good behavior. Although more recent work has gone some way towards situating the use of marble within specific landscapes and their associated rituals and practices, including assessment of the placement of monuments within urban contexts, the emphasis remains attached primarily to the visual and propagandistic aspects of sculptural programs. In other words, the material and its placement remains part of a deliberate deployment of highly charged messages. Marble blocks were used occasionally in the construction of tumulus chambers in Sardis, as well as for external funerary markers (Roosevelt 2006b).

These projects contrast with studies of the quarries themselves that have emphasized imperial administrative practices above all else. Fant's (1989b) work in the green marble quarries of Teos, Waelkens's (1985) description of stages of production in the Phrygian quarries at Dokimeion (building upon Röder's earlier work), and Asgari and Drew-Bear's (2002) work at Proconessus and Marmaris all focused on associated inscriptions and organizational aspects of extraction in large-scale marble quarries in

Asia Minor. More recently, as interest grew in understanding where marble used in civic contexts originated, the deployment of archaeological science to source marble has exploded in popularity. In Roman Asia Minor, this research has not meshed well with the growing interest in situated practices, as seen relating to the procession to the Artemision of Ephesos, or even in Constantine's reuse of Classical sculpture in his new city of Constantinople (Ousterhout 2010). Unexpectedly, the political or landscape dimensions of resource acquisition frequently do not enter into the discussion.

Nevertheless, very good work has been done in this regard. Attanasio (2003) and Attanasio *et al.* (2009), for example, have expanded known chemical signatures for white marble, as well as expanded knowledge about the number and type of marble sources around the city of Aphrodisias. Sourcing of marble in Lydia was undertaken, too, in the 1990s. The project by Tykot and Ramage (2002; see also Ratté 2011) tested marble from the tumulus of Alyattes, the marble quarry above the modern city of Gölarmara, from the Mağara Deresi quarries south of the city, and from three marble architectural blocks from excavated contexts in Sardis proper. Although the current study elaborates on this work in interesting ways, the initial results and interpretations of the Lydian data have proved foundational in my own interpretations and demonstrated significant differences in the chemical signatures of the quarries north and south of Sardis.

The CLAS survey region falls within the boundaries of the Iron Age kingdom of Lydia. Sardis, the capital of Lydia, sits on the north slopes of the Tmolus mountain range (modern Bozdağ range), approximately 15km south of the Gygaean Lake (modern Marmara Gölü) (Fig. 3.2). The area between the Tmolus mountains and the Gygaean Lake is occupied by a fertile alluvial plain that roughly follows the east-west path of the

Hermus (modern Gediz) River. Several tributary seasonal rivers run north from the Tmolus mountains, joining the Hermus River on the north side of this alluvial plain. Today, most of these water sources are controlled in conjunction with the water level of the lake by the presence of a canals and locks. In antiquity, the water level would have been subject only to seasonal variations in rainfall, snow runoff, and changing watercourses (see Roosevelt 2003).⁷¹

In large part, this thesis argues for a high degree of particularism in the Roman economy. In the case of stone extraction, the geological composition is obviously of great significance. More than offering a list of environmental constraints, however, the geology of central Lydia is significant when discussed in association with broader social issues such as politics, economy, and technology. What follows is therefore a discussion of particular landscapes with which differentially comprised social groups engaged, with interest in how the interaction between humans, technology and social groups of different scales contributed to and created new understandings of place. It is therefore neither social-constructivist nor environmental-determinist in character.

The geological setting for which the previously mentioned historical narrative played out was the process of millions of years of change, with the earlier formative layers being Pre-Cambrian in origin (Erentöz 1956; Roosevelt 2003). The geological layers with which central Lydian populations came into closest contact began forming in the early Miocene and have endured persistent formative pressures since that time (Purvis and Robertson 2005: 399). The resulting geological formation is what is now called the Menderes Metamorphic Massif, which occupies most of central western Anatolia, into

⁷¹ The Gygaean lake, at various points in time, changed in location and size rather dramatically (Besonen and Roosevelt 2008).

which numerous intrusive and extrusive igneous formations have crept. Central Lydia sits in what geologists call the Alaşehir graben (sometimes the Gediz graben), an east-west running alluvial depression that cuts horizontally across the Menderes Massif between two faults, and which comprises mostly neogene soils partially derived from the lake and partially derived from the Gediz (Hermus) river itself. To the south, the Menderes Massif cuts underneath the bedrock basement, creating mountainous terrain. The massif itself is characterized by “gneiss, mica-schists, quartzites, marbles, phyllites, amphibolites and chalcite-schists” (Erentöz 1956: 41; see also Kamen-Kaye 1971; Roosevelt 2003). The mica-rich stones give the soil of the region its characteristic golden hue, while the limestone and marble offered the most commonly utilized construction stones. Granodiorites (intrusive igneous rocks) also caused contact metamorphic processes contributing to the metamorphic massif’s composition.⁷²

The neogene faulting created rich alluvial systems overlaying the half graben, resulting in fertile agricultural soils in a broad plateau. This plateau corresponds to the Sardis hinterland and Bin Tepe region – the area south of the Gygaean Lake and north of the Tmolus mountains. The high degree of neogene faulting helps explain the current topography of western Turkey (Roosevelt 2003; Roosevelt 2009: 47). These fault zones, which are still active, result in colluvial soil deposition in the half graben as well. Limestones appear dominant in the southern portion of the Gygaean Lake region, while marble around Sardis (in the Tmolus mountains) derives directly from the Menderes Massif. The marble north of the Gygaean Lake, however, arises from a reemergence of the massif or from contact metamorphism. The hills of northern Lydia are sources of

⁷² Contact metamorphism is the process during which igneous rocks (slow cooling) come into contact with sedimentary rocks (limestone etc.), super heating them until they metamorphose. This usually results in lenses of metamorphic rock closer to the surface.

granite, basalt and andesite, which suggest active geological processes beyond the formation of the Menderes Massif itself and the possibility of contact metamorphism. Such a possibility makes the marble of this region potentially differentiable from the marble sources in the southwestern massif zone, at ancient cities like Ephesos, and from other known marble sources at Aphrodisias. The contribution of alluvial soils following the neogene faulting contributed to the sedimentary composition of the half graben's limestone as well, suggesting that both of the region's dominant construction material might be uniquely composed, aiding in a description of how the material moves throughout the region.

The neogene faulting holds significance for the regional study undertaken here. It is significant to note that Sardis and the CLAS survey area rest within the Menderes Massif, but adjacent to a region of considerably older crystalline massifs that have metamorphosed differently. Similar to the Menderes Massif, these older massifs are rich in gneiss, schist and quartz (Whitney and Bozkurt 2002; Whitney and Hamilton 2004), though they differ in substantial ways as well. The neogene volcanic activity that gradually created the Menderes Massif created a geological zone that is in many ways observably different from the older crystalline zone immediately to the south of the Sardis region. Characterizing the material used and preferred in construction in Lydian and Roman Sardis and elsewhere in central Lydia offers the potential to better define the resource interaction zones during these periods of time. The Menderes Massif was created by a process of recrystallization due to upward faulting and the incorporation of alternative mineral components that were not present in the same percentages during the high heat metamorphic formation process. This distinguishes it from surrounding

metamorphic zones both positionally (it is higher in elevation) and compositionally (mineralogically and chemically).

South of the lake and north of the alluvial plain sits the region now called Bin Tepe (“1000 mounds” – Fig. 3.4). This hilly area is believed to be the location of the tombs of three Lydian kings and many other post-Lydian burials that dot the landscape as large artificial tumulus mounds (Hanfmann 1975; Ratté 2011; Roosevelt 2009; Luke and Roosevelt, In press). Several of the tumuli have been connected to historically attested kings, with varying degrees of certainty, such as Gyges and Alyattes – prevalent members of the Mermnad dynasty. The majority of the remaining tombs, which once numbered more than 137, of which 116 still remain, are dated through architectural assessment of the internal chamber and its associated remains to the Lydian and Achaemenid periods (Roosevelt 2003; 2009). Although demonstrating clear significance to the Iron Age populations, survey has shown that the Bin Tepe region, and the lake district more generally, was a focal point for populations dating as far back as the Early Bronze Age (Luke and Roosevelt 2009; Roosevelt 2007; 2010; Roosevelt 2009: 44; Roosevelt and Luke 2008; 2009; 2010; forthcoming a, b, and c). On the north side of the lake, a different geological zone appears to predominate, being subject to local metamorphic processes that did not impact the southern limestone and alluvial regions.

The Lydian kingdom, however, extended well beyond the reach of the CLAS survey boundary, incorporating large portions of central western Anatolia and, during its peak in the 6th century BCE, much of western and portions of central Anatolia as well (Fig. 3.5). Prior to the Lydian kings, the Bronze Age region was probably referred to as the Seha River Land in Hittite texts (Hawkins 1998; Luke and Roosevelt 2009; Roosevelt

2009; 2010).⁷³ This region, in both the Bronze Age and Iron Age, extended from the Meander (Buyuk Menderes) River in the south to the Caicus River in the north, running into Phrygia on the east (the Halys River), Ionia on the west, and Caria in the south.⁷⁴ Lydian expansion under Gyges began in the early 7th century BCE (Hanfmann *et al.* 1983). Gyges influenced neighbors, particularly in Ionia and Caria, without physical conquest, though frequent assaults were made against Smyrna, Ephesos and, in particular, Miletus. Alyattes, Gyges' grandson, pursued conquest and began a phase of mass territorial expansion that ultimately ended with the destruction of Sardis, and the Lydian royal line, by Cyrus and the Achaemenid army in the mid-sixth century BCE, a well known episode from Herodotus' *Histories*.

Its position between the Ionian and Carian members of the East Aegean koine and the central Anatolian peoples such as the Phrygians (and the scant evidence for contact with Medes and Assyrians), has led to the description of Lydia as a type of cultural bridge. Clear contacts are seen from both directions, giving the false sense that Lydian culture was caught between two opposed worlds. A very distinctive form of pottery developed that early scholars described as a borrowing of Mycenaean or Aegeanizing ceramic decoration styles, called the streaky glaze wares (Cahill 2008). By contrast, several vessel shapes have parallels in Phrygia (Cahill 2008). The Herakleid period (9th-7th centuries BCE) saw external influence in ceramic decoration, during a period that Moody calls the East Aegean Koine. The expansion of Aegean populations into western

⁷³ Note, however, that debate about the location of such geographical indicators, and indeed the veracity of their names at all, has only recently attained anything approaching consensus.

⁷⁴ These neighboring groups are all attested textually as well. Current debate, such as that seen in the recent Koç University symposium *Nostoi*, revolves around whether these are cultures, ethnicities, polities, or some other designation.

Anatolia brought about the spread of Aegean styles and schemes, many of which reached the Lydian capital. The interchange of ceramic styles expanded even further under the Mermnad kings (Kerschner 2010). Architecturally, Lydian settlement was, until CLAS, difficult to describe given the emphasis on monumental structures, but such architecture has clear parallels to the western Ionian and Carian cities. Conversely, several scholars have suggested that Lydian material culture was perhaps best exhibited by the highly skilled production of textiles and jewelry, which leaves few archaeologically detectable traces (Greenewalt and Majewski 1980; Kerschner 2010).

In principle, however, Lydia and its territory were centered in the region around Sardis and the Gygaean Lake, occupying other portions of Anatolia only tenuously. Other efforts at diplomatic relations are known, such as Gyges' attempt to garner military support from the Assyrians for his campaigns against the Cimmerians at the beginning of the Mermnad Dynasty, but these connections are minimal and speak primarily to burgeoning Lydian involvement in Anatolian and Aegean politics rather than to territorial control or active engagement in shaping political discourse prior to the 6th century BCE (Hanfmann *et al.* 1983). Croesus' failed interaction with the Persian forces precipitated the end of Lydian political and military might in western Anatolia, but did not mark the end of prosperity in the Gygaean Lake region, as recent survey in the region and excavation at Sardis both suggest.⁷⁵ Archaeological survey reveals that the well-known tumuli of Bin Tepe cluster according to families or communities, rather than representing

⁷⁵ On the destruction, see Greenewalt (1992), who pulls together archaeological evidence for a destruction layer dated to this period, including the remains of a soldier in his 20s holding a rock in his raised arm a few meters away from an iron military helmet. The literary tradition preserves multiple stories of the destruction of Sardis, some of which have Croesus dying, others living.

a “monolithic” burial zone (Roosevelt 2009: 100). That is, the tumuli reflect lived spaces with closely associated communities rather than a single, large, monumental cemetery.

Sardis was, during the Achaemenid period (or Late Lydian period - Roosevelt 2009), turned into a western Anatolian satrapy for the Achaemenid empire: it was the western Persian capital. Artistic parallels between western Anatolia and the Persian capitol are seen in such monuments as Taş Kule near modern Foça and the Pyramid Tomb in Sardis (Cahill 1988). It is probably this event that has most meaningfully led to the discussion of Anatolia as a region caught between east and west. With the eastern Greek influence present on the Ionian cities of western Anatolia, and the eastern Anatolian influence variably changing between eastern empires, from the Hittites to the Assyrians to the Achaemenids, western Anatolia is seen in some circles as wedged between dominant cultural forces.⁷⁶ Aside from the implicit support of the notion that imperial cultures dominate those regions with which they come into contact, the literary and archaeological evidence seems to suggest that a high degree of continuity existed even during Sardis’ time in the satrapal system. Administration of the city was left to both Persian and Lydian authorities (Roosevelt 2009: 27), though during certain periods, historical documents attest to Artaphernes (the brother of Darius I) holding power at the Sardian court (Mierse 1983: 103-104), while archaeological traces of the Late Lydian period have only scarcely been found by almost 60 years of excavation in the city (Dusinberre 2003). Most of the changes to the urban core are represented by changes of trade and material wealth rather than in physical changes to city layout or in the construction on new monumental architecture (Mierse 1983). Sardis became an

⁷⁶ This notion has come under increasing amounts of scrutiny of late. A 2002 volume of *Anatolian Studies* takes on this issue directly (cf. Efe 2007; Zimmerman 2007).

emporium (Mierse 1983: 108) for the Persian empire, but its supposed cultural affinity is considerably more difficult to determine. The ceramic typologies that are being produced by CLAS for the hinterland of Sardis have not identified a particularly strong Achaemenid influence on the material culture of the region, except in some relatively rare cases of specialty fine wares located at only a few mounded sites. Much more clearly represented by the ceramic typology are the wares that are typically attributed to the Hellenistic period, suggesting clear differences in how Achaemenid and Hellenistic interaction impacted the region.

This naturally had ramifications for the definition of Lydia and the hinterland of Sardis with respect to political boundaries. Although the city was tied to a wider geographical and political entity during the Achaemenid and Roman periods, the physical area of control under Sardis was reduced in scale compared to the heights of Lydian power (Hanfmann and Waldbaum 1975; Greenewalt *et al.* 2003; Greenewalt and Rautman 2000). The relationship between the countryside of central Lydia and the capital of Sardis over time, however, is still unclear given the sparse nature of ceramic evidence dating to the Lydian, Late Lydian, and Hellenistic periods, though the evidence from pedestrian survey suggests long-term and continued settlement presence in the Marmara Gölü region, with settlement location tied closely to the variability in water level. Whether the central Lydian hinterland was utilized by the urban core for resources, however, has not been proven, with the notable exception of the use of soils in the construction of monumental tumuli (Roosevelt 2003; Wolff 2008). The region, which is rich in fertile soils, limestone, marble, and wetlands, has not offered clear lines back to the capital, posing the question: What motivated the people in central Lydia and by what

means did they associate with their immediate landscape? The particulars of the region around Sardis, it seems, continued to influence the nature of human interaction with the landscape in terms of settlement and resource acquisition.

Architectural and sculptural programs within Sardis that utilized a variety of primarily local stones – including marble, limestone, and sandstone – offer a noteworthy window into landscape interventions during this time. Indeed, construction and artistic programs during the Iron Age were undertaken on a monumental scale (see Hanfmann and Ramage 1978). Limestone rubble was used in the construction of the city wall, the acropolis foundations, pyramid tomb and the inner *crepis* wall and chambers of most burial tumuli (Hanfmann and Ramage 1978; Cahill 1988; Ratté 1992). Marble was used as well, with a special emphasis on sculptural programs that bear similar stylistic patterns to Greek patterns, while maintaining a strong local identity as well (Hanfmann and Ramage 1978; Roosevelt 2009).⁷⁷

Although a thorough discussion of known statuary is provided by Hanfmann and Ramage (1978), obviating the need for a complete discussion here, it is noteworthy to point out several traits of stone use during this time. To begin with, an attempt to analyze the marble from Sardis and the quarries at Mağara Deresi by using petrographic analysis and X-ray Diffraction, suggests that much of the sculptural marble that was analyzed in the 1970s was consistent with marble from local sources (Hanfmann and Ramage 1978: 4-7). Finer resolution conclusions were not drawn at the time, either for precisely which source, or for marble dating to different periods. Nevertheless, it is clear that marble was

⁷⁷ At least some of the Lydian marbles survived into the Roman period. The Nannas monument, in particular, is taken as indication of Late Roman attitudes towards the past. An eagle and two lions, both common forms in Lydian statuary, were repositioned by a later, Roman, audience (see Hanfmann and Ramage 1978: 20-21).

used for a variety of purposes, such as stelae and graveside monuments (Roosevelt 2006b) and statuary, and that central Lydian sources plausibly provided much of this material. Limestone, however, provided the bulk of basic construction and monumental building material, such as the city wall, pyramid tomb, tumulus chambers and walls, funerary furniture, and stelae (Hanfmann and Waldbaum 1975; Hanfmann and Ramage 1978; Cahill 1988; Roosevelt 2006b; 2009).

The capture of Sardis by Alexander the Great in 334 BCE marks the second major disruptive event in the city's post-Lydian history. It is during this period that construction began on the temple to Artemis in the city, its first major monumental construction in marble (Hanfmann and Ramage 1978; Hanfmann *et al.* 1983). To what extent the Hellenistic period can be called materially Hellenistic is debated. Sardis remained culturally and politically significant, and imported finewares reached the city, attesting to its involvement in broad economic trade connections, though similar finds are only rarely attested for rural settlements. Local production of either imitation wares or the continuation of Lydian styles persist outside of the city itself. The aftermath of the Hellenistic conquest of the city is the periodic infighting over the city by the successor kings. Antiochus III most notably sacked and conquered Sardis in the late 3rd century BCE, and an earthquake devastated the city in the early first century CE. All of these conquests and devastating events resulted in Plutarch warning that the Sardis seen in his day was not the 'Sardis of old'.⁷⁸ Compellingly, the discourse of upheaval is reflected in the material record demonstrated by the regional survey of central Lydia: the aggregate number of Achaemenid and Hellenistic period sites is minimal (Roosevelt and Luke

⁷⁸ For recent work on Plutarch's words and their significance, see Rojas (forthcoming), who treats Roman antiquarianism through literary descriptions of the city and the region.

2008; 2009; 2010; forthcoming a; b). Hellenistic sites typically are moved to defensible positions, and there is, at this point of collection, only one site in central Lydia dating clearly to the first century CE. (It is unlikely, however, that settlement was limited to this single location during this time.)

Following the earthquake of 17 CE, Sardis underwent many structural changes, and the region's settlement appears to have changed as well, growing in density. Within this landscape are signs pointing to increased quarrying activities, but on a substantially smaller scale than reported for other major cities in western Anatolia. Regrettably little is known about individual building programs in the region surrounding Sardis. Roman authority in the region changed in 296 CE, when the Tetrarchs reordered the provinces such that Lydia became a political entity once again, and late Roman and early Byzantine settlement data seem to reflect a change in orientation and location (see also Foss 1976; Yegül 1974; 1986; 1987). These major events, however, do not mark the rhythms of daily life, and the evidence from pottery is too crude at this juncture to posit whether settlement change followed or predated political change.

A fundamental question regarding the relationship between rural settlements, resources and changing political regimes is how much of rural life and resource acquisition depended on political control. And how do we demonstrate this for a given region? Having selected stone as a way to access issues of control, I aim to develop these ideas by demonstrating the methods of resource extraction for different periods of time and in different scales of production. Before expounding on the characteristics of Roman imperial policies, the characteristics of a regional tradition need to be established. And to do that, I need to establish the geological features present in central Lydia, as they hold

importance for social life in more ways than with respect to which stones were used in construction projects.

The transition to the Achaemenid period, the early portion of which is often elided with the Late Lydian period in terms of material culture, witnessed elements of both discord and continuity. The political structures in place in Sardis itself, some 15km south of central Lydia, were new in the sense that the role of Sardis as the capital of a polity was replaced by the role of Sardis as regional capital after Cyrus the Great “sacked Sardis and left scattered throughout the city impressive remains of destruction” (Roosevelt 2009: 65). Nevertheless, the physical space of the city and the distribution pattern of Lydian-period sites in the countryside remained relatively constant over time, with a persistence of primarily non-imported ceramic wares. New construction of monumental spaces at Sardis is not well-attested, though reconstruction of demolished remains does occur for the fortification walls (Roosevelt 2009: 65). In the countryside, local production on a relatively small scale, of both ceramics and stone products, indicates that rural settlements were not accessing the same traded goods as reached the urban core, even as some portions of the Lydian countryside saw growth in population numbers, if the location of tumulus clusters and settlements is taken as a strong indicator of settlement location and density (Dusinberre 2003; Roosevelt 2009: 114).

Subsequent Roman settlement expansion and reinvestment in the city of Sardis and in the countryside is obvious, as is an apparent curiosity about the history and legacy of Lydian Sardis (Hanfmann *et al.* 1983; Rojas forthcoming). Population growth in the countryside follows the reemergence of estates and hamlets, with the movement of settlements away from defensible locations to more open terrain, particularly in the fertile

saddle in the southeastern portion of the survey region (Roosevelt and Luke 2008; 2009; forthcoming a, b, and c). The data from survey, which are discussed more in Chapters 4 and 5, provide some evidence for activity in the hinterland. Nevertheless, data for the Roman period, both within Sardis and in its hinterland, are lacking compared to other periods. In particular, this dissertation explores the viable connections in which the CLAS survey region participated during the Roman period, providing some commentary on how the relationship between hinterland and city changed from the Iron Age to the Roman imperial period.

The presence of both monumental and elite construction increased during the Roman period, supported by a subsequent rise in marble extraction at Mağara Deresi, much of which appears to follow general changes in political and social life in western Asia Minor. Elite benefaction in the form of construction in Lydia is in some instances directly related to the political involvement in Roman imperial affairs. Investment is attested in the Marble Court associated with the Bath-Gymnasium complex as early as the reign of Lucius Verus in the mid-2nd century CE, though including inscriptions from a Severan-period (early 3rd century CE) reconstruction (Yegül 1976; 1986). The Marble Court and Bath-Gymnasium complex combined a variety of stones, including local limestone for base construction, bricks, and marble veneer. Colossal statuary is present in Roman Sardis as well, including sculptures of the imperial family and common Roman deities. A colossal Zeus, and colossal Antoninus Pius and Faustina, are some of the more famous examples found within the urban core (Hanfmann and Ramage 1978: 82).⁷⁹ Some

⁷⁹ For a more complete discussion of the total sculptural program at Sardis, see Hanfmann and Ramage (1978).

of this material was reused or burned to create lime in kilns associated with Late Roman and Byzantine contexts (Hanfmann and Ramage 1978: 82).

Other major stone features within the city include continued investment in the Temple of Artemis and a second theater. The temple was started during the Hellenistic period, though not completed until perhaps the 2nd century CE. Base layers of the structure include sandstone and limestone construction, while columns were made of intricately carved marble. The theater, with an original date of construction in the Seleucid Hellenistic period, was reconstructed with marble and limestone slabs during the Roman period (Hanfmann *et al.* 1983: 116).

The volume of marble and limestone construction dating to the Roman period is suggestive of significant investment in a professionally driven stone industry in the region. No calculations of the volume of stone required for construction during this period exists, to my knowledge, though crude comparisons of volume calculated for the eleven quarries surveyed north of Marmara Lake can inform a discussion of stone resource sites and distribution patterns during this period. Estimates suggest, at this time, that major sources beyond the capacity of those in the northern hinterland were required to facilitate the variety of construction and sculptural projects undertaken during this time. This suggests changing social conditions, with a corresponding relocation of major resource sites to the south, mirroring a shift in settlement activity to the fertile southern plains as well. The tools of the trade, so to speak, changed as well. Ratté's (2011) study of the tools used in Lydian masonry suggests that some of the tools used during the Iron Age persist into the Roman period, whereas other Roman-period evidence indicates the introduction of specialized tools as well (Hanfmann and Ramage 1978).

This period also witnessed the rise of smaller towns and villages in greater Lydia. An inscription with a find-spot near modern Yeniköy, for example, refers to a town called Arhillenoi (De Ligt 1993 – see Chapter 6 for a full discussion). The inscription attests to negotiation with Sardis, connections to imperial authorities, and a high degree of independence: the town is requesting its own market-day through a subtle jibe at its southern urban elite neighbors. Those neighbors, located at Sardis, had entered a period of growth and prosperity beginning in the 2nd century CE, following periods of grain riots and shortages, and general discontent with Roman authority (Hanfmann *et al.* 1983). Following a visit by Hadrian, and the appointment of a proconsul during the earlier reign of Trajan, imperial and elite benefaction in the city gave rise to new monumental construction within the city, much of which was adorned with marble from primarily local quarries. Sardis was also, during the Late Antique period, the site of one of the seven churches of Asia, suggesting continued importance politically and socially.

Existing CLAS Survey Data: Background Context

The survey program entailed multiple scales of research targeted at addressing different questions. The overarching goal of the survey was to provide chronological and spatial data for settlement types and distributions in the regions immediately surrounding each quarry or quarry district. This stage of fieldwork built directly upon existing research programs already employed by the Central Lydia Archaeological Survey in the Marmara Lake Basin, including extensive and intensive survey of large portions of the survey region. Because the results and findings from previous CLAS seasons provided

critical chronological and spatial data for the 2011 quarry survey, a brief review of methods and conclusions drawn from the data about the region is included here.

The CLAS survey design has changed substantially from its inception in 2005 to its present form, becoming progressively more intensive and systematic as the project's objectives shifted from a primary interest in the correlation between mortuary landscapes and settlement clusters to a comprehensively diachronic study of settlement and social dynamics throughout the region (Roosevelt 2006a; 2007; 2009; Roosevelt and Luke 2006; 2008; 2009). The current broad scope of the project incorporates archaeological material from the Paleolithic through the modern period, studied periodically by lithic and ceramic specialists from relevant periods. The project includes specialists in cultural heritage management, architectural preservation, mapping of remains from an abandoned village dating to the 20th century, a strong ethnographic component to understand the politics and implications of current land use practices, and archival research on the increasingly significant Ottoman period for the survey region.

Results from CLAS have dramatically altered scholarly understandings of the significance of the landscape in the Marmara Lake Basin in political and historical terms. The longstanding belief that the region called Bin Tepe, which sits north of Sardis and south of Marmara Gölü, was sparsely populated through time and that the central Lydian landscape was insignificant has been overturned in light of archaeological evidence produced by CLAS (Fig. 4.1; Roosevelt 2007). As a case in point, the expansion of the survey project after the initial 2005 season was the result of unexpected results for dense settlement in Bin Tepe, particularly during the Medieval and Ottoman periods, and the early recognition that a ring of Bronze Age citadels was located in the hills surrounding

Lake Marmara. The survey has demonstrated plausible claims that the lake basin was the location of a Bronze Age regional capital of the Seha River Land (Roosevelt 2009; 2010; Luke and Roosevelt in press), drawing the political significance of the region north, away from the comparatively scanty evidence for Bronze Age activity at Sardis. In total, four Bronze Age citadels occupy easily fortified positions around the Lake, with Kaymakçı the largest and most likely location of the regional capital.⁸⁰ Secondary, smaller hilltops sites also date to Bronze Age in the fields and hills in the southwest portion of the survey zone.⁸¹

The recognition of this scale of Bronze Age activity also had clear ramifications for the location of the royal funerary mounds in Bin Tepe in the late Iron Age. The implications are now that Iron Age populations, after the Late Bronze Age collapse, of the existing political structure, retained strong connections to the Bronze Age ancestral landscapes that were focused around Lake Marmara (Luke and Roosevelt, In press). Lydian material is limited in scope and appears to be local productions of finewares and coarsewares (Fig. 4.2). Local production of imported styles carries over into the Roman period as well, although material from this period is generally greater in number than the preceding archaic, Achaemenid and Hellenistic periods, which are not well represented (Roosevelt and Luke 2008; 2009; 2010). The Middle-Late Roman material, which indicates a growth in population density in the countryside, is a mix of locally produced

⁸⁰ Kaymakçı and Bronze Age sites at Bozyer, Kılcanlar, Asartepe, Gedevre Tepesi and Kızbacı Tepesi were studied in 2007 and 2008 through a combination of microtopographic documentation and surface collection of artifacts. The methodology employed used a Real Time Kinematic (RTK) GPS unit to stakeout a grid. Finds from the citadels are often coarse and utilitarian (Roosevelt and Luke 2008; 2009; forthcoming a; b; c).

⁸¹ Most evidence for these secondary Bronze Age sites comes from the material collected during the 2010 season (Roosevelt and Luke forthcoming b).

finewares and utilitarian cooking wares (Fig. 4.3). There is a dearth of evidence from the Early-Middle Byzantine (Fig. 4.4), but settlement numbers expand greatly in the Medieval and Ottoman periods in this region (Fig. 4.5 and 4.6; Roosevelt and Luke forthcoming c). Estates, hamlets and farmsteads define most Lydian and Roman settlement, though the intervening Achaemind and Hellenistic periods do not offer a clear picture of settlement types at this time.

In addition to providing the chronological and socio-political context for changing settlement dynamics, CLAS has demonstrated a strong correlation between the region's topography, changing environmental conditions, and social life throughout time. Coring in and around the lake suggests that the lakebed moved westward over the previous three millennia, in conjunction with changes in river courses and spring outlets (Besonen and Roosevelt 2008).⁸² The region is heavily dependent on seasonal water flow for agriculture and fishing, and the precise courses of water flow have changed over time, resulting in modified land-use patterns. Chapters 5 and 6 will explore the correlation between settlement location and resource acquisition more closely, particularly within the framework of changing political contexts. Furthermore, it is within this context that the marble quarries most appropriately fit. The quarries were located during the 2006 and 2009 seasons during extensive reconnaissance of the foothills in the region to the west and northwest of the lake. In total the survey identified eleven quarries in three discrete clusters. More thorough analysis of the quarries was undertaken in 2011.

⁸² Such dramatic changes in the hydrology of the region are attested to in the modern era as well. Topographic maps of Lydia produced in the 1940s reveal a lake that is substantially smaller than its present condition.⁸² The advent of dam construction in the 1950s, with the assistance of American machinery as part of the Marshall Plan and using stone from local limestone and marble quarries, is the first effort to control water levels in the lake through a canal system running southwards to the fertile plain north of Sardis itself. See Luke and Cobb (in press) and Luke (personal communication).

The 2011 Survey Program: Design

Pedestrian Survey

The design of the intensive survey program in 2011 was highly targeted towards addressing the quarry features encountered during previous seasons of fieldwork in order to elucidate the regionally specific nature of small-scale quarrying during the Roman period (Fig. 4.7). Although limestone quarries are known to have existed around the major tumulus mounds in Bin Tepe, which tend to have a limestone *crepis* wall on the interior of the tomb's construction, survey focused on the marble quarries, which had received no scholarly attention prior to 2011.⁸³ Originally labeled POI06.12, POI06.16, POI09.04 and POI09.08 (with POI standing for Point of Interest, and representing the project's nomenclature for documenting features within the region), the marble quarries are now recorded as SUs (survey units), representing the fact that they have been studied in detail.⁸⁴ Here, they will be labeled according to nearest town, and given a unique numerical identifier (Table 4.1). The quarries were found during the 2006 and 2009 field seasons. The 2006 seasons conducted primarily extensive ridge-walking survey on the west and northwest side of the Lake, while the 2009 season conducted intensive survey on the north side of Lake Marmara.

⁸³ See Ratté (2011) and Greenewalt, Jr. and Rautman (1998) for discussions of the limestone quarries and the sampling programs that were undertaken at them. Limestone from outcrops surrounding tumuli was sampled and petrographic analysis was performed to determine local origins. A total of 71 limestone samples were collected.

⁸⁴ SU11.2-SU11.12.

Because most of the quarries were identified through extensive survey, appropriate documentation required that agricultural fields that had not previously been surveyed were selected for intensive pedestrian field-walking and surface collection. The determining factor for which fields to incorporate in the survey is proximity to a quarry of no more than 500m. The basis for selecting a 500m buffer is the existing publication of several projects in which quarry fields were surveyed, particularly in Egypt and Greece (Vanhove 1996; Peacock and Maxfield 1997; Heldal and Bloxam 2008), and also Turkey (Fant 1992). 500m represents a distance from the primary stone source that is arguably great enough to encompass the debris pattern of stone from the quarry, as well as to include associated features such as outposts, shelters, reduction areas, and slip roads. Field-walker spacing was set at 10m intervals, or twice the intensity of the existing CLAS spacing standard. The team consisted of three walkers and one team leader. The field walkers followed transects between crop rows in the interior of fields while the team leader (the author) recorded the survey unit sequence number, ground coverage, surface visibility, visibility of other landscape features from the field, and recorded general descriptive comments. The team leader also walked the perimeter of the field to record its boundaries with a handheld GPS, and to collect surface finds. Photographs were also taken of each survey unit.

Justification for this spacing was the impetus to use survey as a means of documenting specific known features, rather than as a methodology to locate a representative sample of sherds or sites within a defined territory. Because quarry debris features can be difficult to identify, and because they are often diffuse scatters of chipped stone, the increased intensity offered a better opportunity to encounter finds related to

stonecutting activity. All features were documented and all diagnostic finds were kept and recorded in the lab. Non-diagnostic sherds were counted but not retained due to limited storage space available to the project in the Manisa Museum.

Gridded Quarry Survey

In addition to the survey of fields within a 500m buffer of each stone source, the quarries themselves were surveyed in a total coverage fashion (Fig. 4.8 and 4.9). Each quarry was gridded at 5m x 5m intervals using the project real-time kinematic (RTK) GPS to stake out the four corners of each survey unit (SU) along the cardinal directions. Each grid within each quarry was surveyed in its entirety using hand rakes. Diagnostic sherds were kept and any markings related to stonecutting were recorded. Features such as possible ramps and cut blocks were recorded as well. All survey units within the overall grid were photographed and recorded independently, with the recording form only a slight modification from the intensive survey form. The following brief description of the individual quarries characterizes the collection process in each location.

POI06.12 (SU11.2 – Fig. 4.11): Haciveliler 1 – This quarry is of a whitish-gray marble was found during the 2006 season. The quarry is located in the foothills to the northwest of the Marmara Lake at an elevation higher than that of Haciveliler 2 (the nearest quarry). The marble layer sits under a visible layer of conglomerate stone that is physically much harder than the marble itself. This quarry is accessible only by a system of dirt track roads that follows the lower course of a valley with tributary channels running off of it. The quarry itself sits above a seasonal stream. Maximum height of the quarry is

approximately 2.5m. Maximum dimensions of the quarry are 12m x 15m. A total of 16 grid squares were laid out in the quarry.

POI06.16 (SU11.3 – Fig. 4.10): Haciveliler 2 – This quarry of whitish-gray marble, found during the 2006 season, is a 5-6m cut into a ridge in the foothills on the northwest side of Lake Marmara. A dirt road along a natural ridge that runs along a deep ravine leads to the quarry, which is 800m west of the main Gölarmara highway. A modern gravel quarry marks the start of the track road leading to the quarry. The area is a mixture of rolling agricultural fields and mountainous geology. According MTA, the Turkish geological society, veins of marble are quite limited in surface extent in this area. Schist, limestone and quartz are also present. Maximum length of the quarry is approximately 40m, and the maximum width of the quarry is 15-20m. The quarry has well-defined vertical walls on the eastern face and slopes more gradually to the west. Evidence for ancient extraction is limited primarily to the eastern wall of the quarry. 20 5m x 5m grid squares were laid out in this quarry.

POI09.04 (SU11.4 and SU11.5 – Fig. 4.12 and 4.13): Kılcanlar 1 and 2 – This point of interest (POI09.04a and POI09.04b) proved to be at least two quarries that were likely used exclusively during the modern period. Both quarries, found during the 2009 season, yield marble that is beige in color. Their location is remote, high in the hills north of the lake in a region that is not serviced by roads. Extraction at these quarries followed natural topographic contours and was limited in volume. Although sampled, these quarries were not surveyed intensively due to the obviously modern traces of extraction and the

difficulty in accessing them. POI09.04a was 13m long and POI09.04b was approximately 40m long. Depth dimensions were not discernable.

POI09.08a (SU11.6 – Fig. 4.14 and 4.15): Yeniköy 1 – The marble in this quarry, found during the 2009 season, is whitish-gray. The quarry is visible from the road that runs along the edge of Lake Marmara – the only visible quarry in the survey boundary. The vertical surface of this quarry reached as 8-9m. The traces of quarrying cover a maximum horizontal extent of approximately 60m across by 50m deep. The extent of extraction appears to be outlined by the formation of a platform at the edge of an agricultural field immediately to the south of the quarry. In places the marble is heavily degraded by acid rain, though this quarry does yield the most extant ancient tool marks. This quarry, and all other POI09.08 quarries, are accessible by a dirt track road that connects to the main highway around the lake. The quarry is at the elevation of the lake with good lines of sight to the water and Bin Tepe to the south. 32 grid squares were established for total collection within the boundaries of this quarry.

POI09.08b (SU11.7 – Fig. 4.16): Yeniköy 2 – Located immediately north of SU11.6 during the 2009 season, this quarry also yielded whitish-gray marble. Unlike SU11.6, however, this quarry is in the shape of a basin rather than a regressive cutting into a rock face. It is in this quarry that the geology of the quarry district is most clearly visible. The track road by which the sites are accessed follows the top of a ridge into which all 5 of the southern-most whitish-gray quarries cut. The basin measures 60m x 30m at maximum extent. Most of the extant markings of ancient stone-working appear on discrete outcrops

along the eastern and northern sides of the basin. The central portion is filled with some marble rubble. In total 22 grid squares were surveyed.

POI09.08f (SU11.11 – Fig. 4.20): Yeniköy 6 – This quarry is situated at the end of the dirt track road servicing the southernmost marble quarries in this district. Found during the 2009 season, the material is whitish-gray, although portions of the quarry do see intrusive layers of quartzite and schist. The western side of the quarry has been worked in the modern period, resulting in huge blocks of stone of roughly 2m x 2m x 2m, each with hydraulic drill marks. Ancient tool marks are located in the western portion, which is set at a higher elevation, likely because modern quarrying brought the bottom surface down in the east. The total east-west length of the quarry is approximately 70m, though the north-south dimensions are only 15-25m. Maximum height in the modern portion approaches 10 meters, though the ancient tool marks indicate much less vertical depth – 3m. A total of 26 grid squares were established and surveyed in this quarry, but only in the eastern, ancient section. Modern blocks and vegetation obstructed survey in the western portion.

The remaining six quarries (Fig. 4.17, 4.18, 4.19, and 4.21) were not surveyed according to the grid method either because of difficulty of access, degree of slope, modern construction or extremely dense vegetation.⁸⁵ Notable distinctions between the quarries are that the farther north the quarries are located in the hills near the modern

⁸⁵ 2011 was an extremely wet year in Turkey, resulting in substantially more wild vegetation in uncultivated areas than witnessed during the 2010 season.

village of Yeniköy, the more gray the marble is. Additionally, the gray marble is much harder than is white marble (See Figs. 4.22-4.33 for sketch maps of each quarry).

Photorectification

Running in conjunction with the intensive survey of the quarries floors was the mapping and documentation program of the quarry walls. This program is explicitly intended to answer questions about subtle changes in tool use over time in the archaic, Classical, Roman and post-Roman periods by measuring and photographing the marks left behind by the tools used in the extraction process.⁸⁶ This program employed sketch drawings of vertical quarry walls and detailed mapping with a total station in order to produce photorectified images (pseudo-3D imagery) that are both highly accurate and measurable. Not all quarry surfaces were measured using the total station due to poor conditions of preservation in the tool marks or to a lack of substantial height in the extant cut surfaces. A total of nine quarry walls were documented with the total station and converted to 3-dimensional images. A full discussion of tool marks will appear in Chapter 5.

Following CLAS protocols developed for documentation of architectural façades (Roosevelt and Luke forthcoming b; c), the process of photorectification entailed converting the point cloud produced by the total station into a spatially oriented .dwg file in the program AutoCAD.⁸⁷ Once correctly oriented (with correct spatial information) in

⁸⁶ For the best general literature on tool traces in cut stone, see Bessac (1988), Waelkens et al. (1988) and Rockwell (1993). For the Lydian period, see Nylander (1970) and Ratté (2011). For the Roman period see Bessac, Waelkens and Rockwell above, in addition to Adam (1994).

⁸⁷ Thanks to John Valainis, who performed much of the initial photorectification process during the 2011 season.

AutoCAD, the points were opened in ArcMap, where a jpeg image of the documented quarry surface was tagged to the correct points. This process requires detailed documentation of precisely where on the quarry surface a particular point was recorded using the total station. The point, in ArcMap is then georeferenced to the same point on the image. This is done first for the boundary points that mark the exterior limits of the quarry, and then to the 'topographic' points taken along the inside of the quarry wall. The result is the reorientation of the quarry image to the points, which carry X, Y, and Z values, making the image measurable. The final image, although georeferenced in ArcMap, must be converted to a 'tin' in the program ArcScene. The 3D-image is, currently, only visible in its 3-dimensional format in ArcScene.

Quarry Topography

The RTK GPS unit that was used to stakeout the quarry survey grids was also used to map the internal quarry surfaces and the areas immediately surrounding the quarries. The extent of each quarry was mapped, with the exception of Yeniköy 7, which is too steep and covered in loose debris to allow safe walking with a stadium rod. The same quarries that were gridded were also covered completely with the RTK GPS. Having established a series of base stations near each quarry cluster, the RTK GPS was programmed to create an artificial grid system set at 1m x 2m, according to which a team member would traverse the quarry's topography at 50cm intervals. The RTK GPS created a point cloud with highly accurate X, Y, and Z values that were converted into a DEM and a series of hillshades using the programs Arc and ArcMap, respectively. The data

recorded for the DEMs were also instrumental in calculating the estimated maximum volume of stone removed from each quarry (see Chapter 5).

The Sampling Program

Accompanying the survey program was a systematic program of materials sampling from each of the eleven quarries that fall within the survey boundary. The sampling program was intended to address questions of material distribution as it relates to landscape, trade, economy, and chronology. Instead of focusing on the narrow question of how extensive the Roman-period trade of marble may have been, this program intends to place the data generated by materials science analysis into the context provided by the other methods of investigation already outlined in this chapter. All too often archaeological samples of marble are discussed without any reference to their exact physical location, proximity to other sites and settlements, and with no discussion of the chronological significance of new results. The results presented here combine the materials science program with the survey data.

Field Methods

The sampling strategy employed for the collection of marble from the eleven quarries studied in this dissertation was designed to provide a sample size large enough to run multiple kinds of tests, as well as to provide enough samples to create an accurate chemical signature for each quarry. While some geologists and geochemists suggest a minimum of 20-30 samples per source, this claim is made without a clear reference to the

size of a source. Because the quarries in the Marmara Lake Basin are small compared to the quarries typically studied in a sampling program, which can be hundreds of meters in length and tens of meters in height, the sampling strategy employed in this study systematically sampled every 10m horizontally and at the top and bottom of each vertical surface. In this way, a minimum of four samples were collected for the 12-15m long quarries at Kılcanlar 1, and a maximum of 25 samples were collected (Yeniköy 6). Table 1 shows the number of samples from each quarry, noting that POI06.16 was sampled at 5m spacing rather than the 10m spacing used in all other quarries.

The distances were measured using 50m nylon tapes by the author and the project commissioner. Samples roughly 2-4cm in size were removed from suitable surfaces in close proximity to the 10m spacing lines. Cut surfaces with extant tool marks were avoided, and edges of exposed marble were preferred to minimize the amount of material removed with the use of a steel geological hammer. Samples were labeled and bagged in the field according to the survey unit number and sample number (e.g. SU11.2.1 for 2011 season, survey unit 2, sample 1). The location of samples was noted in sketch plans drawn in the field prior to the sampling process. In total, 166 samples were collected from these quarries over the course of 4 days.

Additional samples were collected from three other sources: cut-stone finds documented during previous seasons of fieldwork, the marble chamber of a tumulus that had been looted during the 2011 field campaign, and a marble from a Bronze Age citadel in the northwest corner of the survey boundary. As with samples collected from the quarries, a geological hammer and a steel point chisel were used in the collection of field

finds, tumulus marble, and possible Bronze Age marble sources as well. Each sample was bagged according to individual survey unit numbers for this stage of sampling.

The marble collected from the interior chamber of the tumulus deserves special attention, as signs indicate that looting had occurred at the site as recently as the night prior to our visit. Very large metal chisels, candles, sand bags, shovels and other tools were found in a tunnel dug directly to the interior marble chamber. All looters' tools were confiscated and given to the military police in the town of Gölmarmara. The fact that the tumulus had been looted, however, made possible the sampling of the material. The looters had caused a tremendous amount of damage to the interior of the chamber, breaking through the marble outer wall, shattering portions of the chamber door, and destroying the twin *klinai* that occupied the chamber. The floor was dug through to approximately 2.5m below its surface, and the looters had begun trenching underneath the opposite outer wall. Because the finds had been damaged so aggressively, 1-2cm samples were collected from eight different locations within the chamber, one of only two marble tumulus chambers known in the region. Damaged blocks of marble from different architectural and sculptural features only were targeted for sampling, since two visibly distinct colors of marble were used in the construction of the tumulus.

Laboratory Methods

The samples collected in the field were flown back to Brown University on 12 July 2011 to be analyzed using three complementary materials science techniques in labs housed in the School of Engineering and the Department of Geological Sciences. These

methods are Stable Isotope Analysis, X-ray Fluorescence (XRF) and X-ray Diffraction (XRD).

Stable isotope analysis, the method most commonly used to source marble, provides highly specific information about a sample's carbon and oxygen isotope content. It is often more precise than other elemental analyses because it produces information about the absolute content of two elements rather than ratios of a range of elements within a sample. Because the values of oxygen and carbon are dependent on the formation and cooling processes specific to a bed of marble, it is sometimes possible to differentiate the range of isotopic signatures from one quarry from the ranges detected at others.⁸⁸ That many of the marble beds in the Mediterranean were formed under the same geologic process produces a high degree of overlap between sources. Nevertheless, the method can prove useful in differentiating between a sample and a known source, determining with greater accuracy where materials did *not* originate than where they certainly, or were likely to have, originated.

All 2011 samples were examined using a mass spectrometer held in the Department of Geochemistry at Brown University.⁸⁹ Samples were prepared by producing scrapings of marble using a steal punch. Only 40-70 micrograms of marble are necessary for this procedure. Samples were scraped onto weight paper before being transferred to individually labeled vials. In most cases, up to five times as much marble was scraped than is necessary to run a sample, allowing room to retest a specific specimen should the machine fail to run successfully. After scraping all of the samples,

⁸⁸ The determination of these ranges appears to be the driving motivator behind an increasingly large corpus of known signatures.

⁸⁹ Guidance and expertise in running these samples was provided by Dr. Steve Clemens.

40 glass vials were filled with 40-70 micrograms of marble powder.⁹⁰ This amount was selected using a modified paperclip, a microscope, an aluminum boat with known weight and a microscale. The process of loading 40 vials for the mass spectrometer takes up to 3 hours to complete. Once all 40 specimens are loaded, nine standards with known isotopic signatures are loaded into specific locations in a carousel as controls. Liquid nitrogen is loaded into the bottom of the machine, an acid is dropped on the sample, which, when setup for a single test of 41 specimens, runs for approximately 24 hours. All samples, with the exception of 21 that had to be retested due to mechanical failure during the final run, were completed over the course of two weeks in August 2011.

Understanding the geochemistry of the stone, which is one of the more prominent applications to archaeological materials, and of obsidian in particular (Davis *et al.* 2010; De Francesco *et al.* 2010), offers a closer look at potentially unique elemental attributes of a given source. Although a less commonly used technique for marble, the pXRF utilized in this study irradiates a complete sample (a sample that is not pulverized) by bombarding the surface with X-rays and detecting the destabilization of electrons. Different elements will destabilize at different intensities, such that the equipment determines the elemental composition of a geological sample. For marble and limestone, which, in Turkey, are predominantly calcite (or dolomite, in other regions of the world), the instrument is mainly used to detect trace elements that were incorporated into the rock during the process of sedimentation (for limestone) and metamorphism (for marble). This is the reason that the unique composition of the Gediz half graben is potentially revealing for the central Lydian stones. The formation of the graben and the subsequent

⁹⁰ 40 is the maximum number of samples that can be run at one time.

recrystallization of the rock in the formation of the Menderes Metamorphic Massif might yield detectable variations in the rock chemistry of this region. Detecting these can go some way towards offering a ‘fingerprint’ for the material of this region.

This method’s growing popularity is attributable to the recent production of portable XRF devices that facilitate in-the-field identification of specific geochemical signatures. Whereas stable isotope analysis yields information specific to two elemental isotopes, XRF irradiates a portion of the sample detecting the energy output for a wide array elements.⁹¹ The utility of such an approach has not been applied to marble in antiquity to this point, largely because the results of XRF are not ideal for answering questions specific to quarry sourcing. The method is, however, good for answering questions about the specific geochemistry of a sample, which can provide information for a host of other questions, including whether certain materials or inclusions in stone sources were favored (deliberately or not) in the marble extraction industry. All 2011 samples were examined using the pXRF housed in the Department of Geochemistry at Brown University.⁹² No sample preparation is required, as the XRF ‘gun’ is positioned over each sample and told via the computer to run two tests at 90 seconds each. Each sample therefore takes three minutes to run, making this the fastest procedure used in this study. XRF was completed over the course of three days in September 2011.

The final method employed is XRD, which provides the most general information about the sample. The process of diffraction detects crystal structures within a given sample. In most cases, a sample of stone must be crushed or ground into a powder. Powders are preferred because they evenly distribute the crystals across a plain, allowing

⁹¹ It is not, unfortunately, good at detecting trace concentrations of light metals.

⁹² Guidance and expertise in performing XRF was provided by Dr. David Murray.

greater intensities of signature detection. A total of 13 samples were run using XRD, due to the more general nature of the results that either confirmed or rejected the notion that the marble under study contained high ratios of calcium carbonate, dolomite and silicate. Portions of these samples were ground using a mortar and pestle. The powder is loaded into the disc of a thin film sample tray, which is mounted in the X-ray machine between the X-ray emitter and the recorder.

The running time for each sample depends on the user settings. In this study, each sample was given the following parameters: The angle was set to run between 20 and 61 degrees, with the step size (that is, the interval between degree settings) established at 0.0500 degrees. The step size was determined based on the clarity of crystal structure readouts (or the lack thereof) during trial runs at larger step sizes. The larger the step size, the greater the background noise, reducing the precision of the readout. The degree range was established through a database search of the location of peaks for calcite, the presumed major mineral structure within the sample. Dolomite falls within this range as well. Once these settings are established, the machine is instructed to run according to these parameters. For these settings, each run lasted 68 minutes.

How individuals interacted with the specific geology of the quarry depends to a great extent on the mineralogical and chemical profiles of the stone source. In archaeology, mineral and chemical characterization of stone has often been conducted for the purpose of sourcing a particular artifact to a single quarry. Characterizing a stone source, however, can address a range of questions with significance for social organization that go well beyond interest in where something came from. The regional

focus of this study also allows for the social significance of particular types of stone to be addressed, since it provides a series of datasets that can be compared to each other as well as to the available settlement data. Thus, we can use the mineralogy and chemistry of particular quarries to answer questions about preference for types of materials during specific periods of use by drawing on evidence for mineral inclusions, solubility, hydrology, and crystalline fracturing patterns, as well as more basic concerns such as color, hardness and availability.

Conclusions

The aims of this project are set firmly within a contextual understanding of the specific landscapes in which the quarries of the Central Lydia Archaeological Survey reside. Critically, this project understands such a contextual understanding as dependent upon the historical, geographical, social, geological, and technological factors present in the region. In the case of central Lydia, compelling historical and cultural questions coincide with the opportunity to apply new techniques to the study of ancient marble and limestone. Sardis, and central Lydia more generally, witnessed a variety of different imperial regimes, within which the city and region fulfilled different roles. Much like the three-tiered perspective on historical development outline by Braudel (1995[1966]), the role of this region involved processes that moved at different rhythms and speeds, some more static and slow-moving than others. This project proposes to apply the techniques listed above to a more complete understanding of the region by addressing the particular

everyday aspects (*événements*) of how humans interacted with the stone (*longue durée*) in the context of changing political and economic systems (*conjonctures*).

This project, however, is also about more than following a Braudelian model of landscape history. The combination of these different aspects of the region into a single study offers the opportunity to more completely identify the associations between production, policy, politics, and economy, all of which were at play in the extraction and utilization of stone during antiquity (as in all other time periods as well). In contrast to most of the existing scholarship about stone, which aims to identify specific sources of material, this project aims to characterize the region and its geological particulars to better understand how the environment played into social practices during the Roman period. The combination of mineralogy, chemistry and petrography facilitate this by providing the data to assess whether and how humans attended to the stone in the process of extraction. Connecting this information to the settlement dynamics that have been documented by CLAS takes a step towards altering how we understand the motivations for working stone and its ramifications, socially and economically, for a particular region.

In this way, we can begin to explore the relationship between political entities, such as the Roman empire, and the practices that go into empire formation. Much of the recent scholarship on the Roman economy has stressed the need to account for multiple scales of economic activity, including markets of different size, as well as differently organized social units used in the production of different goods. Ceramic guilds that produced according to fundamentally different hierarchical labor practices are now readily seen in the archaeological record, suggesting that the economic model is potentially more of a factor, rather than the sole factor, in determining who performed

what activity. In this way, the study brings eastern Mediterranean stone-working literature into greater contact with the scholarship on political economy and craft production, while further merging the sciences and humanities in a way that addresses a basic question: who controlled such activities in the Roman empire?

Table 4.1: The marble quarries surveyed, dates, and associated finds.

Quarry Name	POI Number	SU Number	Tool Marks Style/Date	Associated Finds (by date)
Haciveliler 1	POI06.12	SU11.3	Shallow curved (probable Roman date)	Near Lydian, Roman, and Modern period finds
Haciveliler 2	POI06.16	SU11.2	Shallow curved and herringbone (probable Roman and Late Medieval-Ottoman dates)	Near Lydian, Roman, and Modern period finds
Kılcanlar 1	POI09.04a	SU11.4	Modern hydraulic drills	None
Kılcanlar 2	POI09.04b	SU11.5	Modern hydraulic drills	None
Yeniköy 1	POI09.08a	SU11.6	Deep curved (probable Lydian-Late Lydian date)	Lydian sherd found within quarry. Near Lydian, Roman, and Late Medieval-Ottoman sites
Yeniköy 2	POI09.08b	SU11.7	Curved, but extant only on some remaining outcrops.	Near Lydian, Roman, and Late Medieval-Ottoman sites
Yeniköy 3	POI09.08c	SU11.8	Deep curved (probable Lydian-Late Lydian date)	Near Lydian, Roman, and Late Medieval-Ottoman sites
Yeniköy 4	POI09.08d	SU11.9	Channeling in some areas, date not known	Near Lydian, Roman, and Late Medieval-Ottoman sites
Yeniköy 5	POI09.08e	SU11.10	Few extant markings, date unclear	None
Yeniköy 6	POI09.08f	SU11.11	Modern and ancient tool marks. Shallow curved and linear pick marks (probable Roman through Late Roman/Medieval)	Near Lydian, Roman, and Late Medieval-Ottoman sites
Yeniköy 7	POI09.08g	SU11.12	Modern hydraulic drills	None

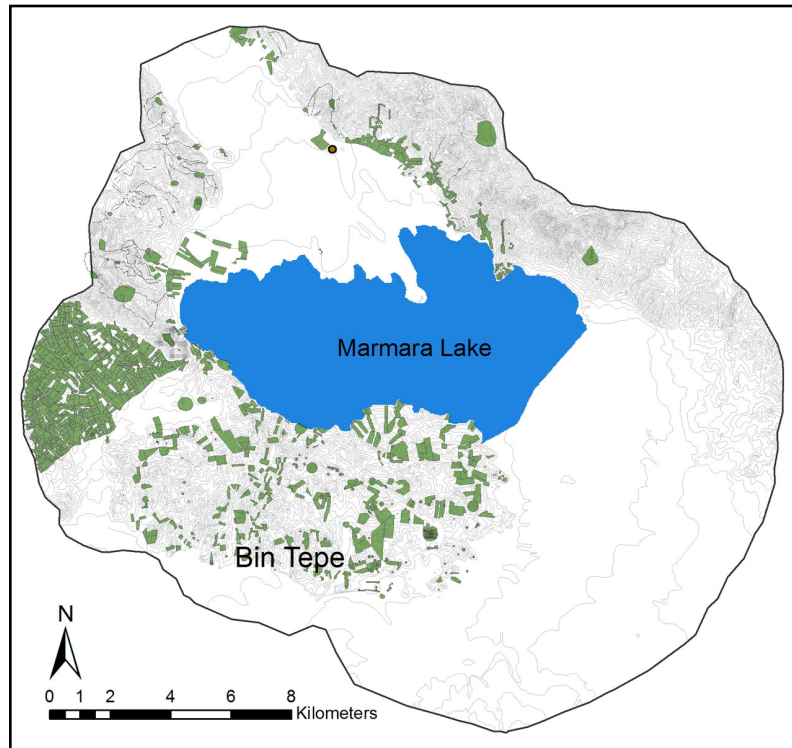


Figure 4.1: CLAS study area with topographic labels (image created by author, courtesy of the Central Lydia Archaeological Survey).

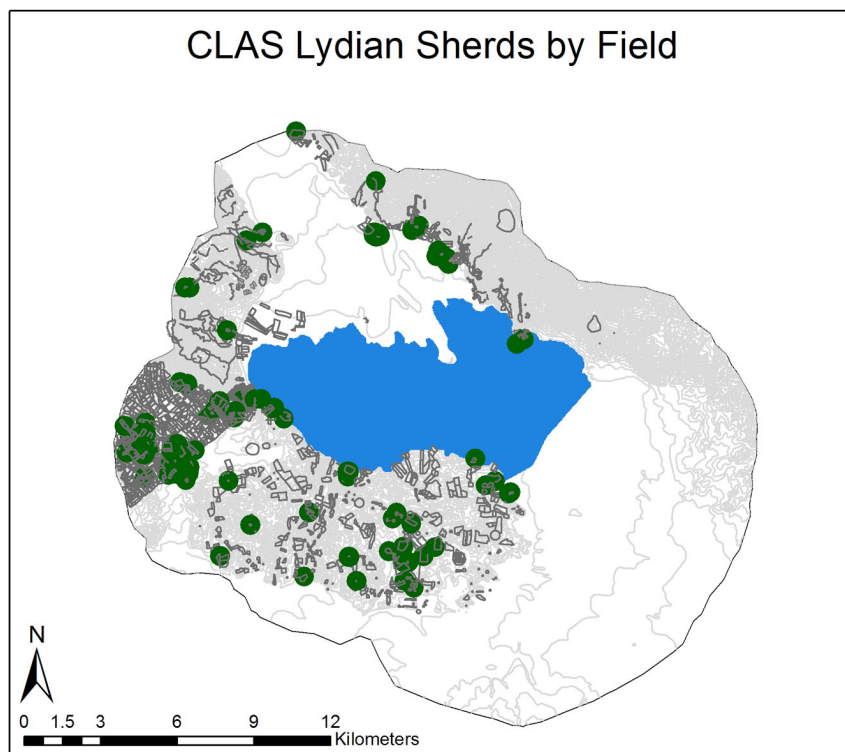


Figure 4.2: Location of fields yielding Lydian ceramics, 2005-2010, based on preliminary dating (image created by author, courtesy of the Central Lydia Archaeological Survey).

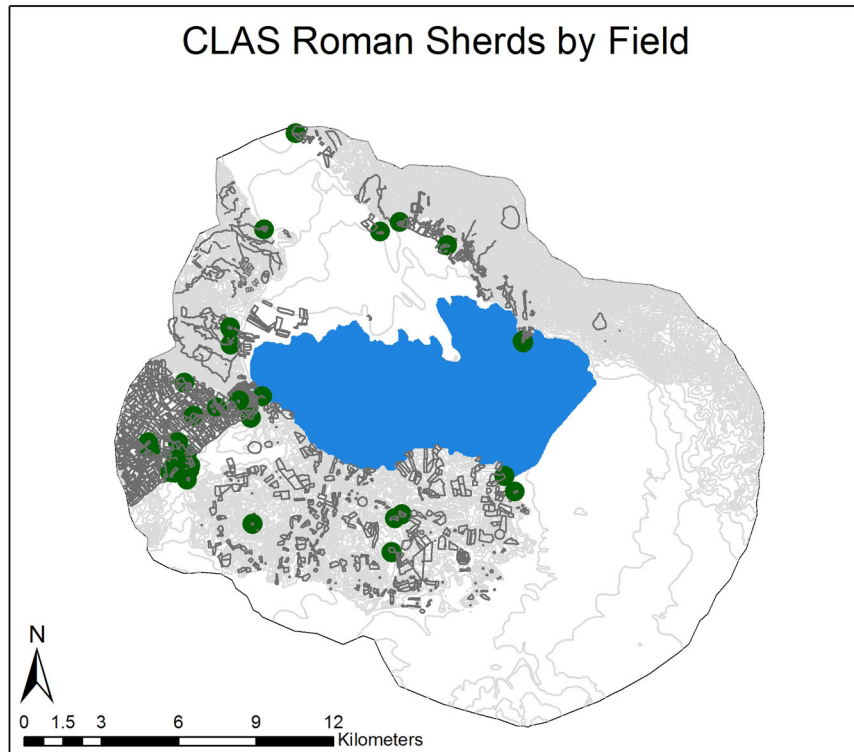


Figure 4.3: Location of fields yielding Roman ceramics, 2005-2010, based on preliminary dating (image created by author, courtesy of the Central Lydia Archaeological Survey).

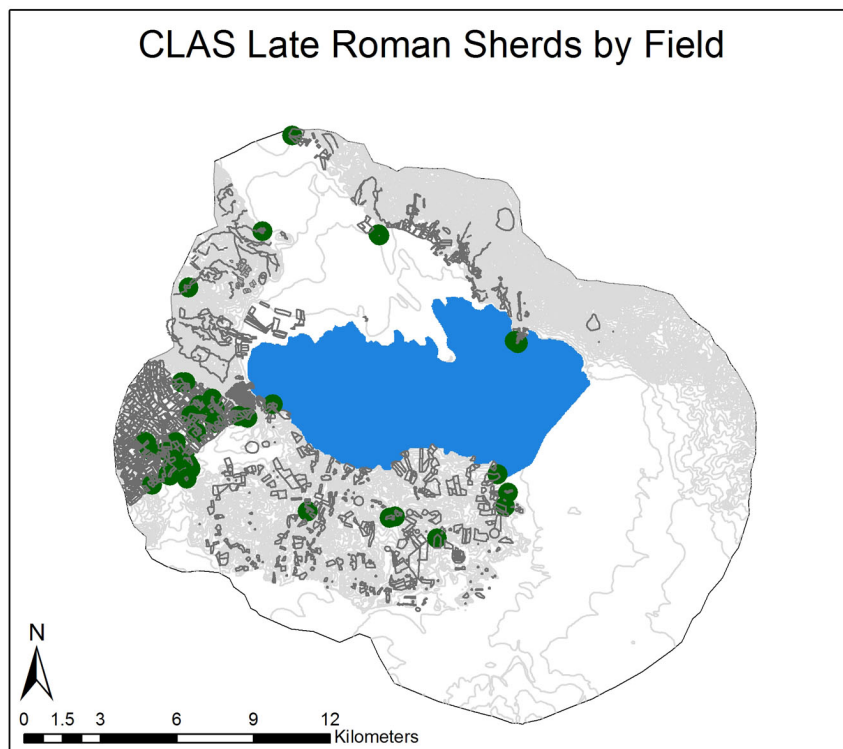


Figure 4.4: Location of fields yielding Late Roman ceramics, 2005-2010, based on preliminary dating (image created by author, courtesy of the Central Lydia Archaeological Survey).

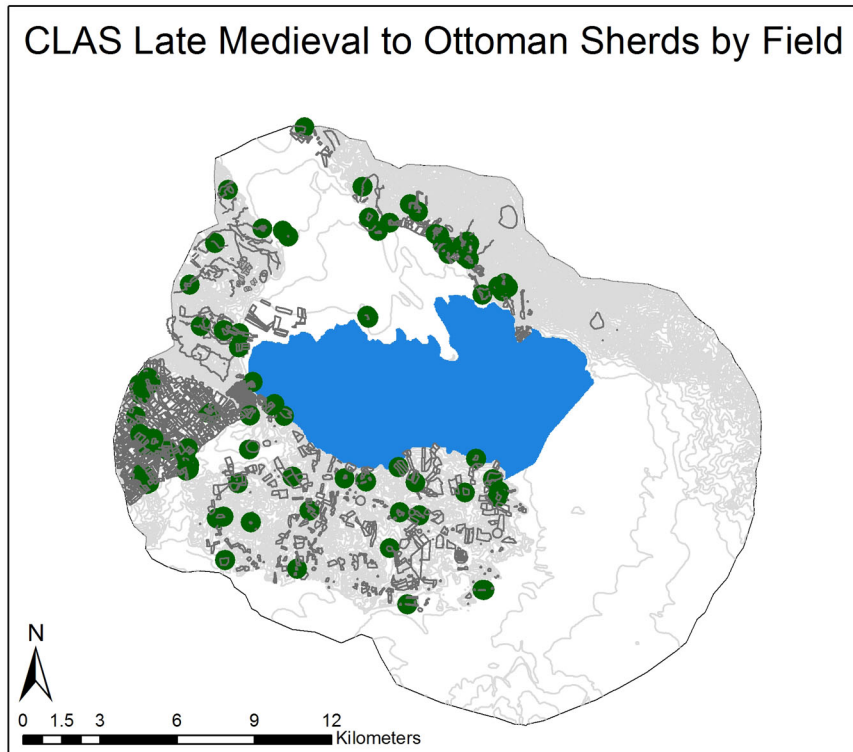


Figure 4.5: Location of fields yielding Late Medieval to Ottoman ceramics, 2005-2010, based on preliminary dating (image created by author, courtesy of the Central Lydia Archaeological Survey).

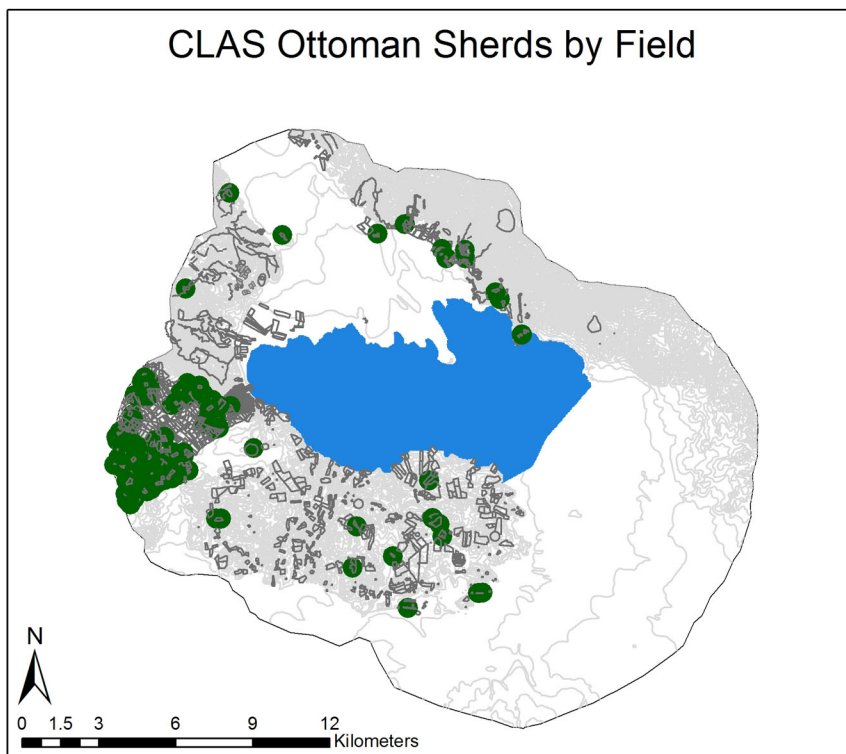


Figure 4.6: Location of fields yielding Ottoman ceramics, 2005-2010, based on preliminary dating (image created by author, courtesy of the Central Lydia Archaeological Survey).

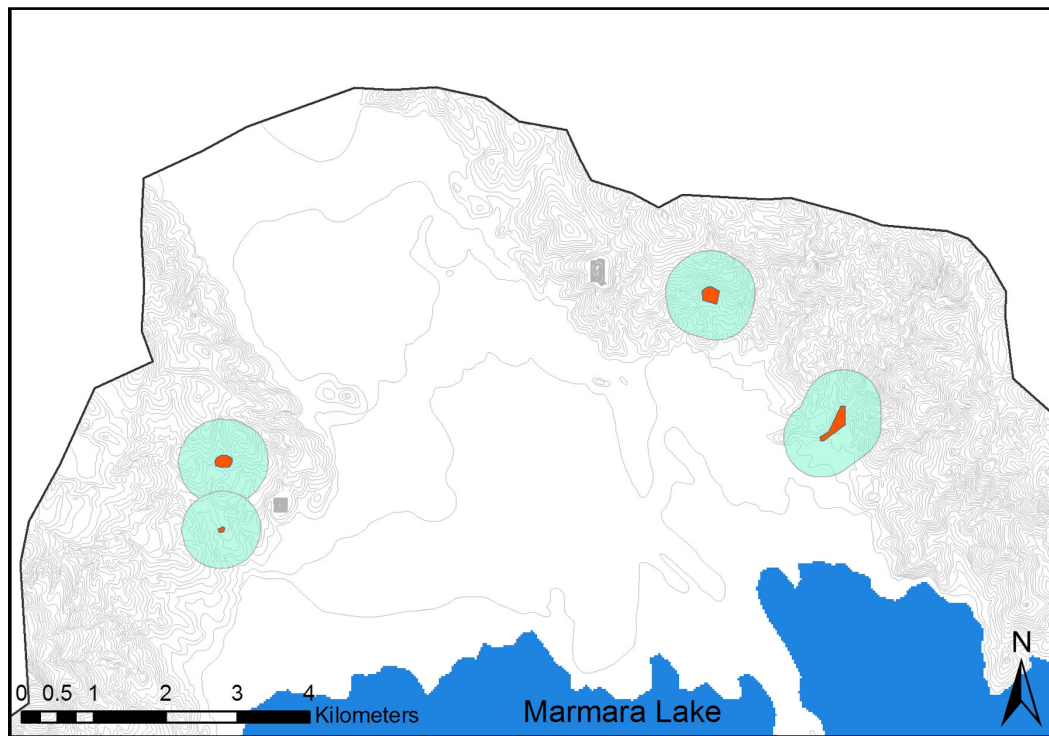


Figure 4.7: CLAS boundaries with quarry locations present and surrounded by 500m buffer (image created by author, courtesy of the Central Lydia Archaeological Survey).



Figure 4.8: POI06 quarries (SU11.2 and SU11.3), near Haciveliler, with 5m x 5m grid (image created by author, courtesy of the Central Lydia Archaeological Survey).

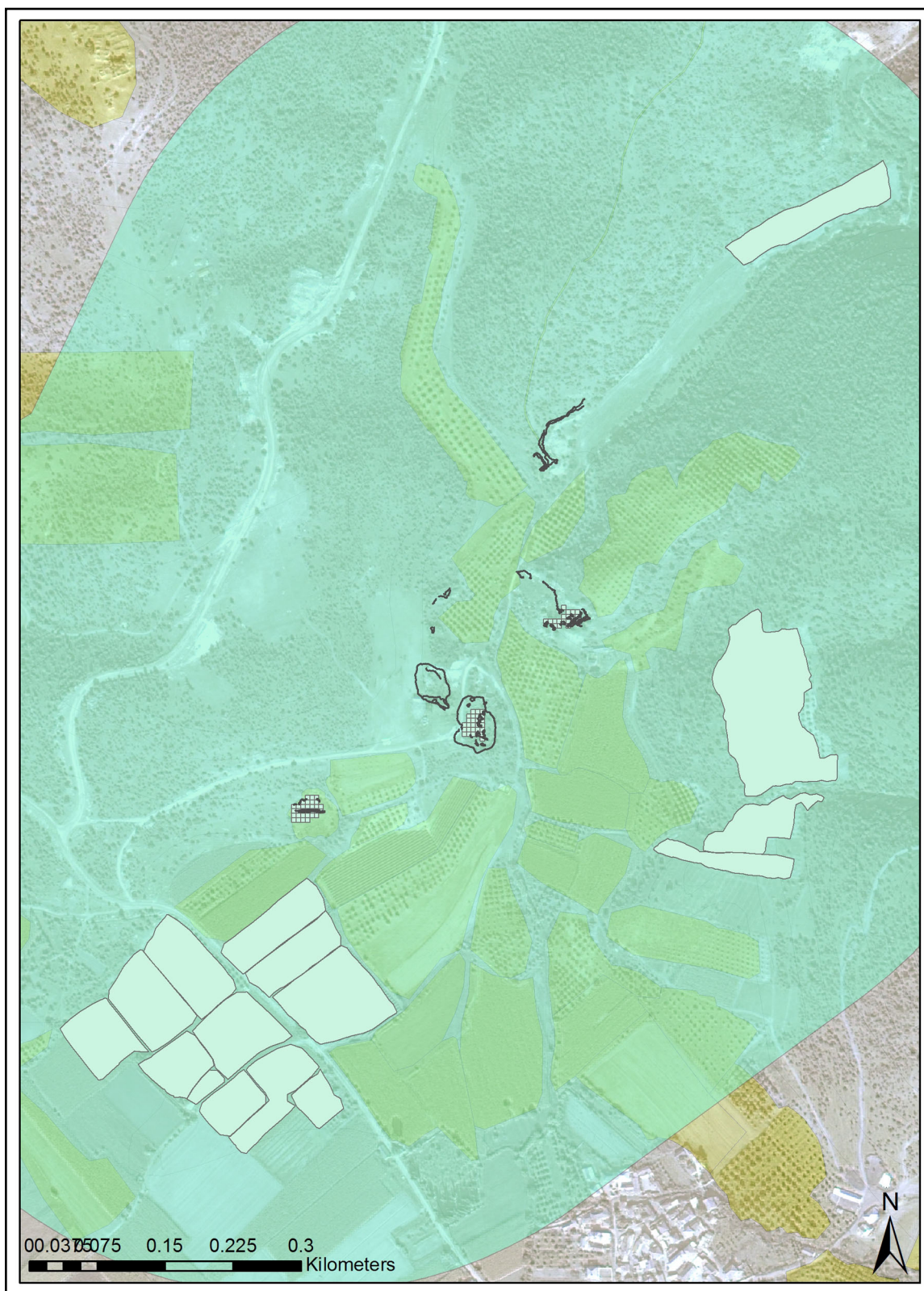


Figure 4.9: POI09.08 quarries (SU11.6-SU11.12), near Yeniköy, with 5m x 5m grid (image created by author, courtesy of the Central Lydia Archaeological Survey).



Figure 4.10: Haciveliler 2 (photograph by author, courtesy of the Central Lydia Archaeological Survey).



Figure 4.11: Haciveliler 1 (photograph by author, courtesy of the Central Lydia Archaeological Survey).



Figure 4.12: Kilcanlar 1 (photograph by author, courtesy of the Central Lydia Archaeological Survey).



Figure 4.13: Kilcanlar 2 (photograph by author, courtesy of the Central Lydia Archaeological Survey).



Figure 4.14: Yeniköy 1 (photograph by author, courtesy of the Central Lydia Archaeological Survey).



Figure 4.15: Close up of extensively cut face in Yeniköy 1 (photograph by author, courtesy of the Central Lydia Archaeological Survey).



Figure 4.16: Quarry Yeniköy 2 on left of road; Yeniköy 3 on right of road (photograph by author, courtesy of the Central Lydia Archaeological Survey).



Figure 4.17: Yeniköy 3 (photograph by author, courtesy of the Central Lydia Archaeological Survey).



Figure 4.18: Yeniköy 4 (photograph by author, courtesy of the Central Lydia Archaeological Survey).



Figure 4.19: Yeniköy 5 (photograph by author, courtesy of the Central Lydia Archaeological Survey).



Figure 4.20: Yeniköy 6 (photograph by author, courtesy of the Central Lydia Archaeological Survey).



Figure 4.21: Yeniköy 7 (photograph by author, courtesy of the Central Lydia Archaeological Survey).

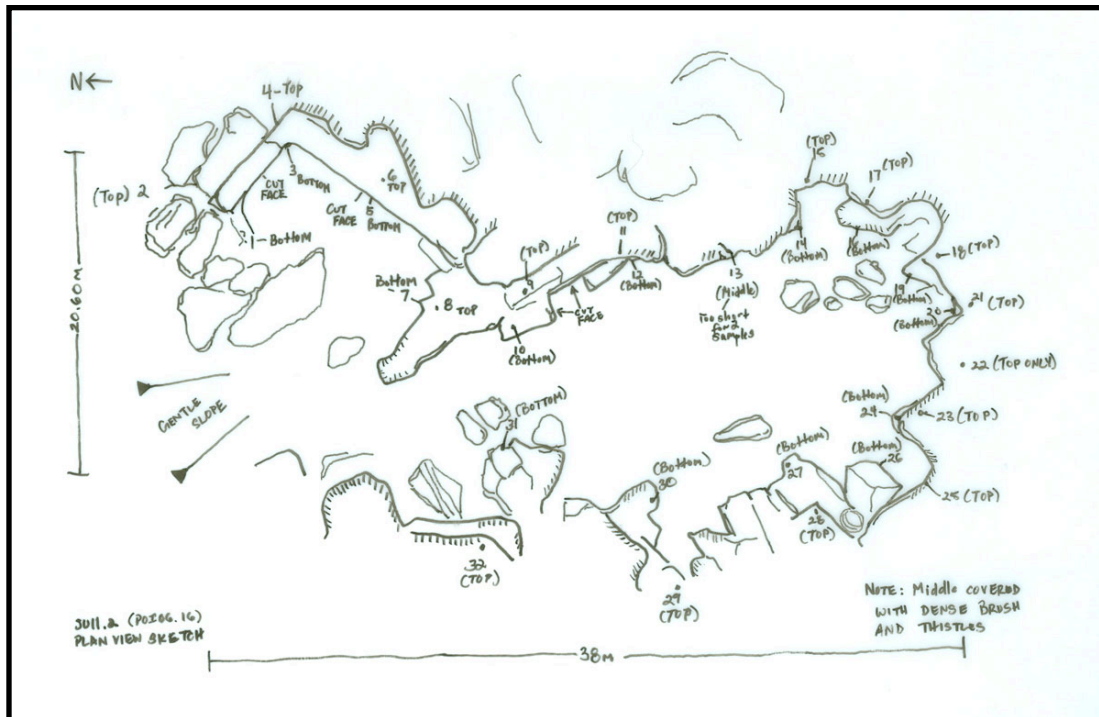


Figure 4.22: Sketch of Haciveliler 2 with location of samples (drawing by author, courtesy of the Central Lydia Archaeological Survey).

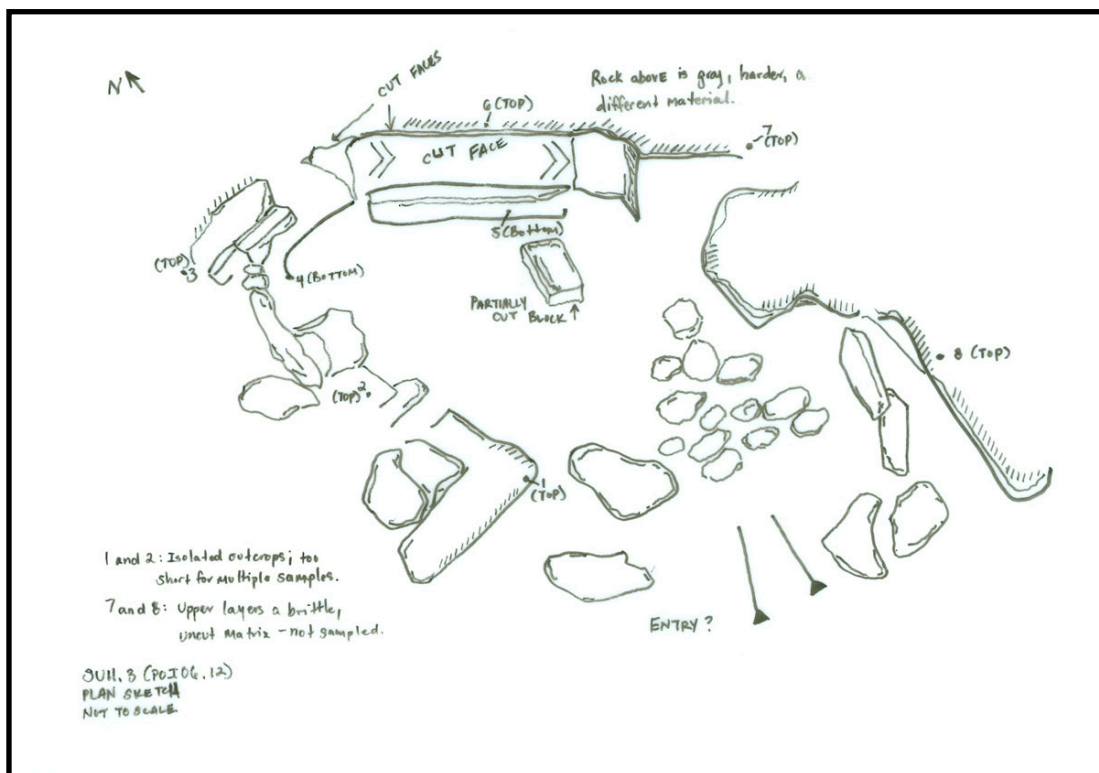


Figure 4.23: Sketch of Haciveliler 1 with location of samples (drawing by author, courtesy of the Central Lydia Archaeological Survey).

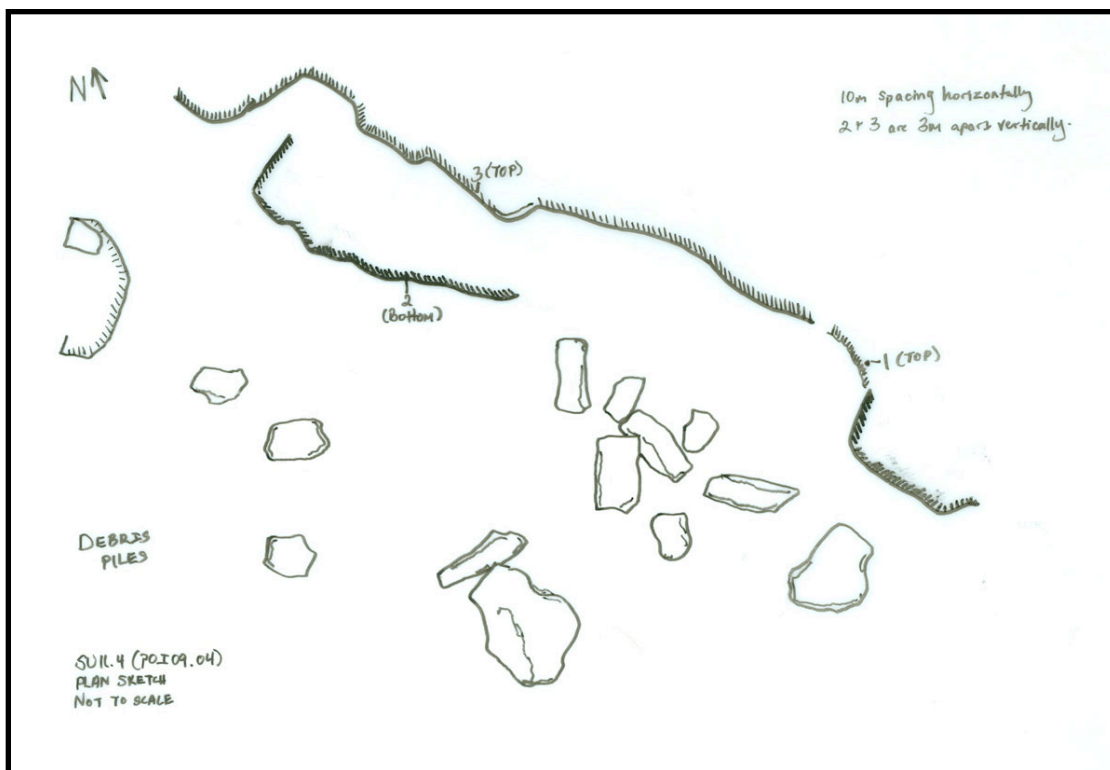


Figure 4.24: Sketch of Kilcanlar 1 with location of samples (drawing by author, courtesy of the Central Lydia Archaeological Survey).

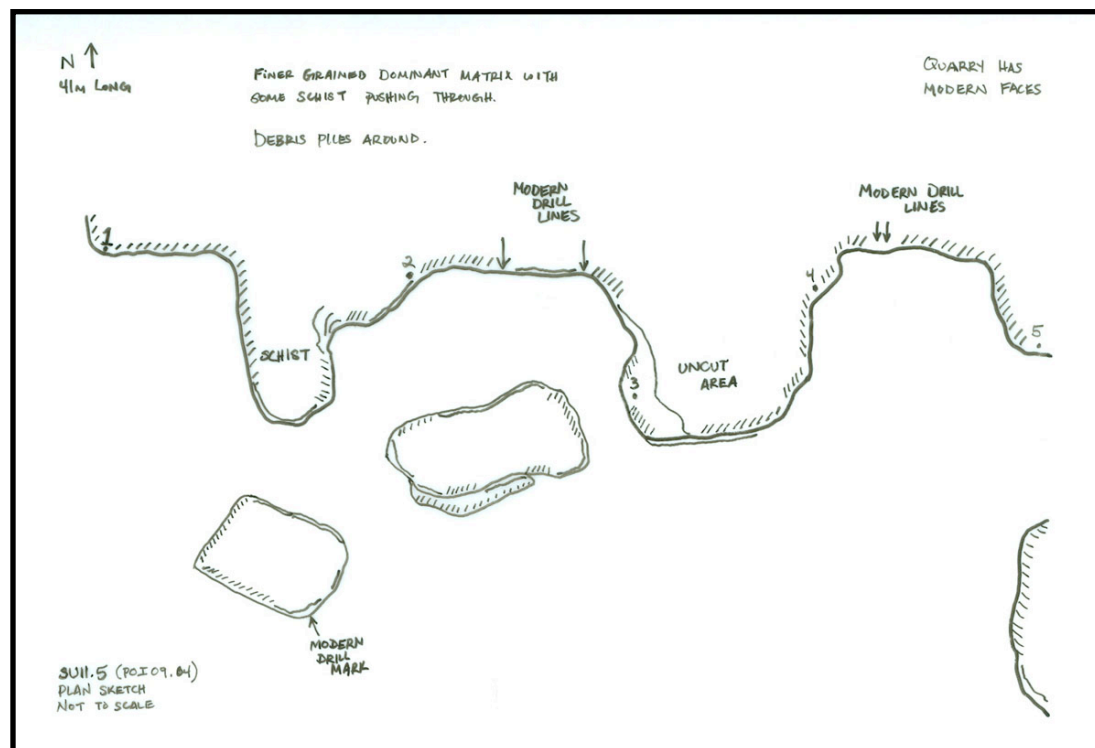


Figure 4.25: Sketch of Kilcanlar 2 with location of samples (drawing by author, courtesy of the Central Lydia Archaeological Survey).

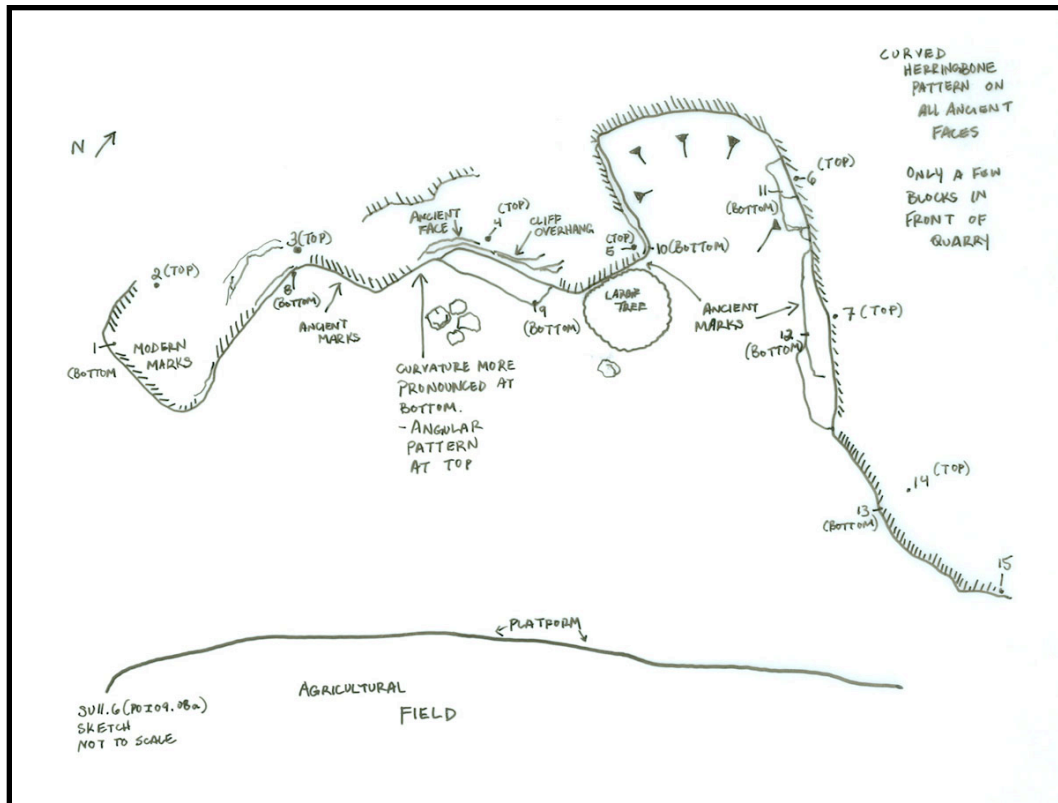


Figure 4.26: Sketch of Yeniköy 1 with location of samples (drawing by author, courtesy of the Central Lydia Archaeological Survey).

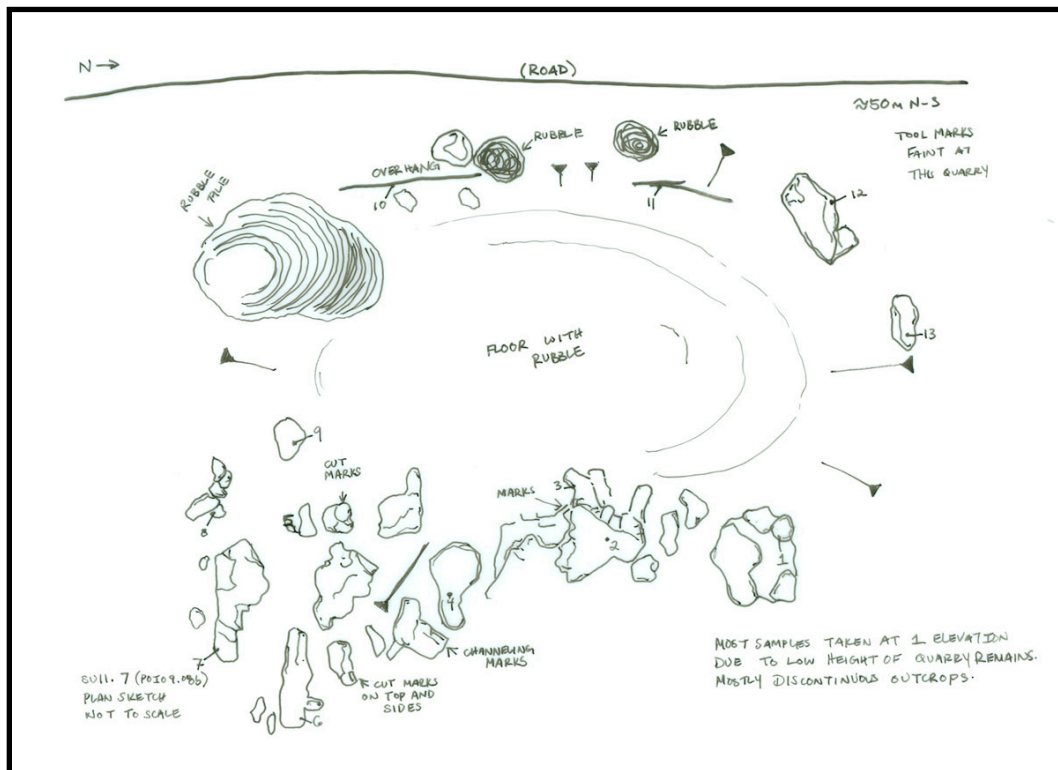


Figure 4.27: Sketch of Yeniköy 2 with location of samples (drawing by author, courtesy of the Central Lydia Archaeological Survey).

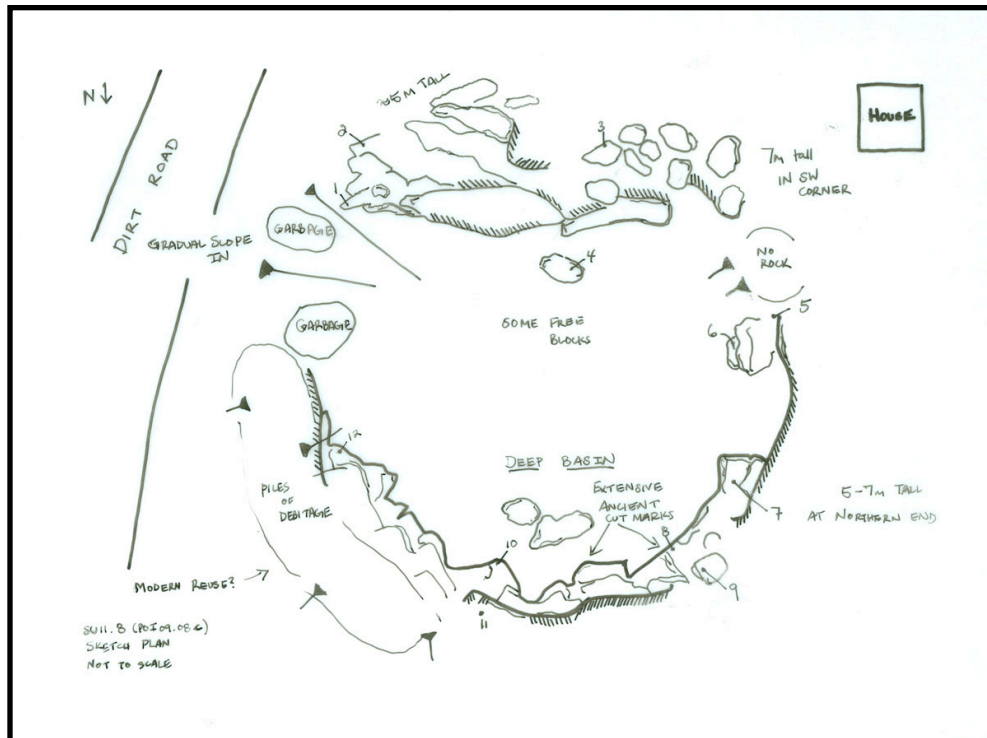


Figure 4.28: Sketch of Yeniköy 3 with location of samples (drawing by author, courtesy of the Central Lydia Archaeological Survey).

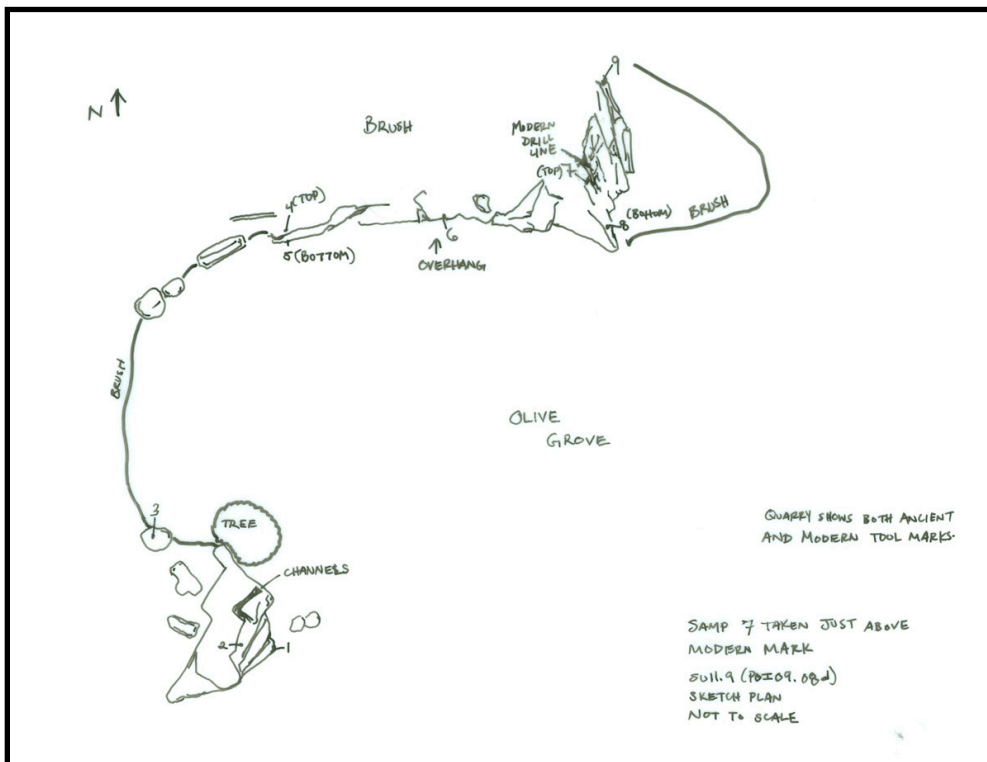


Figure 4.29: Sketch of Yeniköy 4 with location of samples (drawing by author, courtesy of the Central Lydia Archaeological Survey).

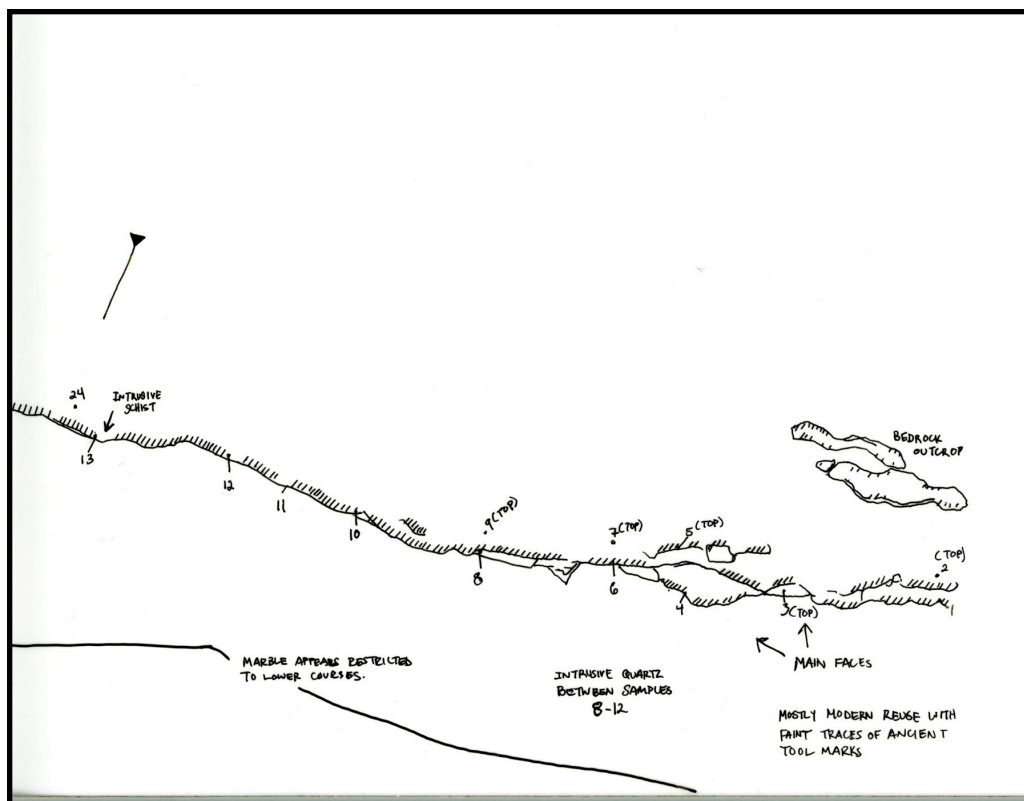


Figure 4.30: Sketch of northern half of Yeniköy 5 with location of samples (drawing by author, courtesy of the Central Lydia Archaeological Survey).

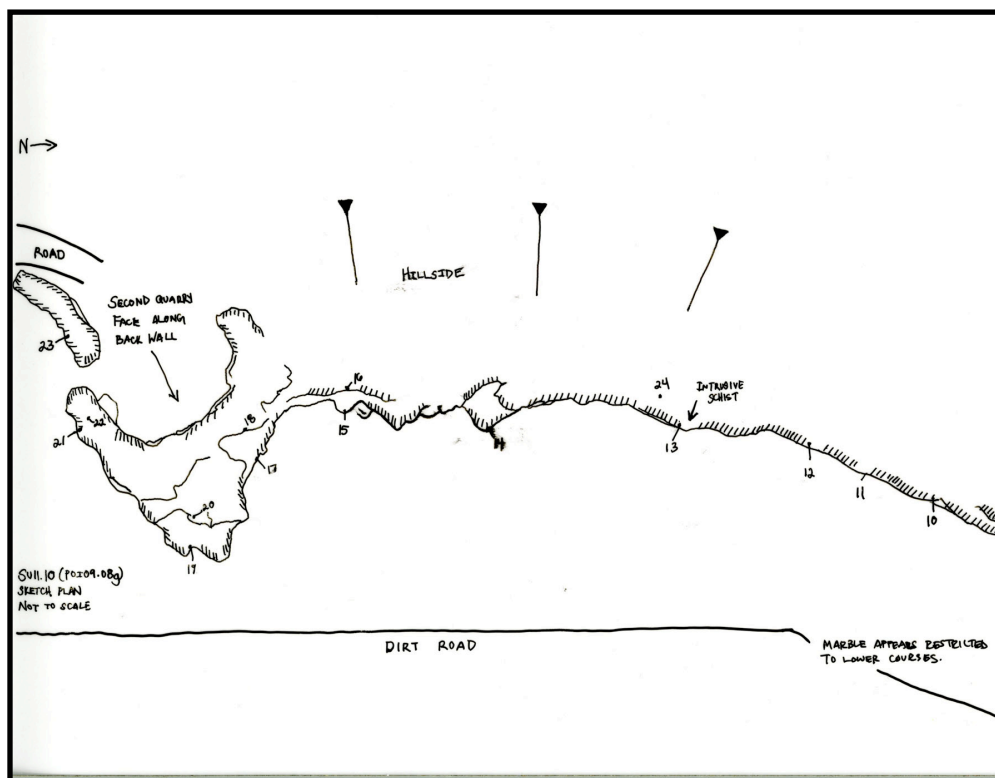


Figure 4.31: Sketch of southern half of Yeniköy 5 with location of samples (drawing by author, courtesy of the Central Lydia Archaeological Survey).

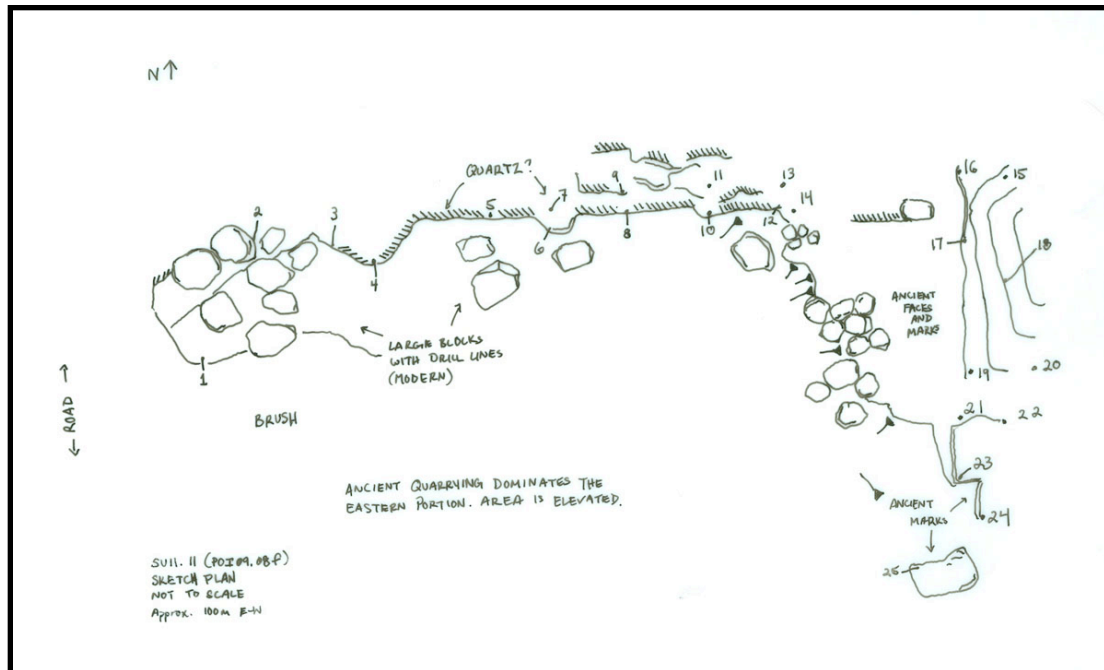


Figure 4.32: Sketch of Yeniköy 6 with location of samples (drawing by author, courtesy of the Central Lydia Archaeological Survey).

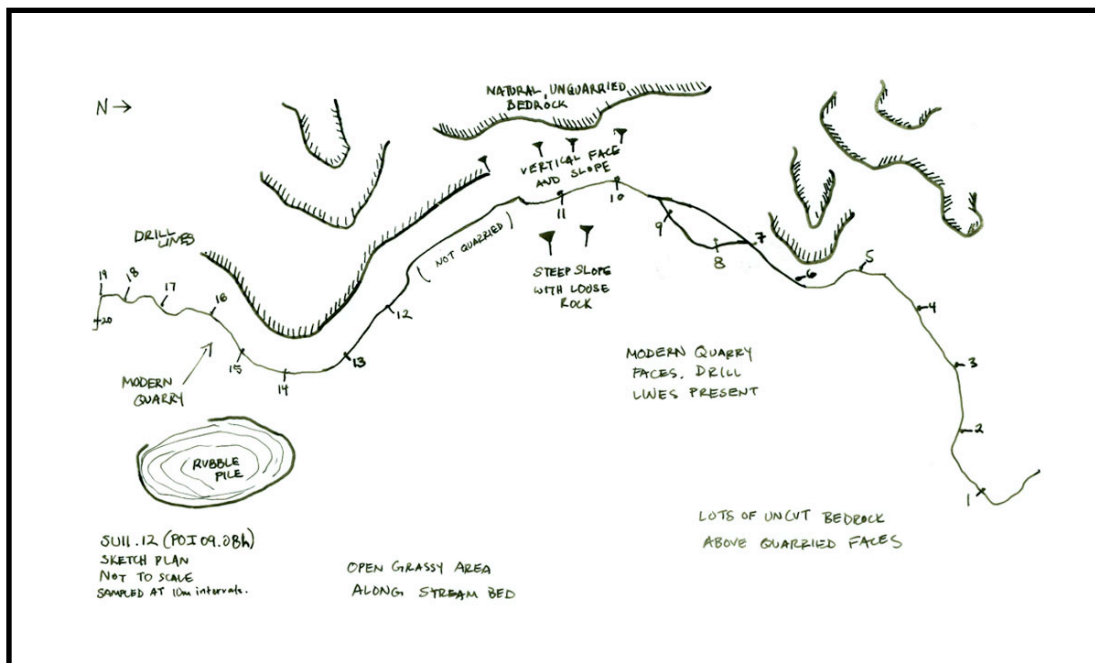


Figure 4.33: Sketch of Yeniköy 7 with location of samples (drawing by author, courtesy of the Central Lydia Archaeological Survey).

Chapter 5

The Marmara Lake Basin Quarries: Survey and Sampling Results

Introduction

Having described the quarry survey methodology and its justification in the previous chapter, the current section deals with the results, as well as some preliminary observations about them. A broader discussion and interpretation of these results is reserved for chapter 6. The data collected through materials science and geochemical techniques result from tests run at Brown University by the author working in collaboration with lab specialists in the School of Engineering Department and the Department of Geological Sciences. Material from the survey was analyzed in the field at the end of the 2011 season, with visual presentation performed by the author at Brown University. Full data tables are available in the appendix, while the main text is limited to the presentation of results that have proven most useful in articulating a story about marble extraction, distribution and characterization.

Field Survey Results

*The 2011 Survey Program Results: The Intensive Survey*⁹³

In total, 39 fields were walked intensively with the 500m buffer of the eleven quarries that comprise this study (see figs. 4.9 and 4.10). No fields were walked around the Kılcanlar 1 and 2 due to their upland nature, and due to the partial survey that covered the area around them during the 2009 season. All fields around Hacíveliler 1 and 2 were walked, since the 2006 season was limited to extensive ridge-walking (Fig. 5.1). Fields around all Yeniköy quarries were included as needed: large portions of the agricultural area around these quarries were surveyed in 2009. The survey was completed in four days and the team consisted of one team leader and three fieldwalkers. A total of 119 diagnostic sherds were kept out of a total of 1400 counted sherds.

Numerous diagnostic sherds were initially kept but discarded due to limited available storage space in the Manisa Museum, where the project houses finds for future study. No non-diagnostic sherds were kept. Storage of finds for projects in Turkey must occur at museums in provincial capitals. These museums have official oversight of all projects that take place within the corresponding province. Most museums have limited storage capacities, with implications for collection and storage strategies. CLAS, for instance, has been allowed a total of eight crates for six years of survey.

The sherd distribution represented in figs. 4.1-4.7 demonstrates the general density of finds, while the densities as they relate to chronological designation. Generally speaking, terrain is a major determining factor for the location of sherds. The more

⁹³ See Table 5.1 for the relevant dates in the CLAS chronology.

mountainous terrain north in the western extremes of the survey around the 2006 quarries yielded only a few modern sherds, likely an indication of increased agricultural activity in the highlands during the Ottoman and Turkish periods, and not representative of permanent settlements. Only the Late Lydian and Roman periods are well-represented near POI06.12 and POI06.16, with a high concentration of finds in one particular location.

The Late Lydian-Roman material is a mix of finewares and coarsewares (Table 5.1) that covers an area of 300m x 150m, with greatest sherd density at the top of the ridge. The site rolls into ravines to the north and south. The finewares include slipped and glazed plates and bowls, an unguentarium, and several larger closed vessels. Some of the shapes correspond to the vessel descriptions provided by Rautman for Roman period pottery at Sardis, though Roosevelt and Luke (forthcoming c) note that the fabric is local. The coarsewares are all from larger, closed vessels for either cooking or storage. Tile counts were also high for this site, suggesting the presence of a farmstead or hamlet.

In contrast to the abundance of Late Lydian and, principally, 1st-2nd century Roman material around the 2006 quarries is the very large quantity of Late Medieval and Ottoman sherds located near the 2009 quarries outside the modern village of Yeniköy. The total sherd density counts for these fields are the highest for any fields surveyed in this area during both the 2009 and 2011 seasons, with only these two periods represented in high quantities. Some early-late Roman coarsewares were found here, in the form of cups and fragments from large storage vessels (including handles and jug fragments), which is consistent with the evidence from 2009 for Roman material concentrated at one site in particular. Nevertheless, the sheer density of finds from the Late Medieval to

Ottoman periods suggest that settlement activity during the 15th-19th centuries was more intensive in the hills behind modern Yeniköy than during other periods, whereas the Roman material comes primarily from fields closer to the modern and ancient lakeshore. The full range of material culture found is shown in Table 5.2.

The survey also yielded two new possible quarries. These are very small, and appear to have been used either as test sources for new material or for specific needs, such as field-wall construction, rather than as concentrated long-term resource sites. Full documentation of these quarries will be carried out in 2012. No other new features were found during the survey outside the quarry locations themselves.

The 2011 Survey Program Results: Quarry Survey

114 grid squares were surveyed within five of the eleven quarries (Figs. 5.3-5.7). One quarry, which is currently cultivated for olives, was surveyed at 20m spacing during the 2009 season, and the five un-surveyed quarries were too densely overgrown to be included in the season's survey program, with ground visibility effectively 0%. A total of five diagnostic sherds were collected and kept during the hyper-intensive quarry survey that consisted of one team leader and three surveyors. Prior to survey, the grid was cleared of large brush using axes and a gas-powered weed wacker. The clearing and surveying process took four days to complete. During the completion of the hyper-intensive survey, one team member also completed the topographic mapping program, (see below).

Most of the material recorded during surface collection of the quarries was dated to the modern period in the field. These finds were coarsely made cooking wares or jugs

of local fabric, and likely represent detritus from workers in the nearby agricultural fields. The five diagnostic sherds that were collected, however, are ancient in period of production. Two sherds have been dated to the Late Lydian period, while the remaining three sherds date to the Roman period: one likely dating to the early Roman period, the other two dating to the Late Roman period.⁹⁴ All of the datable diagnostic sherds come from the quarry district north of the lake (Yeniköy), indicating activity during the Lydian and Roman periods. The Lydian materials are a probable jug and a probable table amphora or hydria (Roosevelt and Luke forthcoming c; see also Greenewalt 2010). The Roman finds include a cooking vessel, a Late Roman C 3 (LRC 3) plate and a sherd too heavily abraded to identify closely; the identification of the latter as Roman is due to its fabric, which relates to other Roman period finds from the survey and from Sardis (Roosevelt and Luke forthcoming c; see Rautman n.d. for a discussion of Late Roman C vessels at Sardis). This is the only sherd collected from within the quarries that can be securely connected to vessels also found in the city center itself.

The survey also attempted to document worked stone and debris fields. Each quarry showed evidence for chipped stone debris, but without clear signs of tool marks.⁹⁵ Only two quarries yielded blocks of worked stone. Haciveliler 1 contained one block of cut stone in the middle of its basin. This block measured 92cm along its length and 45cm along its shorter axes. Five marks from the wedging process were recorded along two sides as well, indicating that the block was partially reduced in the quarry following its extraction, but not only to a rough form. The only other quarry to yield definitive blocks

⁹⁴ Dating of these sherds was conducted by Andrea Berlin of Boston University.

⁹⁵ The tool marks on the quarry surfaces will be discussed in the section on mapping and photorectification.

of worked stone is Yeniköy 3. These blocks, however, are less uniform in shape and have suffered considerably more damage, likely due to modern activity in the region.

Occasional wedge marks are the only indications of the extractive processes on three blocks of stone that sit deep in the overgrowth.⁹⁶

As mentioned, the debris fields of chipped stone, although extensive in some quarries, were nondescript in providing evidence for particular tool use. They can, however, be contrasted with quarries yielding definite modern activity, using a combination of dynamic and hydraulic drills. Debris scatters in modern quarries cover dramatically larger areas of their surface, an observation that is consistent with the suggestion that ancient quarrying was more efficient (in terms of how much stone is wasted) than modern practices. The debris fields for modern quarries reveal a higher scatter to quarry size ratio, and the proximity to currently used agricultural fields appears to have a negative correlation to the size of debris fields as well. Quarries Yeniköy 1 and Yeniköy 4 have agricultural fields within the limits of their vertical basins, and reveal only modest debris scatters. This is especially surprising for Yeniköy 1, which retains the most evidence for ancient stone-working activity on its vertical surfaces. In general, the debris from ancient quarrying suggests efforts to remove stone chips from the central extraction site during the stonecutting process, deliberately removing the debitage to external locations. Such regard for spatial differentiation in modern quarrying is entirely lacking, as most reduction practices are performed off-site. The modern quarries exhibit

⁹⁶ This quarry was not surveyed intensively due to the complete overgrowth coverage within its basin. Late winter and spring of 2011 were particularly rainy in western Turkey creating substantially taller and thicker ground coverage. These blocks were documented outside of the normal survey program. Further study is needed because of the lack of study available as a result of thick and wet ground coverage.

very large blocks of extracted marble with tell-tale hydraulic drill marks, resulting in angular, yet roughly hewn, blocks measuring at times more than nearly 2m tall.

One of the main indicators that quarrying in the Roman period was minimal in scale in these quarries is the lack of large debris scatters. Around the quarries at Aphrodisias and Sardis, for example, are large mounds of chipped stone debris. Such scatters of quarry detritus can become so large as to obscure the full extent of a vertical wall, making approximations or calculations of the volume of marble cut difficult to ascertain (Vanhove 1996; Russell 2009a). Their absence in the Marmara Lake Basin in most of the observable quarries is suggestive of limited-scale quarrying and, in all probability, of reduction processes occurring outside the quarry in most instance.

Overall, the total coverage quarry survey did not reveal more than general patterning for the spatial layout of sites, and most of the changes in spatial layout are attributable to dramatic changes in technology (such as that between the modern and the ancient tools used for extraction), revealing little about subtle changes in spatial patterning between the various chronological periods of antiquity. Such subtle differentiations are only visible when the quarry survey data are combined with other forms of analysis, including the mapping and documentation of tool marks on the rock surfaces.

Quarry Technology: Mapping and Documentation Program

The documentation of tool marks revealed two distinctive quarrying practices employed throughout the Marmara Lake Basin in the pre-modern periods (i.e., excluding

modern quarrying with dynamite and hydraulic drills as a clear third category).⁹⁷ These patterns are indicative of tool technologies that are typically attributed to the Hellenistic period introduction of a heavier iron pickaxe, that resulted in a curving and overlapping pattern of cut marks (Waelkens *et al.* 1989). Although the accuracy of such dating is challenged below, the first category can be characterized by large sweeping curves, while the second category is characterized by shorter, more angular cuts in a true herringbone pattern. The curved pattern, however, reveals some subtle variation that might correspond to Lydian (a deeper set of curves) and Roman (a shallower set of curves) quarrying, respectively. Category one reveals a fair amount about the extraction process based on the tool patterning. Although the tool marks appear to undercut each other in various places, the vertical height of removed blocks of stone is remarkably consistent within the Yeniköy quarries. These blocks measure approximately 45cm (with 43-48cm marking the spread) in vertical height. The patterning, although changing in direction and angle on the wall, indicates very clearly the movement of the laborer within the quarry. As exhibited most clearly in Fig. 5.10 (Yeniköy 1 image), work began in one portion of the quarry, starting with short cuts at the corners of the vertical quarry surface, expanding in depth and breadth as the block was cut downwards. Once the desired depth of cutting was reached (in this case 45cm), the worker would be required to physically turn within the channel he created to cut in the reverse direction. Three clear directions are visible, with the lower most, usually in the middle of a cut block, indicating a more downward, deeper cutting trajectory, with the two sides cut more horizontally according to the block

⁹⁷ Fig. 5.8, showing how vertical mapping completed.

outlines. Notably, the block size represented in Yeniköy 5 is smaller than those found elsewhere in the quarry district northwest of Yeniköy.

The second category of tool-mark is only represented in one quarry – Haciveliler 2 – and there only in a small portion of the quarry surface (Fig. 5.9). These marks are indicative of a later reuse of the stone source northwest of the lake, probably dating to the Ottoman period. The observed tool marks lie in an almost stratigraphic pattern, wherein the sharper angles are found ‘above’ the curving pick marks, clearly indicating that this pattern came later in time. Coupled with the complete dearth of evidence for the Late Roman and Late Antique periods generally, and the ceramic evidence for Late Medieval to Ottoman habitation in the region, a strong argument can be made for a temporal break in quarrying following the Roman period. The two quarries in this region differ in the type of tool marks generally, with smaller block sizes cut with less consistency within the quarry. The organization of practices near Yeniköy therefore seems more structured than the practices employed at those quarries located in 2006.

Tool-marks that date to the Medieval period and later elsewhere in the Mediterranean support the claim for a shift in tool use and possibly even tool type. Medieval French quarrying involved the partial shaping of the desired object while still in the quarry wall, even for rounded forms such as column drums (Bessac 1996). Although not thoroughly studied, Ottoman quarries tend to reveal more angular tool patterning. Haciveliler 2, therefore, appears to be a Classical Roman and Ottoman quarry. Smaller, more varied patterns of stone extraction, as seen in the Medieval quarries in the western Mediterranean, span the Late Roman to Medieval periods (corresponding to the Byzantine period in the Marmara Lake Basin). Such patterns of extraction were noted in

some contexts in the Yeniköy 6 quarry, with a pattern of stippled markings that are similar to those seen in the limestone and marble quarries outside of Germia (Niewöhner 2010; Niewöhner and Prochaska 2009).

In general, quarrying in the northern portion of the Marmara Lake Basin was at its peak in the Lydian period, during which time the Yeniköy quarries were opened and exploited intensively. Quarrying in all subsequent periods was at a reduced scale compared to the Lydian period. Evidence for Achaemenid quarrying and Hellenistic quarrying is not strong, though possible connections between rural sites from these periods and the quarries will be explored in the next chapter. Roman-period quarrying, with clear crossovers between sites and quarries, tool marks that appear consistent with Roman quarrying elsewhere, and with ceramic evidence from within the quarries, did occur in the lake basin, most prominently at Hacıveliler 1, Hacıveliler 2, and likely at the Yeniköy quarries to some degree. Medieval and Ottoman quarrying might be presented in Yeniköy 6, based on changes in tool use and tool mark patterning. The region has also been quarried in the modern period for dams, mosques and other small construction projects.

Quarry Planning: DEM and Hillshade Production

The final mapping component of the quarry study involved the production of high resolution DEMs (Digital Elevation Models) and hillshades using the project's RTK GPS and ArcMap. Five of the eleven quarries were recorded in this fashion. The procedure in the field involved establishing a 1m x 2m grid in the RTK GPS unit along the cardinal directions, with one team member walking the visible extent of the interior extraction

space and over the immediate vicinity of the quarry in an effort to capture the extent of chipped stone. The team member walked at 50cm intervals, creating a detailed DEM which was then converted into a series of hillshades using ArcMap. These DEMs and hillshades have X, Y, and Z values. The method was selected as a means to document any features in the site topography, such as roads and causeways that can be difficult to determine visually given the overgrowth within and around the sites, facilitating a discussion of how quarries were integrated with the surrounding landscape.

One such causeway is easily visible in Fig. 5.11, which shows a clear rise in the quarry surface leading out of the site between two cut marble walls (see also Fig. 5.12 and 5.14). The causeway or slip-road in this particular quarry led downhill towards a modern dirt road that corresponds to the natural terrain: the road follows a flat portion of land to the north of the steep valley that runs through the mountainous terrain that otherwise characterizes this portion of the survey region. This quarry is also 150-200m west of the large Late Lydian to 1st-2nd century CE Roman site documented during the intensive survey, through which the road runs, eventually emerging at the highway on the lake's margin.

Quarries Yeniköy 1 (Fig. 5.13) and Yeniköy 6 (Fig. 5.15) also yielded information pertaining to the progression of worked areas. Clearly defined, and worked, platforms were present in front of the major ancient cut marble faces, suggesting extensive, coordinated, and systematic extraction at these quarries. The DEM created for Yeniköy 6 also indicates that modern extraction extended well below the ancient platforms, with the ability to extract deeper into the marble bed afforded by the drill and dynamite.

Volumetric calculations were also made possible by the creation of detailed DEMs for these five quarries, displayed in table 5.3.⁹⁸ The base number of estimated volume, however, cannot represent the total amount of usable stone. Long (personal communication) suggests that perhaps 40% of the total volume of a quarry would have been usable for construction or other projects, while Attanasio *et al.* (2009) reduce the amount of usable stone to around 30% of total calculated volume. This has entirely to do with the methods of extraction. Until the recent implementation of diamond-tipped saws that yield only minimal debris, extraction from all periods of time resulted in chipped stone debris that had to be dealt with. In some instances, such as the Karystian quarries on Euboea, great effort was expended to relocate debris scatters away from the quarry itself, lest the abundant debitage inhibit the extractive processes (Vanhove 1996). The method of channeling employed in many ancient quarries, and certainly in those of the Marmara Lake Basin, out of necessity created a gap between extracted blocks of stone to facilitate movement by the quarry-worker (see Bessac 1996 for drawings of the typical extraction process). The result of this is a reduction by more than half of the total volume calculated for each quarry by an estimated 70%.

Although detailed analysis of total volumes of marble used in Lydian and Roman Sardis and the Marmara Lake Basin are not available at this time, some preliminary conclusions can be drawn about both the capacity for these quarries to provide stone for certain structures and for the kinds of labor practices that must be associated with them. The quarries that are best associated with Lydian masonry (those in the Yeniköy cluster)

⁹⁸ Volume was calculated using the 3D Spatial Analyst toolbox in ArcGIS. The raster dataset created by the DEM functioned as a detailed base from which the peak volume was calculated according to the maximum height of the quarry itself. Because of the undulating nature of terrain around each quarry, this method is inherently imprecise to a certain degree. No quarry, however, varied in height by more than a single meter, making such calculations reasonably reliable.

have yielded a total potential volume of extracted stone that far surpasses that of the tumulus of Alyattes and the sampled architectural fragments from within Sardis, making local sources for stone feasible. Preliminary estimates, however, suggest that even 30% of the total volume calculated for the quarries in the Marmara Lake Basin were sufficient to provide a majority of material used in Sardis and this portion of central Lydia, although I strongly speculate that numerous other small quarries were in use during this period throughout Lydia. Calculations of the maximum and estimated volume of stone removed from the five quarries analyzed in this manner do also suggest that full-time labor was not required in the quarries.⁹⁹

Conclusions from the Quarry Survey

From the available settlement data, there are three primary periods of activity in the vicinity of the quarries: Late Lydian through early Roman and Late Medieval to Ottoman, with, in the cases of two of the three quarry clusters, large settlements in close proximity to the resource sites. The evidence from the intensive survey within the quarries suggests that Late Lydian and Roman material, in addition to an overall abundance of modern sherds (very late Ottoman to early Turkish periods) are present as well. These periods of activity correlate to the evidence from the surfaces of the quarry walls, with extant tool marks indicating late 1st millennium BCE to early 1st millennium CE tool use, and Ottoman tool use as well. It is also possible to describe differences in the manner of extraction, changing from more systematic block production in the area around Yeniköy during the Late Lydian – Early Roman periods (probably mostly Late

⁹⁹ See Abrams (1994) and Abrams and Bolland (1999) for discussions of energetics, particularly the expenditure of energy.

Lydian, as will be discussed in the following sections) and smaller-scale, less consistent tool use and extraction practices prevailing in the later periods.

Laboratory Analysis Results

Results: Stable Isotope Analysis

Figures 5.16 and 5.17 show the results from the stable isotope analysis displayed as a scatter plot.¹⁰⁰ The X axis records the percentage of variation in O^{18}/O^{16} from the VPDB standard, while the Y axis records the percentage of variation in C^{13}/C^{12} from the VPDB standard.¹⁰¹ In general, the individual quarries are not clearly differentiable based on oxygen and carbon isotope values alone, suggesting that there is some variation between the quarries, but much of this depends on the range of acceptable signatures, with some quarries being more tightly defined than others. The aggregate average range for the quarries falls in an overlapping location between 0 and 2 for carbon isotope values and between -7 and -4 for oxygen isotope values (Fig. 5.16). The field finds (cut architectural blocks of marble sampled at their find spots), however, tell a completely different story. These blocks fall far from the range established for the quarries. The samples taken from the looted tumulus T03.05 also exhibit a general variation away from the quarries, though this range does fit the rather large scatter of signatures for the grey

¹⁰⁰ Scatter plots are the typical form of visual display for stable isotope data. See Herz (1987).

¹⁰¹ The VPDB standard is from a single block of pure white marble from Carrara, Italy. Samples are pre-ground and distributed as a world-wide standard. This standard is, however, a relatively new replacement for the previous standard called PDB, which ran out. PDB was also from Carrara, but it is possible that some readings differ based on the standard against which they are compared. For this study, the analyses performed in the 1990s were still using the previous PDB standard, which was not available for the current study.

marble quarry Yeniköy 6. The tumulus, however, comprises both white and grey marble, which suggests that its range is not attributable to a single source. Finally, the finds from Asartepe, north of the lake, reveal an isotopic signature range more in line with the field finds than any of the sampled quarries. The significance of these results will be discussed in detail below, when a comparison of the 2011 results will be made to the 1990s results. Three samples from the site of Ahlatli Tepecik on the northern fringe of Bin Tepe match the isotopic signatures from the Yeniköy whitish-gray marble quarries as well.

Critically, the stable isotope analysis fills in a gap in the O and C signatures defined by the earlier study conducted by Tykot and Ramage (2002; see Fig. 5.17). Their study, which sampled from the quarries above Gölmarmara, the quarries at Mağara Deresi, the tumulus of Alyattes, and three architectural blocks at Sardis, revealed a noticeable difference in isotopic values for the two quarries, while the tumulus marble fell between these values. The values reported for the eleven quarries in the Marmara Lake Basin sampled in 2011 fill in this area between the two quarry zones. At considerably higher elevations, the two major quarries (Gölmarmara and Mağara Deresi) are products of geological processes that affected their precise locations differently than the geological zones in which the Marmara Lake Basin quarries sit. They are, in all likelihood, the result of an earlier metamorphic process.

Results: X-ray Fluorescence

As with stable isotope analysis, all samples were analyzed using XRF. In each case, the flattest, most uniform surface on the sample was chosen to minimize the variation in results based on differential surface texture. The results of this study are

generally as expected, though its utility in differentiating between quarry groups has been more successful than anticipated. Calcium (Ca) constitutes the single largest concentration of any element, with iodine (I) the only other element recorded at significant levels for each sample. Other trace elements do appear in some samples, which provide some clear areas of variation between the quarries and some of the finds. These results show that two distinct patterns emerge for the quarries, while the field finds and tumulus samples differ from the overall norm as well.

While the principal component test revealed the strength of five elements, Fig. 5.18 and 5.19 reveal the strength in variability between the different elements and how they correspond to the different quarries. In general, non white-gray marbles are differentiable from white-gray marble, and the two quarry zones of white-gray marble are somewhat distinct from each other.¹⁰² Quarries Kılcanlar 1 and 2 (both beige marble) and Yeniköy 7 (black marble) in particular are distinct from the other quarries in the quantities of iron (Fe), manganese (Mn) and strontium (Sr) present. Haciveliler 2, and to a slightly lesser extent Haciveliler 1, are also high in levels of strontium. Conversely, the tumulus samples exhibit an almost complete lack of nickel, which was detected at trace levels in the vast majority of other samples. The tumulus finds are also high in lead compared to any other sample source, and the tumulus and field find samples are high in strontium content. Thus, through a combination of principal component analysis and through the isolation of specific elements, a pattern emerges that shows general homogeneity among the majority of the quarries present in this study, with the exception

¹⁰² The comparisons are plotted according to the mean value in parts per million of Fe, Sr, Mn, Zr and K. Zr and K had minimal impact on the variability between quarries. Fe accounts for the strongest differentiation between the beige quarries and all the others. Sr charts at higher levels for beige quarries and for the quarries near Haciveliler.

of Hacıveliler 2 and Kılcanlar 1. Additionally, the XRF results provide support for the stable isotopic data that indicate that the field finds and the tumulus samples collected north of the lake do not originate from local sources. In general, XRF detected higher levels of trace elements in non white-gray marble, while indicating that the marble near Yeniköy (POI09.08) is more homogenous than the marble near Hacıveliler (POI06.12 and POI06.16). Whether this corresponds to identifying an elemental fingerprint for marble quarries depends on increased application of XRF to marble quarries.

Results: X-ray Diffraction

The results from XRD, which was performed on only 13 samples (figure 5.20-5.32), are also predominantly homogenous in the crystal structures they detected. Only in rare instances, such as that in quarry Kılcanlar 1, were noticeably different crystals present in the samples. For the majority of the samples, however, there is a fairly uniform presence of crystals suggesting a majority matrix of dolomite and silicate, which would suggest the presence of magnesium in high levels.¹⁰³ Most of the variation exhibited in the readings (Figs. 5.20-5.32) is attributable to sample size and sample prep. In other words, the volume of powder placed in the thin film disc appears to correlate positively with the strength of signal intensity.

That the marble present in central Lydia is dolomitic is somewhat surprising. Recent publications (Tykot and Ramage 2002; Ratté 2011) state that the marble is calcitic, although publications on Aphrodisias note that the marble in this nearby region is dolomitic in nature as well. The high silicate signature in the marble suggests that the

¹⁰³ It was not possible to test for magnesium using the pXRF because this machine does not detect such light elements. Further tests using Flux Fusion, or perhaps the wXRF (wavelength dispersive XRF), could provide needed information about the relative magnesium content of these samples.

marble is typically water insoluble, which strikes a chord when the recent building of a dam using the grey marble from the region is considered. Clearly the attributes of this stone are understood on some level locally. If water insolubility is a feature of all grey marbles, this might help explain its use in the pitched roofs of several central Lydian tumulus chambers and doors instead of the more readily available white marble.

Discussion: Materials Science

There are multiple ways to interpret the significance of the results gathered through the application of stable isotope analysis, XRF and XRD. On the one hand, the three tests, although complementary and indicative of different attributes of the stone studied, lend supporting evidence for the preliminary conclusions drawn from any single test. The indications from the stable isotope results that the field finds and tumulus finds differ from the quarries in the region are reinforced by the analysis of trace elements through XRF. These elements were detected in differing quantities for the field finds and the tumulus samples, suggesting that they are, in fact, not the same material. It also appears that the quarries in the Marmara Lake Basin, and Yeniköy in particular, are the source of marble used in the construction of both the tomb of Alyattes in Bin Tepe and the three blocks from the ‘ByzFort’, a Lydian-period structure (Tykot and Ramage 2002; Ratté 2011). The stable isotope signatures for these architectural features correspond exactly to the results from this study, offering a likely local source for material that was previously considered to have come from as far away as Ephesos (Tykot and Ramage 2002). Additionally, the XRF results show that Kılcanlar 2 and Hacıveliler 2 are distinctive in some ways, reinforcing some subtle distinctions on the stable isotope scatter

plots and on the graphs produced through XRD. Of particular note with the XRD is that the material is dolomitic with high levels of silicate, with the exception of Kılcanlar 2, which again appears to stand out. This is significant because the marble from this particular source is visually distinct, being a beige color rather than a mottled white or grey color. Its texture is also different, being relatively smooth and noticeably harder than the other marble samples collected.

From a more global perspective, the stable isotope analysis can be compared to the growing corpus of studies on white marble in Asia Minor and the eastern Mediterranean. Recent studies of new quarries found in Muğla province outside Aphrodisias (the Göktepe quarries) overlap in quite a few places (Attanasio *et al.* 2009: 330). Similarly, the Ephesos marble quarries yielded a broadly similar, though less tightly clustered, series of isotopic values, which is completely encompassed by the range of values attributable to the whitish-gray marble quarries at Dokimeion (Herz 1988; Attanasio 2003). Proconnesus 1 and two quarries from the hinterland of Aphrodisias also fall in the general range of isotopic values. For the most part this suggests that arguments in favor of one source over others, particularly those coming from the Menderes Metamorphic Massif, require supplementary evidence in some cases. Stable isotope values are useful, but do not offer problem-free solutions to the question of marble provenance.

The successful application of pXRF, which can produce results in a fast and non-destructive capacity, to this marble study is intriguing. While the results are limited in scope, and have so far revealed only structural differences between small quarries of varied quality, the study raises the possibility that further testing and refining of XRF can

quickly and safely enhance marble studies in the future. To this point, XRF has been applied to obsidian and basalt in the Mediterranean to great effect, with the presumption that marble is too uniform to yield clear results. When a study is expanded to incorporate the many small-scale quarries that receive virtually no emphasis in the academic literature, the variation in stone used in a regional context becomes apparent, and the line of questioning shifts from one of sourcing to one of characterizing regional patterns of extraction and production.

These observations raise another way to interpret the significance of these results. While they do speak to the separate signatures detectable within each quarry, it is also possible to think of more sensory interpretations of these findings. Hardness is surely a factor, and the utility of water insoluble material was mentioned earlier. The uniformity of the material matters as well, with less uniformity in the white marble veins (intrusive materials such as quartzite perhaps influencing this) in terms of texture, but a high degree of uniformity in terms of chemical signatures. Smell is also a potential factor. Grinding the samples from Haciveliler 1 resulted in a potent sulfuric odor. The ramifications for this could either influence interpretations of past use (this is one of the very smallest quarries), but more likely reflects the degradation of the material due to acid rain; tests of marble subjected to acid rain suggest that a high sulfur content may result when the material is exposed for a long time.

Summary

Survey and Science

Most important for this project, however, is the potential to place these results into a well-defined landscape context. This is, in part, provided by the combined results of the survey conducted in previous seasons and during the 2011 season. The combination of materials science analysis and survey results allows the following general conclusions that will be expanded upon in the subsequent two chapters. First, it appears that the earliest instances of quarrying in the region north of the lake correspond to the period of tumulus construction in Bin Tepe. Interestingly, the use of these quarries during the Archaic period does not correspond to the presence of any particularly dense settlement in the region during that time. This could suggest that the quarries were traveled to and worked for specific projects, or that the work at the quarries was conducted on only a seasonal basis without the need for major settlement construction nearby. Such seasonal occupation of this territory is still visible today, as a road 150m to the west of the quarries is the site of a major charcoal production camp that appears only in the high summer, disappearing almost entirely throughout the rest of the year.

The smaller quarries, however, appear in conjunction with large-scale sites of later dates. Haciveliler 1 and 2 are close to a major Late Lydian through 2nd century CE Roman settlement, while the quarries north of the lake (Kılcanlar) are near an Ottoman estate. The quarries at Yeniköy are close to both a large Late Roman site and a series of Medieval through Ottoman sites in the immediate vicinity of Yeniköy. In terms of the features located, there is evidence for minor slip roads associated with the minor quarries,

while I suspect that the major dirt road leading between the Yeniköy features reflects the path of an ancient road through the hills as well. The rising and falling flood plain associated with the lake prevent a detailed assessment of other roads along its western and northern shores. There are, therefore, some indications of movement through the region, though a detailed study is currently inhibited.

It is also possible to tie the settlement data, data for movement, and data for distribution to indications of changing physical practices associated with stone extraction, observations that depend on the combination of multiple techniques of study. The evidence for tool marks in the quarries suggests that the heavy iron pick was likely introduced into Lydia *prior* to the Hellenistic period (see Fig. 5.33). This preliminary conclusion is drawn from the appearance of tool-marks in the quarries most likely associated with Lydian production. These quarries (Yeniköy 1-7) reveal tool patterning with deeper marks and a deeper curvature. (Further examination of quarries for these differences is necessary to affirm this position, which will be undertaken during the 2012 season.) Waelkens *et al.* (1989) state that the curved pattern associated with the introduction of a heavier iron pick resulted in curved markings left on quarried surfaces. Because the Iron Age quarries have an exaggerated pattern of curvature, it is probable that a heavy iron pick was in use during the time in Lydia as well. Such a conclusion is not out of the realm of possibility, given the fame of Lydian masons in antiquity (Nylander 1970; Ratté 2011). Subsequent Roman quarrying, as seen at Mağara Deresi, Gölarmara, and in select other smaller quarries north of Marmara Lake, appears comparatively finer in detail and with shallower, though still curving, lines left by the iron pick (Fig. 5.34).

It is also clear that debitage piles in these sites were typically removed from the quarry: the bottoms of areas of craftsmanship are visible in many instances, and the scatter of chipped stone is, with one exception, located principally beyond the quarry walls. In terms of chronology, two periods of stone working are clearly articulated, with a third possible (and perhaps likely). Lydian-period stone extraction occurred to the north of the lake with marble and in the southern lake district with limestone. Roman-period extraction continued, but apparently on a smaller scale and in association with specific settlements. The dominant stone source during this period had shifted to the mountains south of Sardis. The Medieval through Ottoman periods also likely witnessed stone working. Certainly the quarries above Gölarmara were in use during this time, but it is also possible that more immediately local sources of stone were used and reused as well.

Conclusions

The picture developing from interpretation of these results is intriguing. From a materials perspective, the marble in the Marmara Lake Basin is relatively heterogeneous, being a mix of dolomitic silicates with large quantities of calcite present as well. The geological proximity of this marble to other stone types additionally led to relatively impure formation processes. In terms of differentiating the quarries from each other and from other quarries in Asia Minor, the results show that the Marmara Lake Basin material differs substantially from the two main Roman-period quarries in Lydia, though all Asia Minor quarries within the Menderes Metamorphic Massif share the same span of isotopic values. XRF proved more useful than anticipated in determining quarry chemical

signatures, revealing that certain sites had high levels of strontium, manganese, iron and nickel, though these elements are not spread evenly throughout the basin. Some diversity exists within the quarries themselves, but general trends were nonetheless detected. The survey has provided useful results about the proximity of quarries to settlements, and the nature of movement within the quarries and between the quarries and the rest of the lake basin. These topics will be explored in detail in Chapter 6.

Overall, the picture emerging from the combination of materials science studies and archaeological survey is dynamic, with evidence correlating the extraction of marble, and the scale of quarry operations, to changing social and political conditions in the Marmara Lake Basin from the Iron Age Lydian Kingdom through to the Ottoman period. These changing political conditions brought with them different approaches to governmentality that necessitated unique encounters with the landscape that nevertheless confronted the material traces of deep temporality in the places of central Lydia. Although the broader significance of this will be taken up in the following chapter, this study raises several questions worth mentioning here. First, given the evidence for changing associations between the lake, settlement, and resource sites, to what can we attribute differences in proximity between quarries and settlements? Do other, more historically-oriented studies of the region offer a way into analyzing whether these landscapes were remembered differently over time? Where else might the material be going and who was traveling through the region during the Lydian, Roman, and post-Roman periods? What would they have been able to see and how much of this landscape of marble in the past contributed to the eventual notion of the town of Gölarmara as the marble city? In what senses do these findings impact our notions of stone and industry

within the Roman economy, and how do the particularities of this landscape, both topographically and in terms of settlement, influence our understandings of multiple layers of economic activity in the past? In short, how integrated were these quarries, and was this landscape, in the prevailing economic conditions that characterize different historical periods? Did early quarrying leave a legacy, and how do these landscapes factor into the creation of the Roman polity?

The following chapter will begin to explore these questions with an eye towards understanding the presence of, and differences in, resource acquisition practices not as markers of different cultural practices, but as indicators that the Marmara Lake Basin participated in different regional networks, with implications for the shape of the Roman polity as a whole. Changes in quarry technology are dependent not just on different cultural requirements, but on a host of changing material and social networks. The remit of Chapter 6 is therefore to uncover more of what these changing networks entailed, and the degree to which local craftspersons were able to influence the relationship between rural populations and Roman imperial techniques of governmentality.

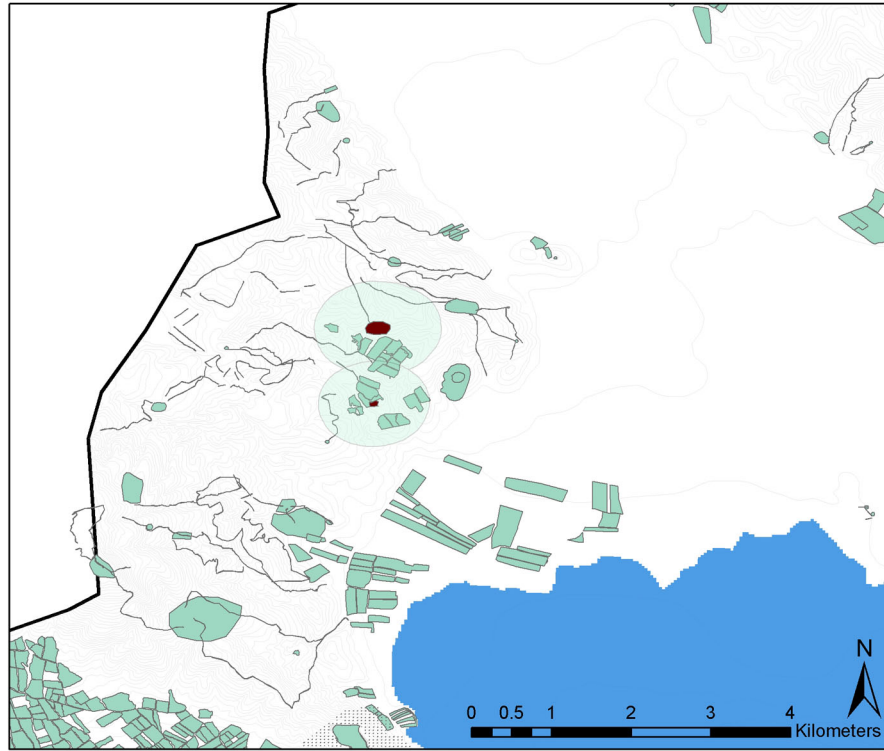


Figure 5.1: Quarries at Haciveliler with 500m buffers and surveyed agricultural fields (image created by author, courtesy of the Central Lydia Archaeological Survey).

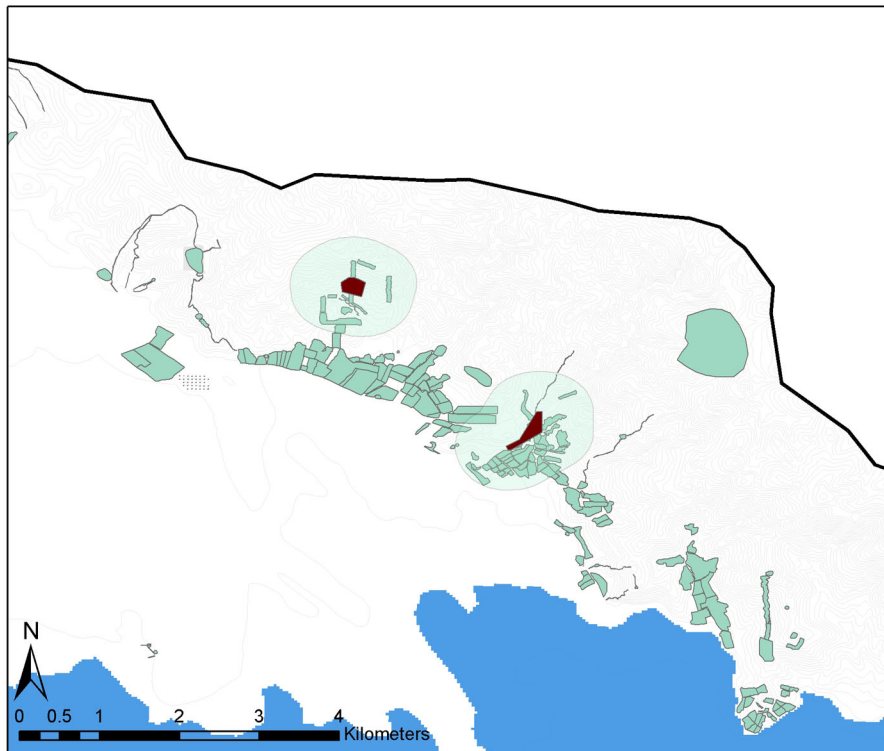


Figure 5.2: Quarries at Kılcanlar and Yeniköy with 500m buffers and surveyed agricultural fields (image created by author, courtesy of the Central Lydia Archaeological Survey).

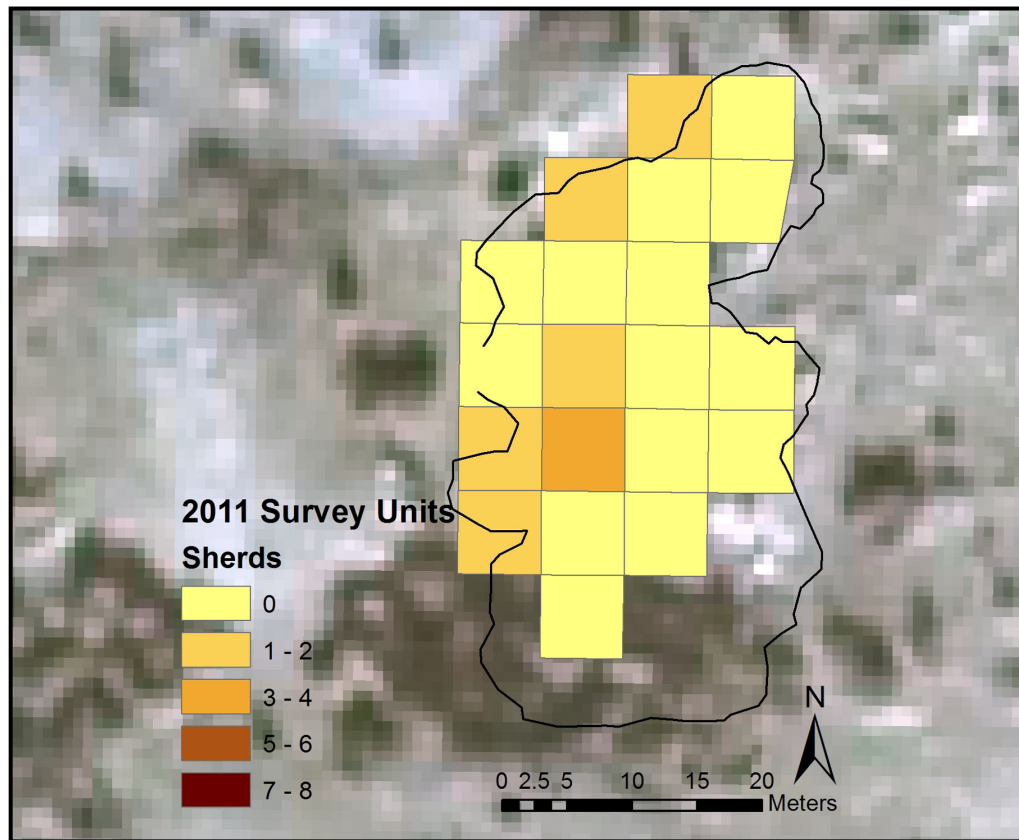


Figure 5.3: Outline of Haciveliler 2 with survey grid squares showing ceramic densities (image created by author, courtesy of the Central Lydia Archaeological Survey).

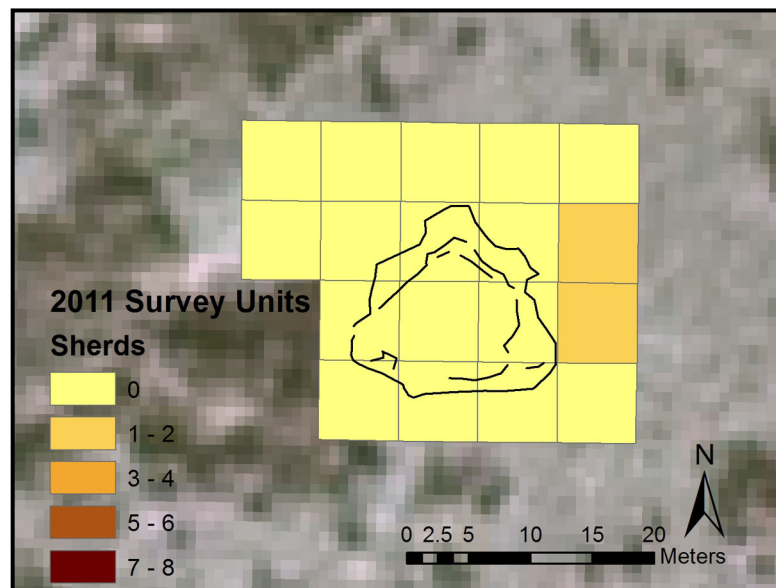


Figure 5.4: Outline of Haciveliler 1 with survey grid squares showing ceramic densities (image created by author, courtesy of the Central Lydia Archaeological Survey).

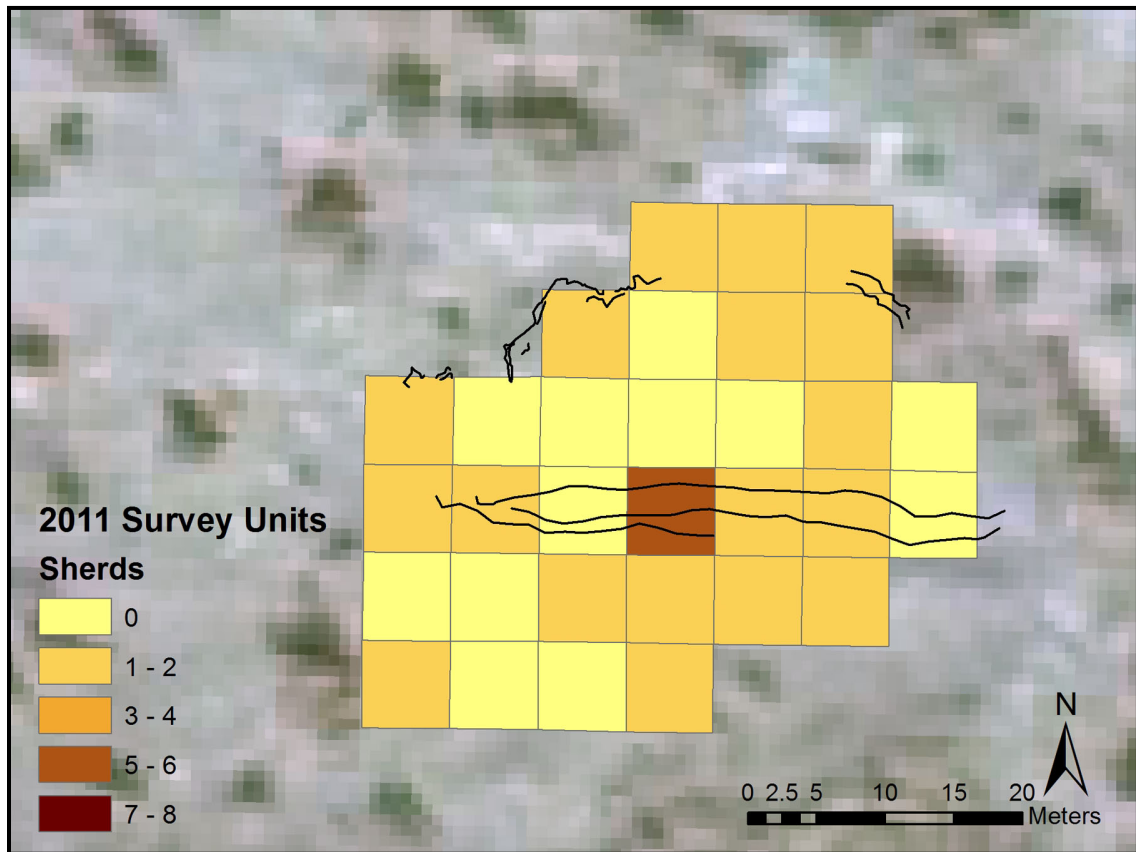


Figure 5.5: Outline of Yeniköy 1 with survey grid squares showing ceramic densities (image created by author, courtesy of the Central Lydia Archaeological Survey).

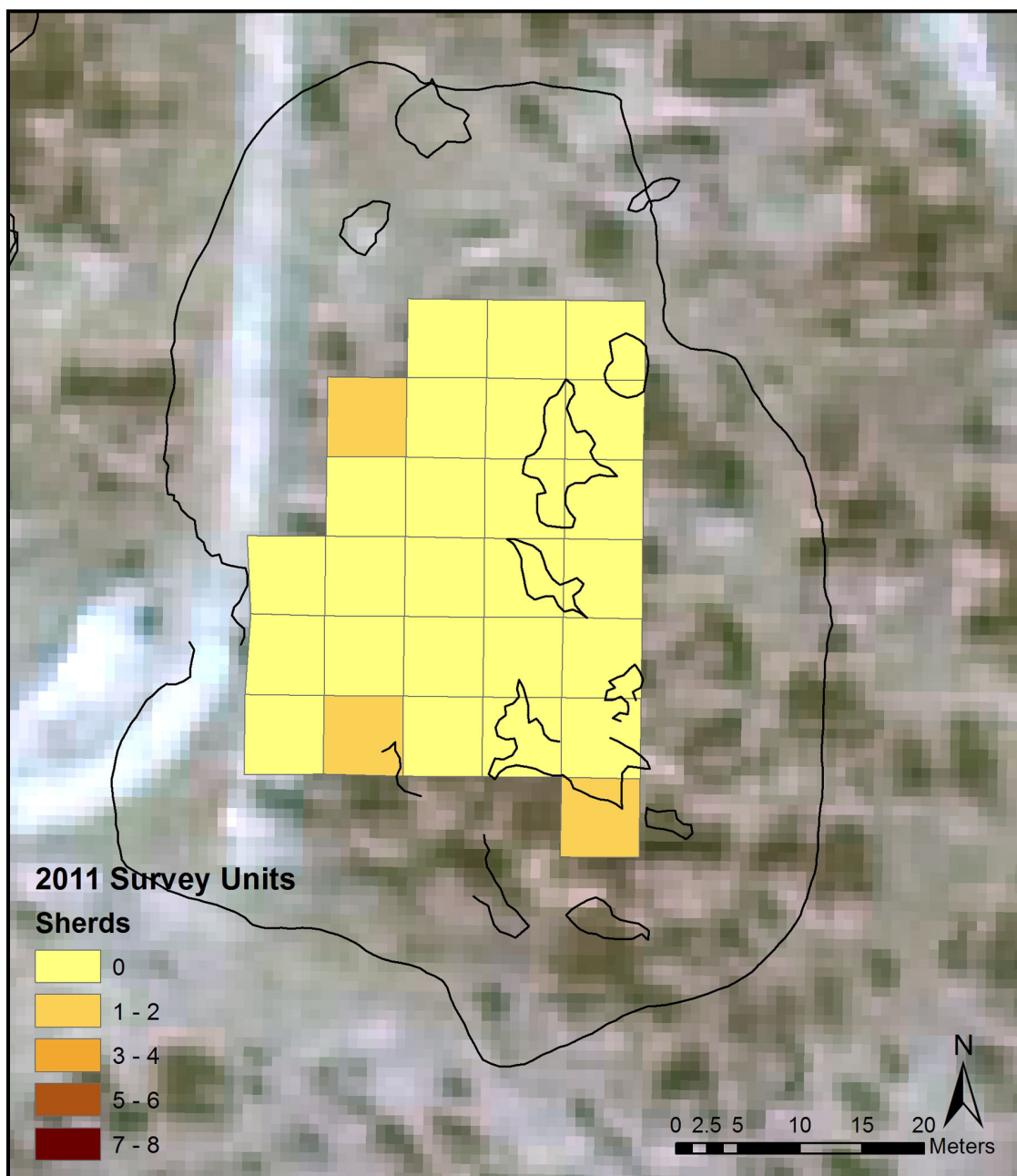


Figure 5.6: Outline of Yeniköy 2 with survey grid squares showing ceramic densities (image created by author, courtesy of the Central Lydia Archaeological Survey).

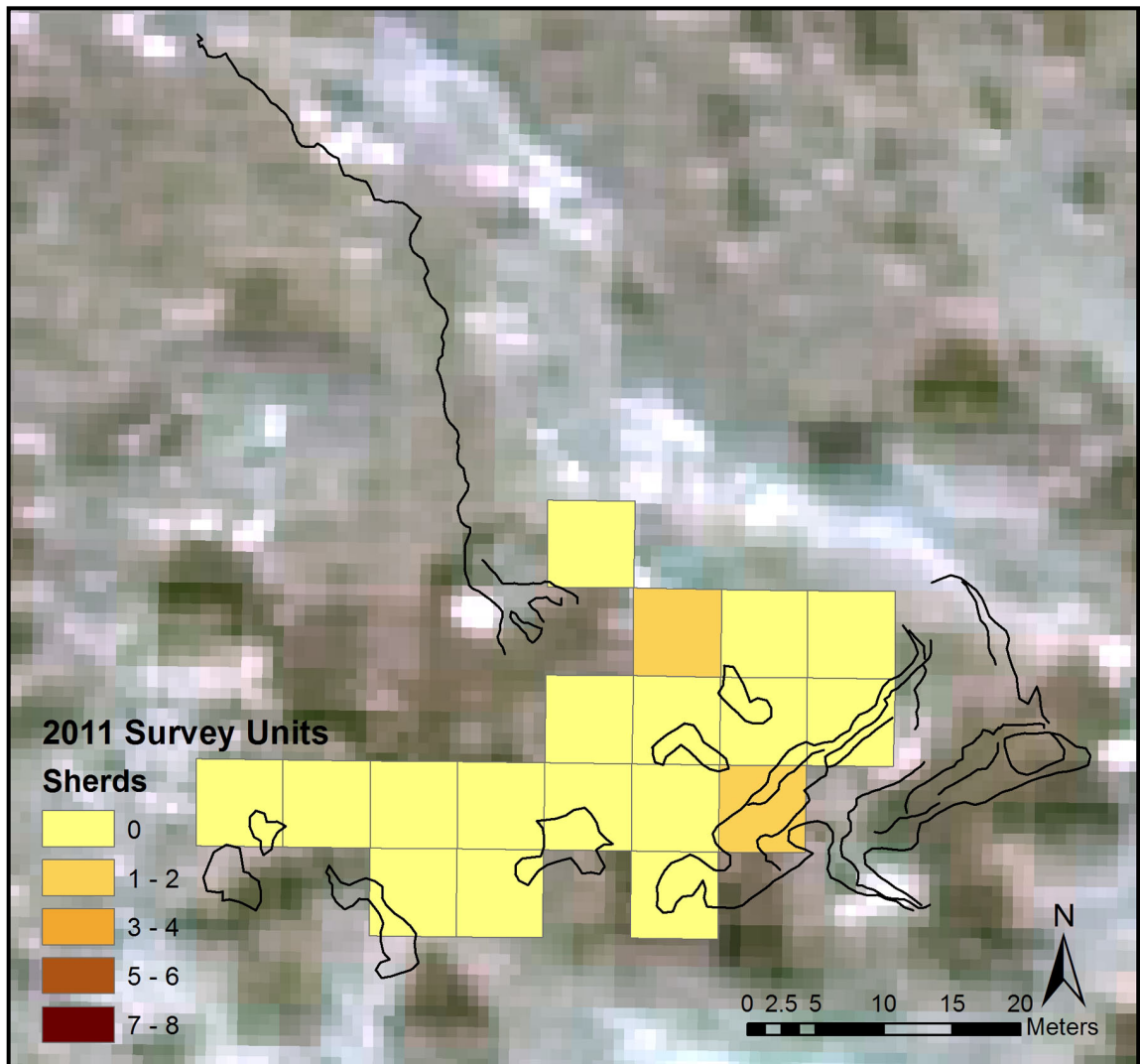


Figure 5.7: Outline of Yeniköy 6 with survey grid squares showing ceramic densities (image created by author, courtesy of the Central Lydia Archaeological Survey).



Figure 5.8: Photorectification points on quarry surface at Yeniköy 6. Green points are anchor points, while red points are topographic points (image created by John Valainis, courtesy of the Central Lydia Archaeological Survey).

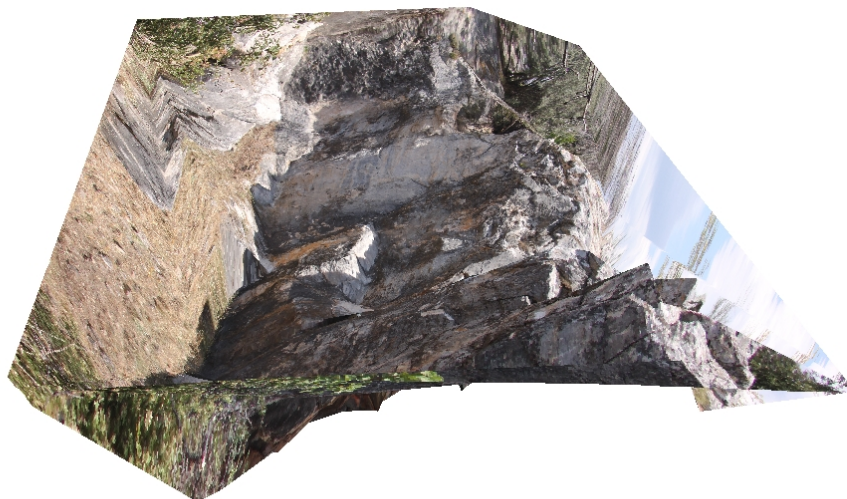


Figure 5.9: 3-D photorectified image of west-facing wall in Haciveliler 2 (image created by John Valainis, courtesy of the Central Lydia Archaeological Survey).



Figure 5.10: 3-D photorectified image of east-facing wall in Yeniköy 1 (image created by John Valainis, courtesy of the Central Lydia Archaeological Survey).

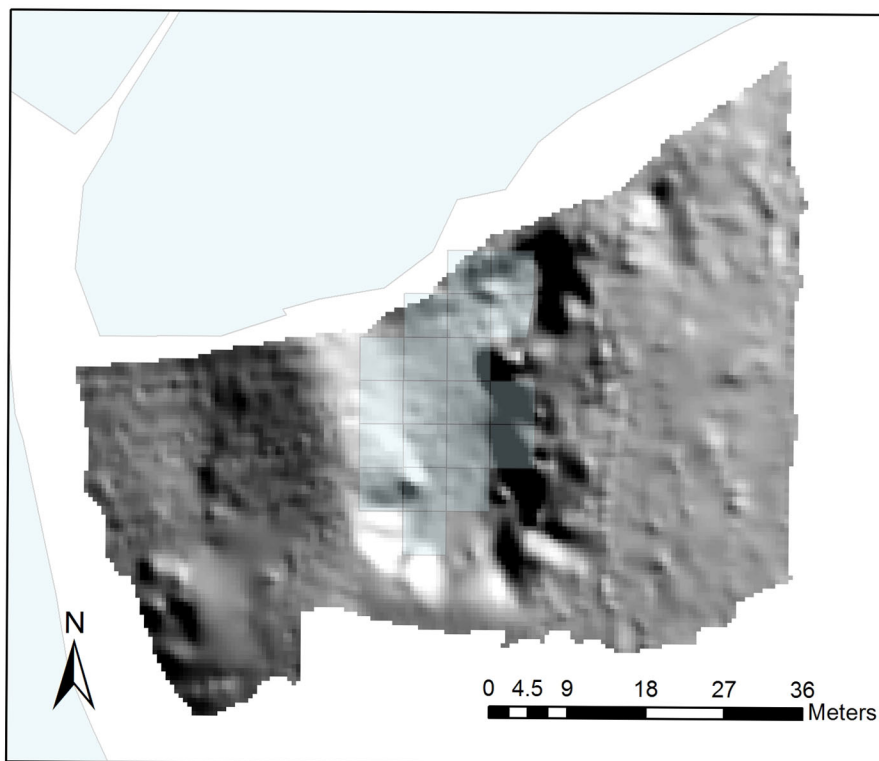


Figure 5.11: Hillshade of Haciveliler 2 based on a 0.5m DEM created using an RTK GPS (image created by author, courtesy of the Central Lydia Archaeological Survey).

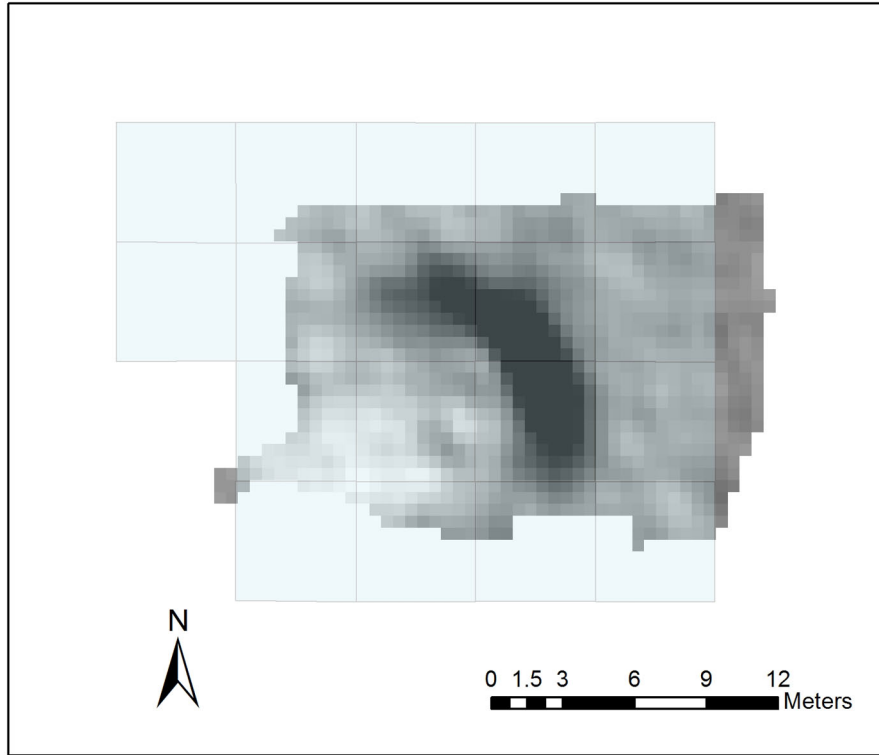


Figure 5.12: Hillshade of Haciveliler 1 based on a 0.5m DEM created using an RTK GPS (image created by author, courtesy of the Central Lydia Archaeological Survey).

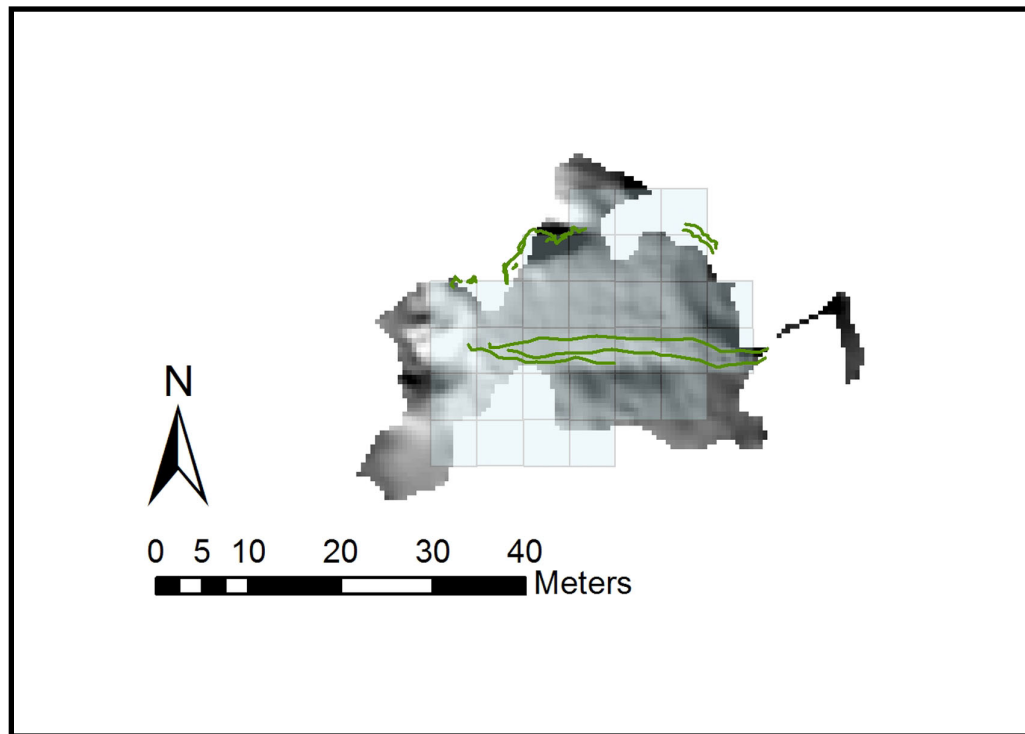


Figure 5.13: Hillshade of Yeniköy 1 based on a 0.5m DEM created using an RTK GPS (image created by author, courtesy of the Central Lydia Archaeological Survey).

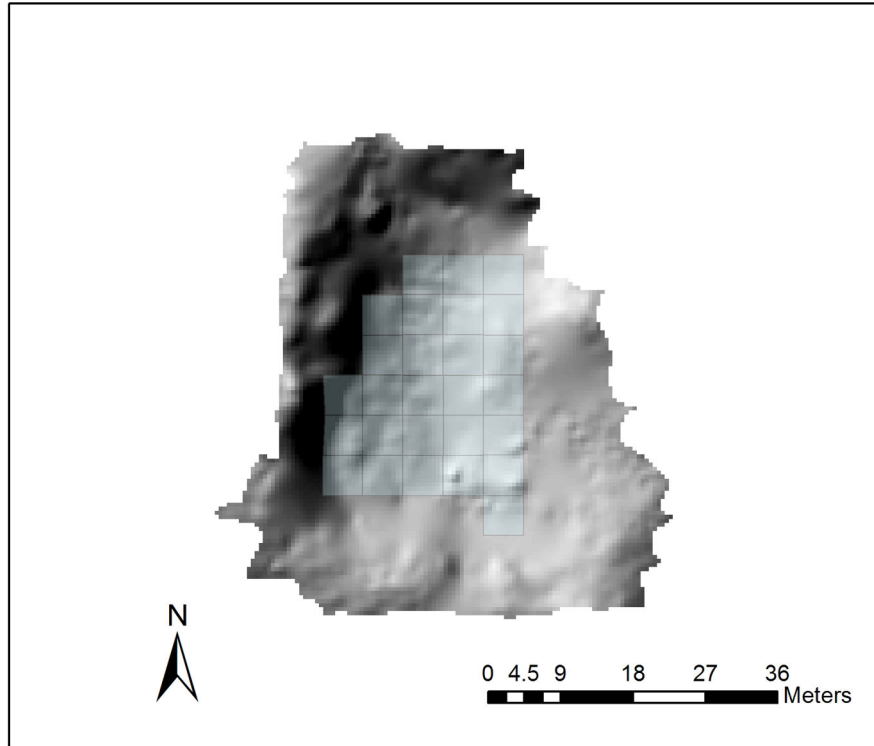


Figure 5.14: Hillshade of Yeniköy 2 based on a 0.5m DEM created using an RTK GPS (image created by author, courtesy of the Central Lydia Archaeological Survey).

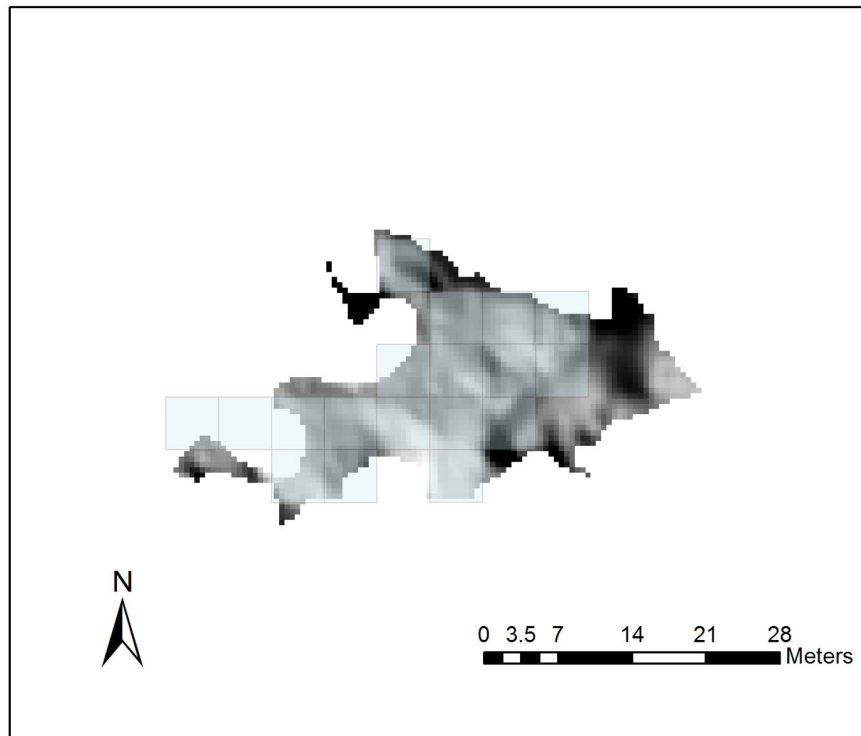


Figure 5.15: Hillshade of Yeniköy 6 based on a 0.5m DEM created using an RTK GPS (image created by author, courtesy of the Central Lydia Archaeological Survey).

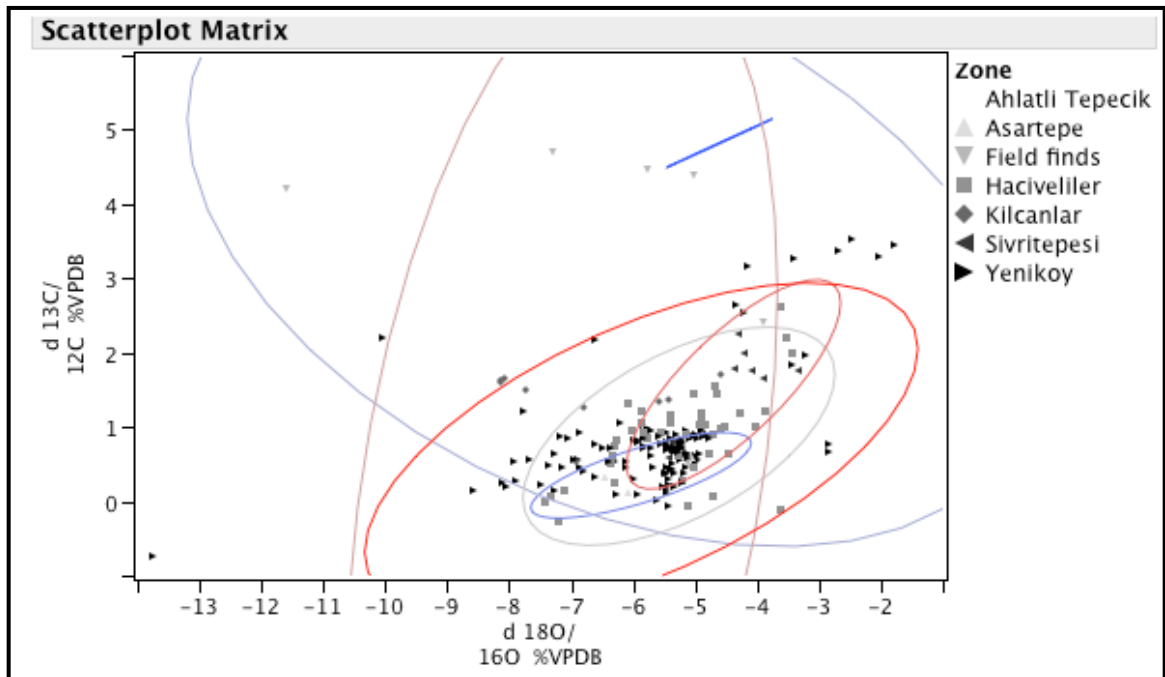


Figure 5.16: C and O stable isotope values. Ellipses outline 95% certainty of each quarry zone sampled during the 2011 season.

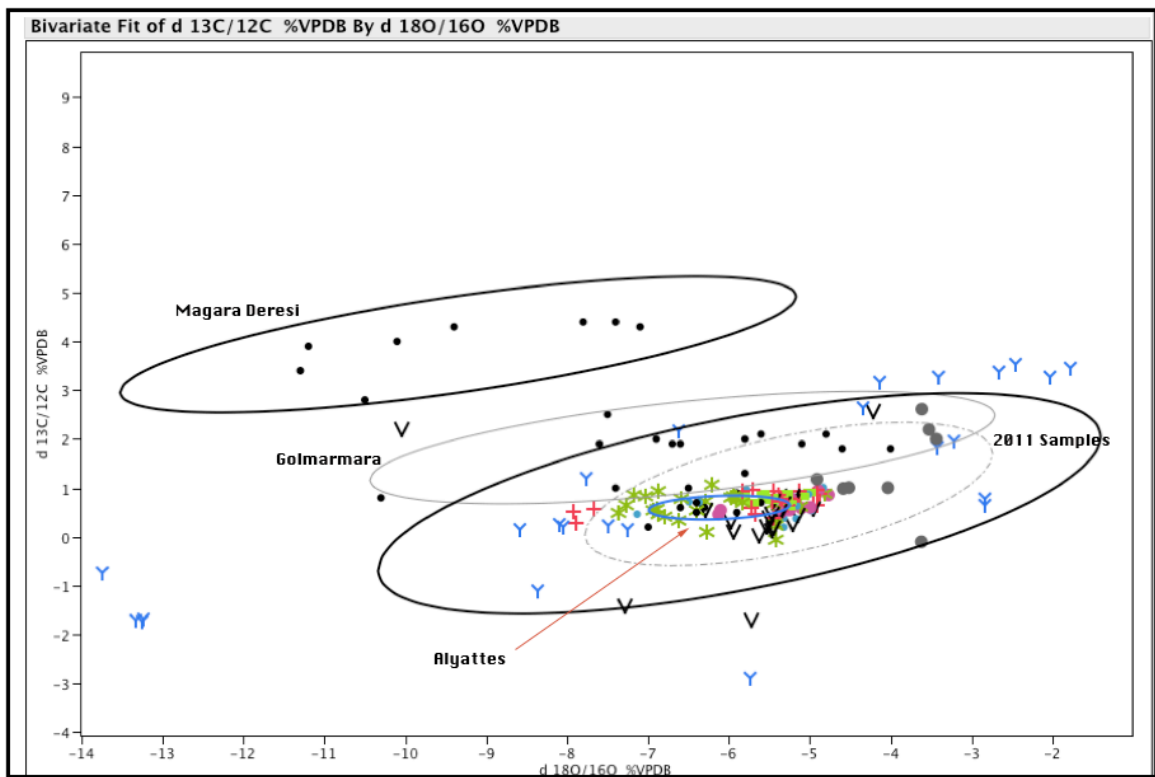


Figure 5.17: C and O stable isotope values. Ellipses outline 95% certainty of 2011 quarry zones (black) and 1996 quarry zones (gray: Tykot and Ramage 2002).

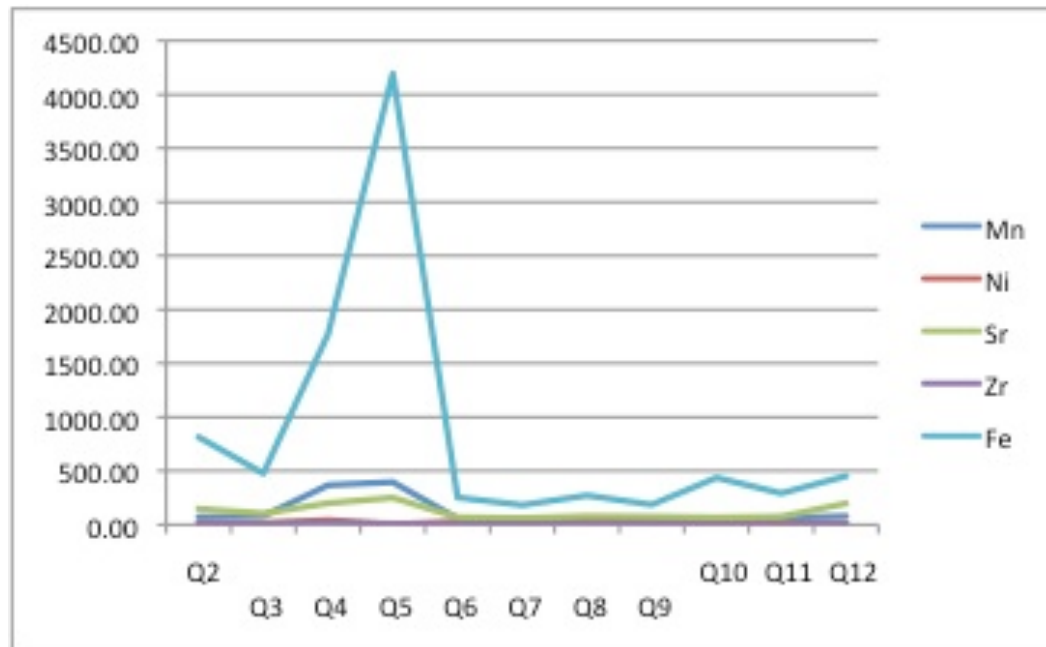


Figure 5.18: Line graph representing the mean values of five elements detected using XRF in parts per million. Fe, Mn and Sr shown as highly variable between quarries.

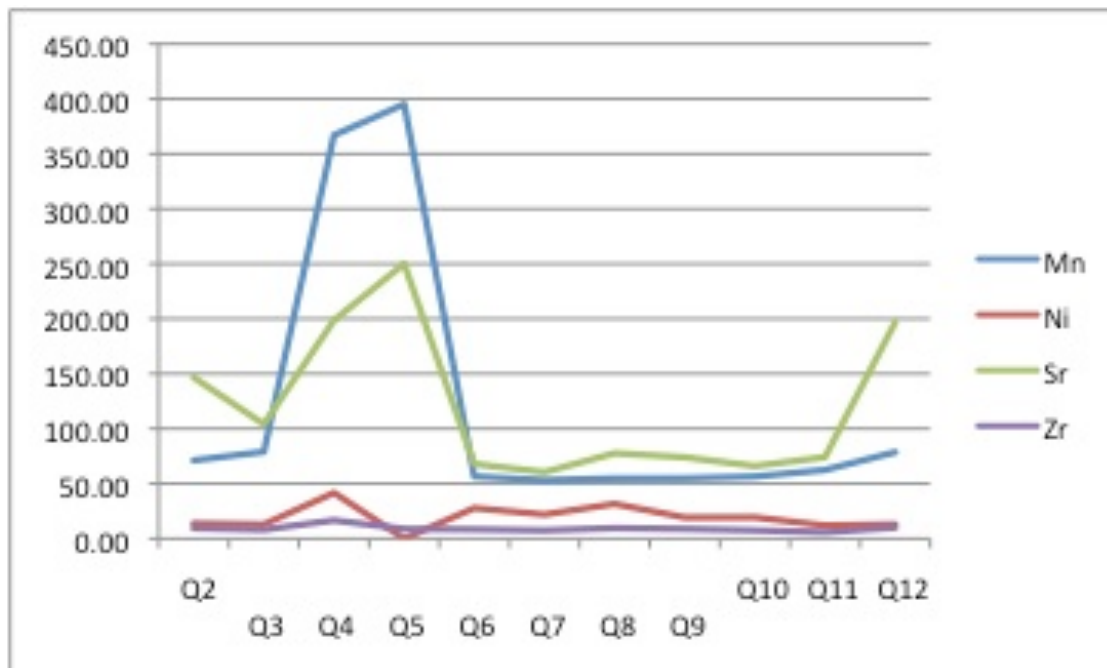


Figure 5.19: Line graph representing the mean values of four elements detected using XRF in parts per million. Fe excluded due to skewing of results visually.

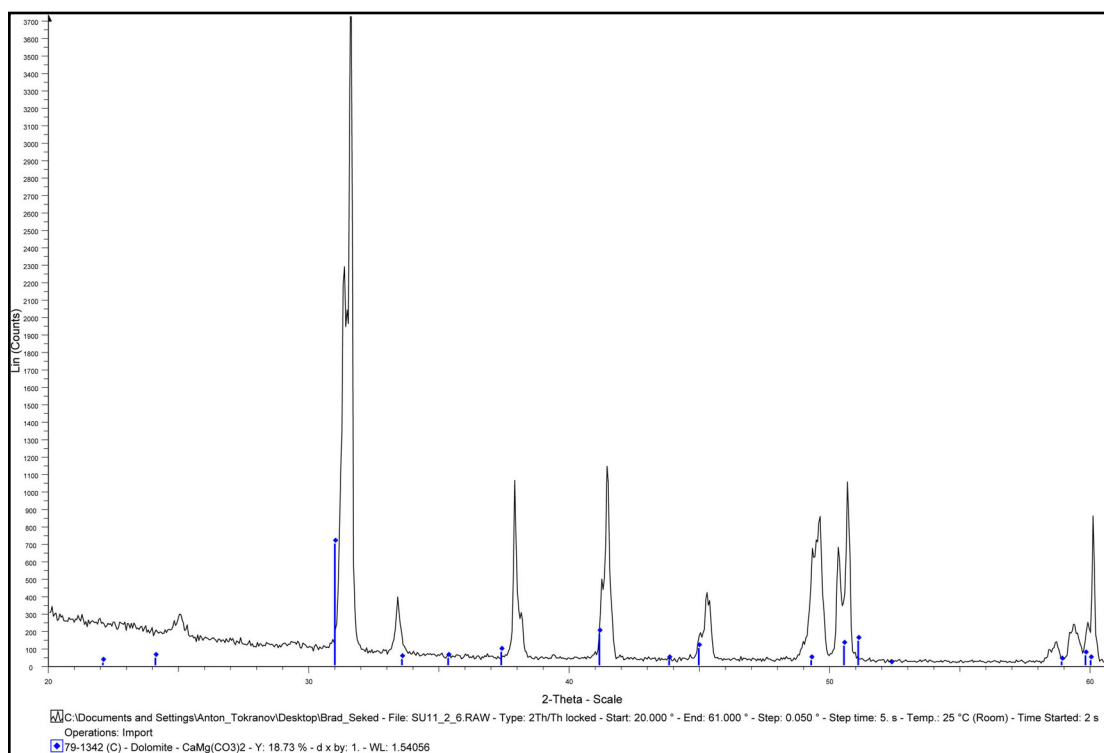


Figure 5.20: XRD results for SU11.2.6. Pointed blue lines indicate standard readings for dolomite.

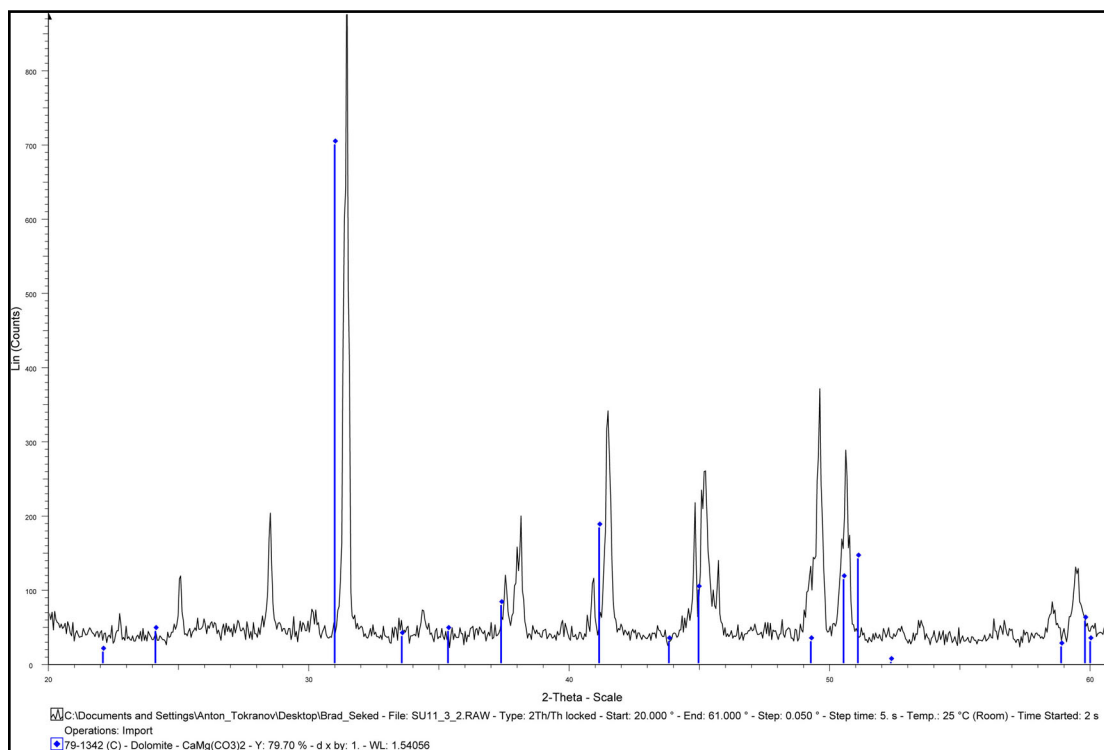


Figure 5.21: XRD results for SU11.3.2. Pointed blue lines indicate standard readings for dolomite.

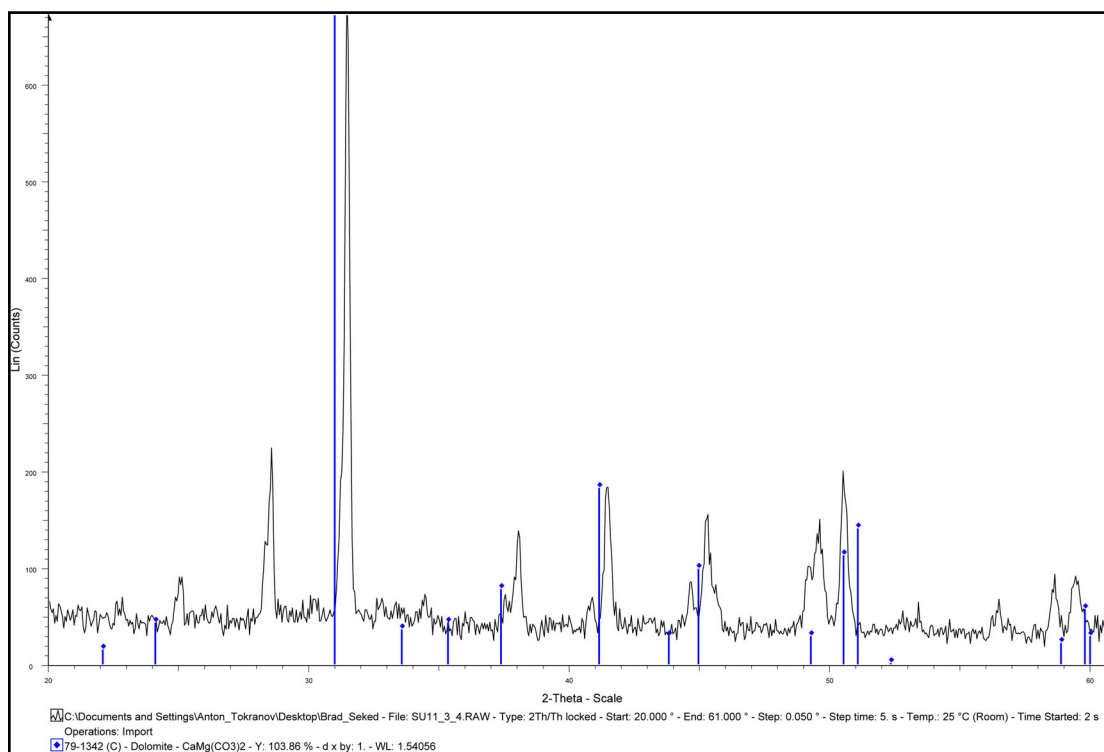


Figure 5.22: XRD results for SU11.3.4. Pointed blue lines indicate standard readings for dolomite.

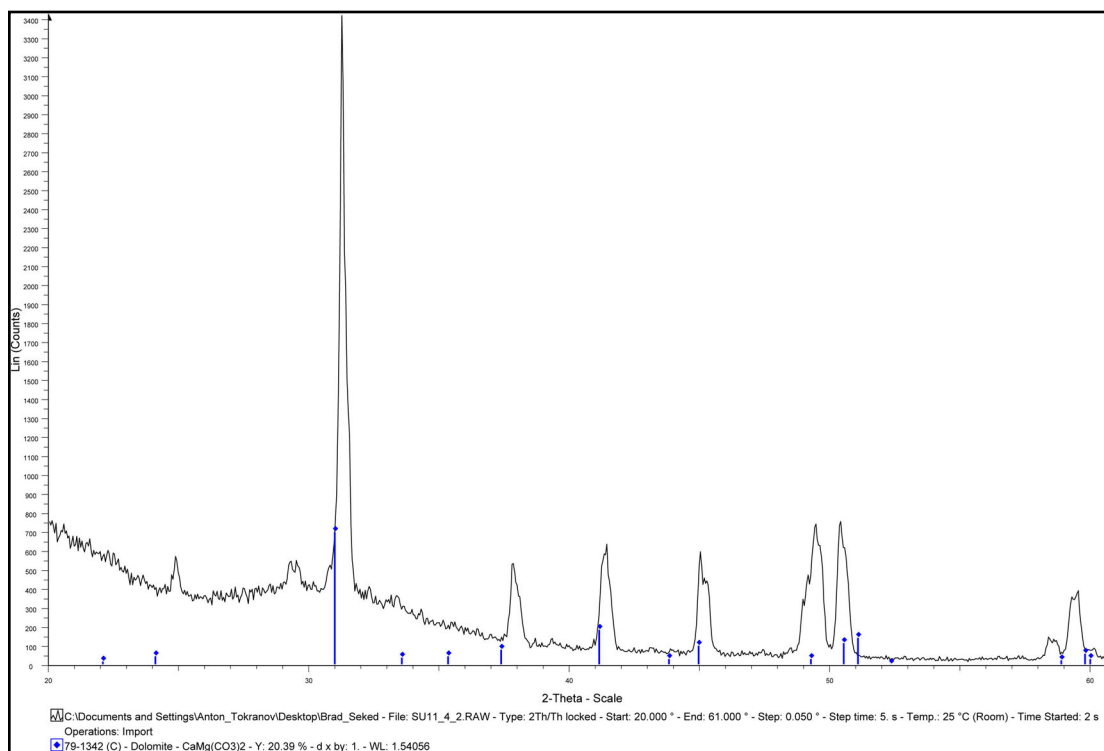


Figure 5.23: XRD results for SU11.4.2. Pointed blue lines indicate standard readings for dolomite.

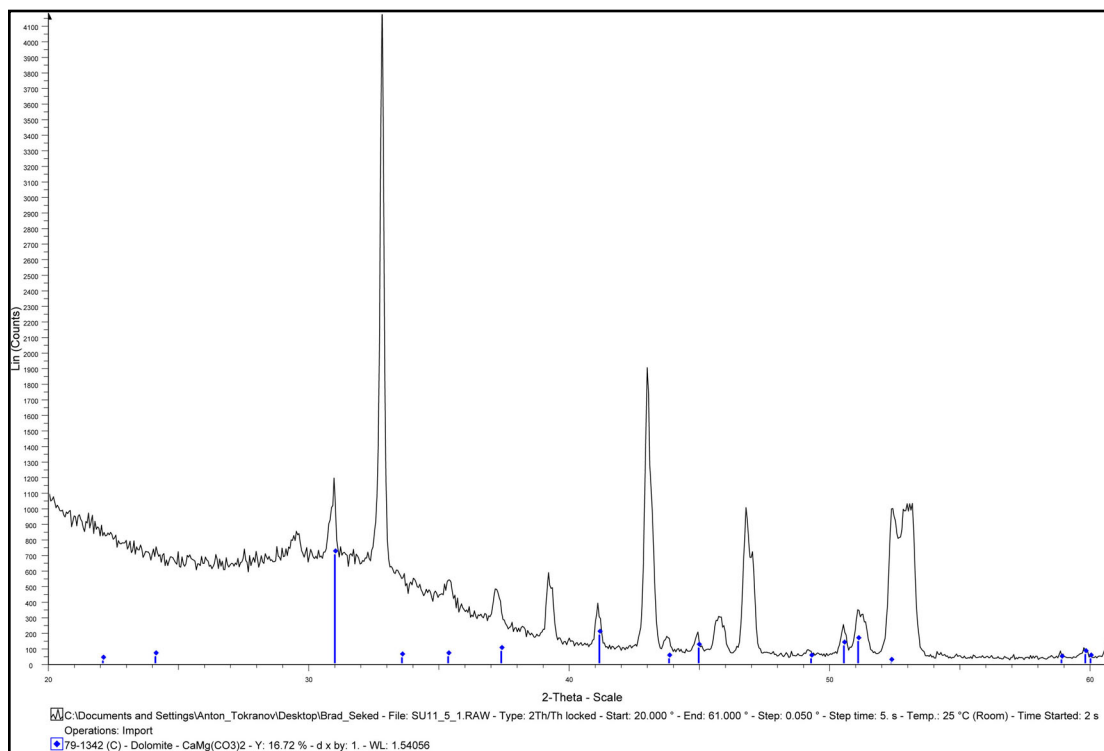


Figure 5.24: XRD results for SU11.5.1. Pointed blue lines indicate standard readings for dolomite.

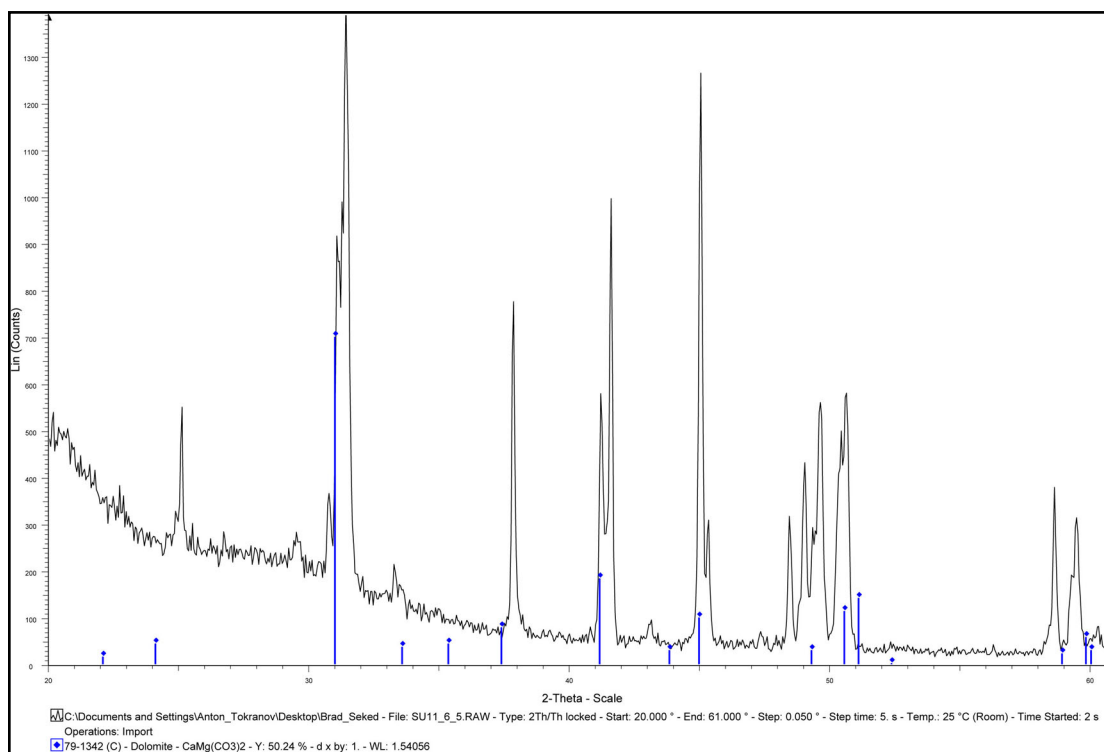


Figure 5.25: XRD results for SU11.6.5. Pointed blue lines indicate standard readings for dolomite.

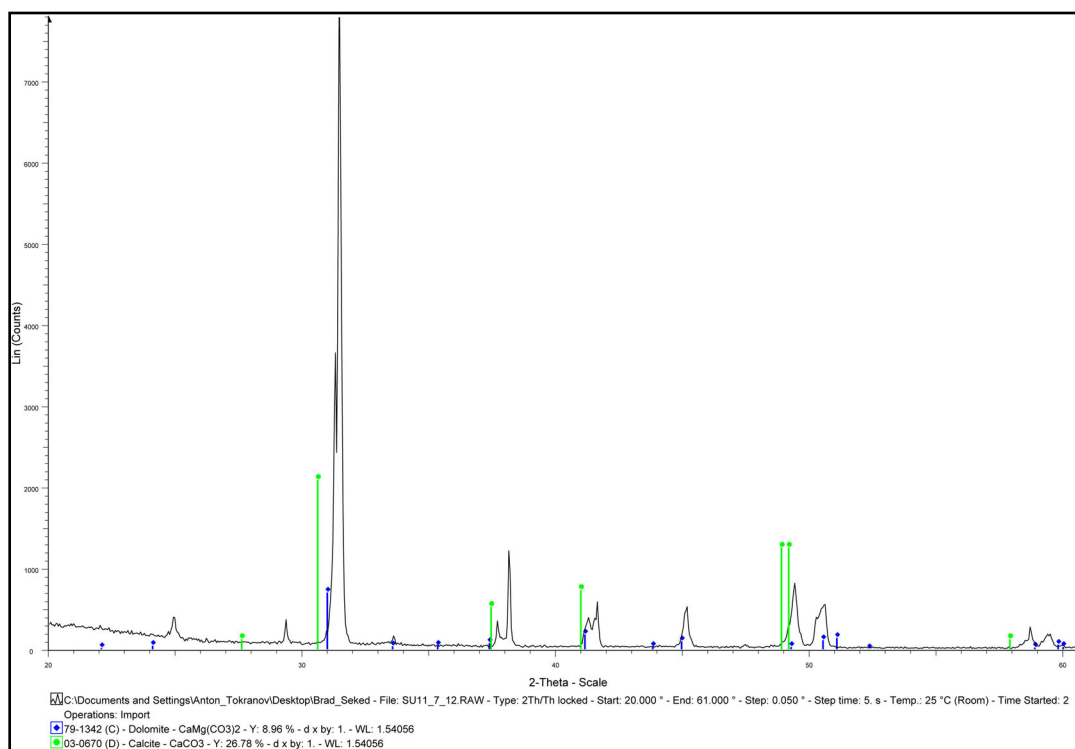


Figure 5.26: XRD results for SU11.7.12. Pointed blue lines indicate standard readings for dolomite. Green line indicates reading for calcite.

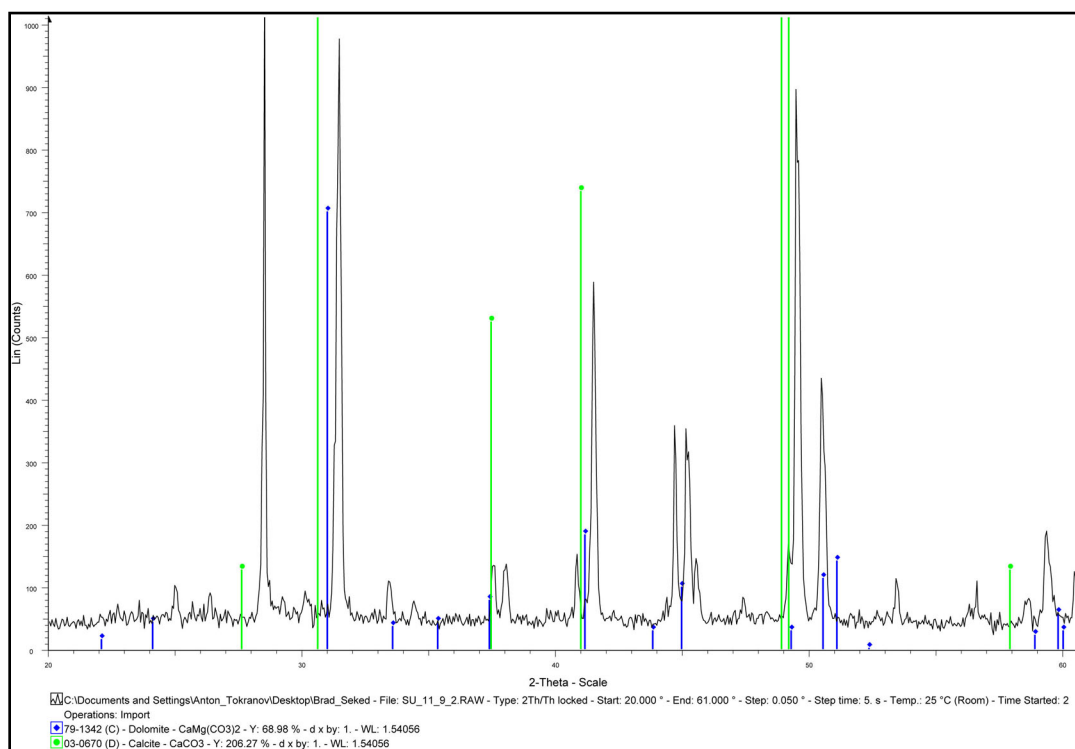


Figure 5.27: XRD results for SU11.9.2. Pointed blue lines indicate standard readings for dolomite. Green line indicates reading for calcite.

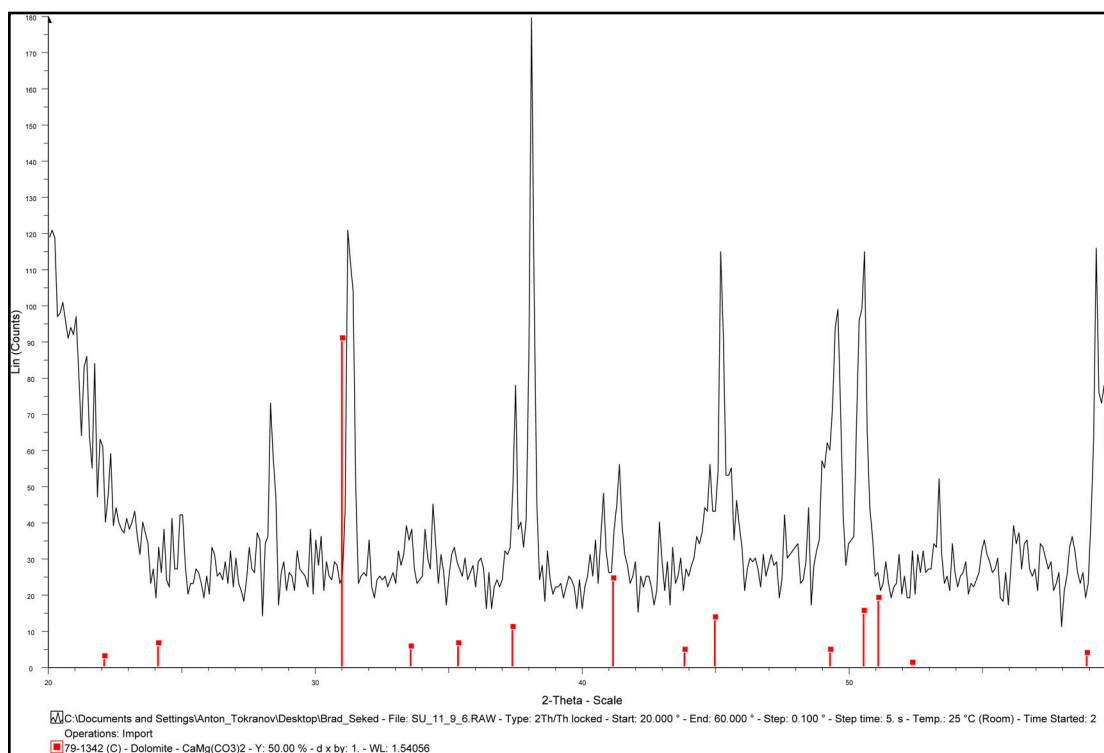


Figure 5.28: XRD results for SU11.9.6. Pointed red lines indicate standard readings for dolomite.

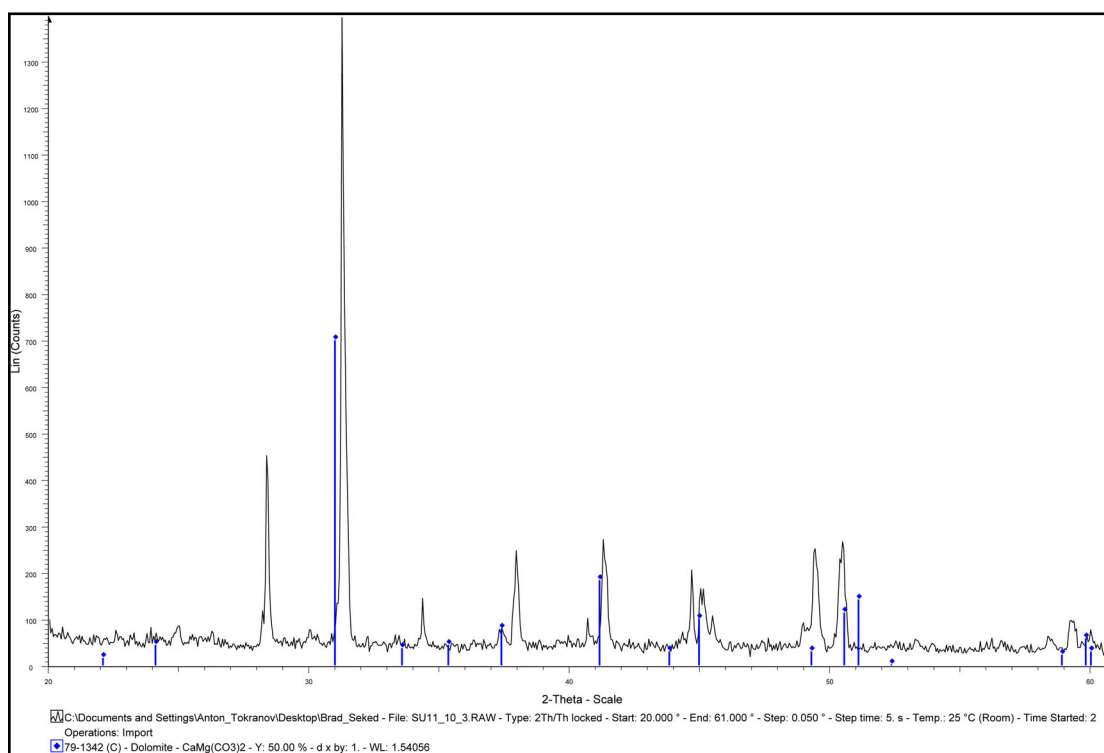


Figure 5.29: XRD results for SU11.10.3. Pointed blue lines indicate standard readings for dolomite.

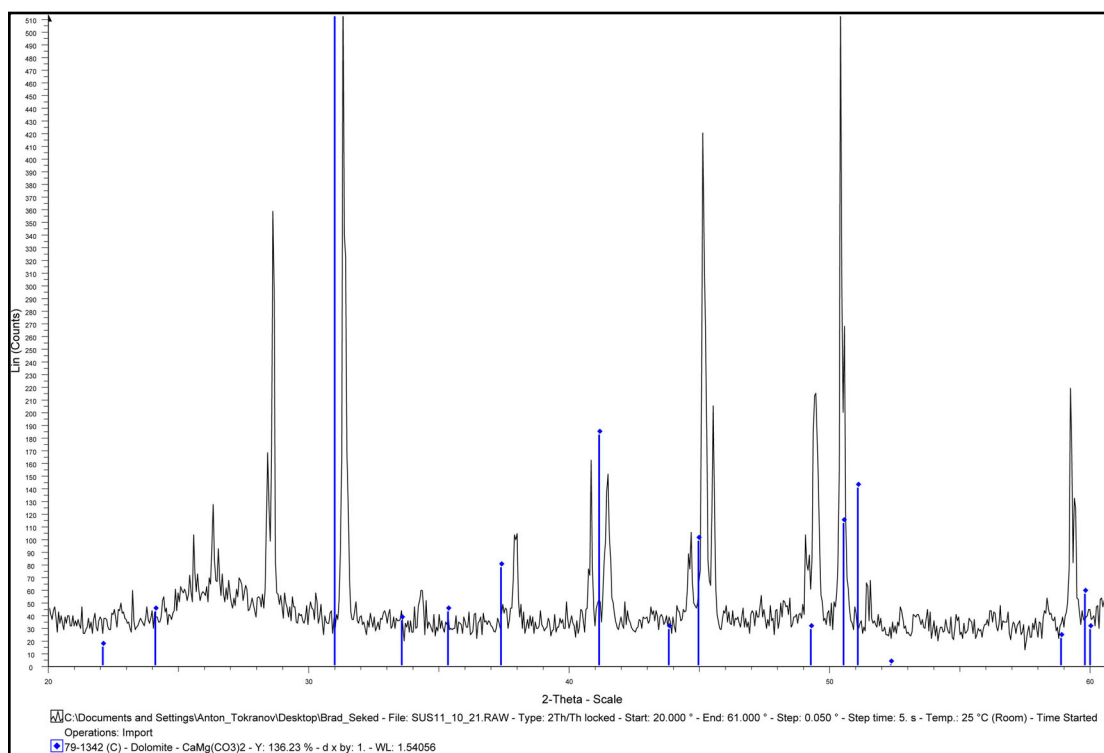


Figure 5.30: XRD results for SU11.10.21. Pointed blue lines indicate standard readings for dolomite.

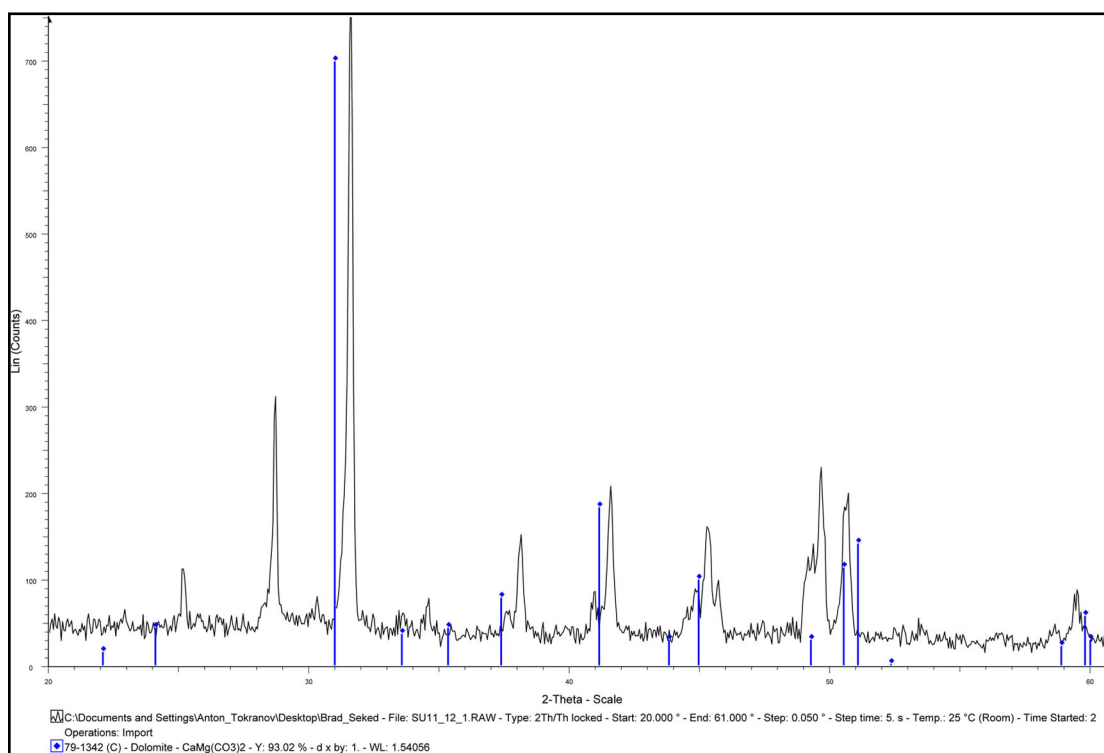


Figure 5.31: XRD results for SU11.12.1. Pointed blue lines indicate standard readings for dolomite.

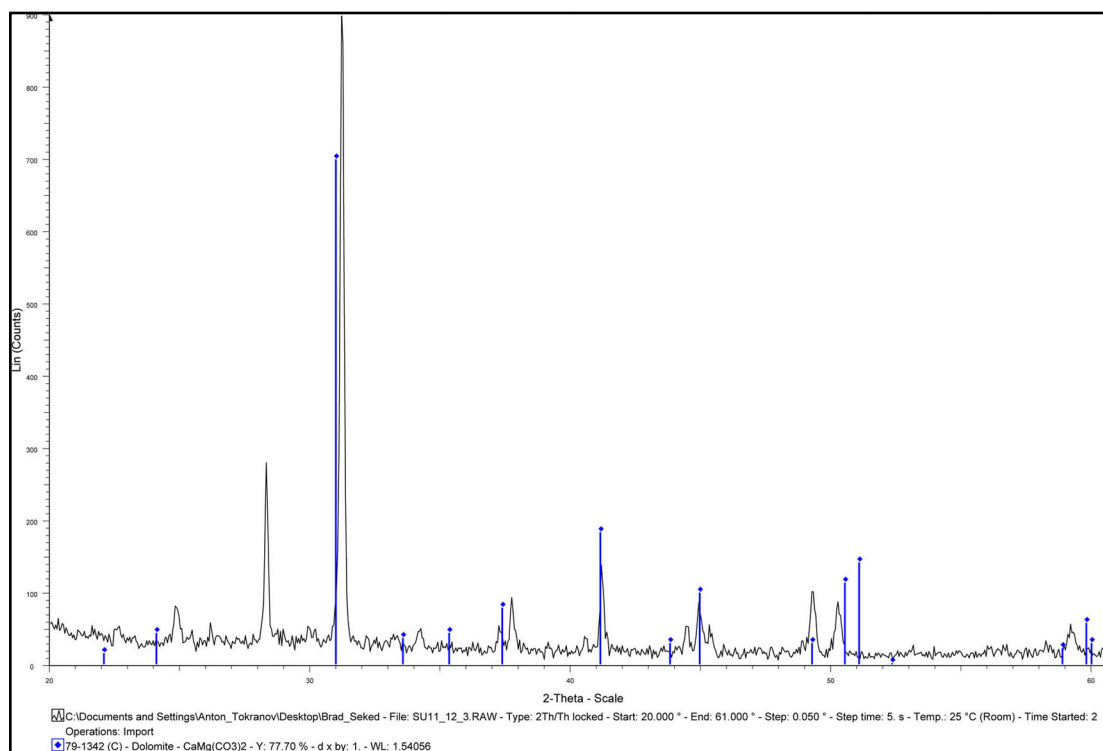


Figure 5.32: XRD results for SU11.12.3. Pointed blue lines indicate standard readings for dolomite.



Fig. 5.33: Deep curved tool marks at Yeniköy 1 (photo by author, courtesy of the Central Lydia Archaeological Survey).



Fig. 5.34: Shallow curved markings at the Gölarmara quarries (photo by author, courtesy of the Central Lydia Archaeological Survey).

Table 5.1: CLAS working chronology

Lydian	
Early Lydian	11th-8th C. BCE
Middle Lydian	7th-M. 6th C. BCE
Late Lydian	M.6th-4th C. BCE
Late Lydian I	M. 6th-5th C. BCE
Late Lydian I– Early Hellenistic	5th-3rd C. BCE
Late Lydian II	4th C. BCE
Late Lydian II– Early Hellenistic	4th-3rd C. BCE
Late Lydian II– Middle Hellenistic	4th-2nd C. BCE
Late Lydian II– Late Hellenistic	4th-1st C. BCE
Hellenistic	3rd-1st C. BCE
Early Hellenistic	3rd C. BCE
Middle Hellenistic	L. 3rd-M. 2nd C. BCE (Antiochus III and IV)
Late Hellenistic	L. 2nd-L. 1st C. BCE (dissolution of the Ptolemaic world)
Roman	
Roman or (Late Medieval-) Ottoman	
Roman or Modern	
(Late) Roman	Probably Roman but could be Late Roman

Table 5.2: 2011 Finds

SU Year	SU SeqNum	Find number	Known category	Sherd type	Vessel form	Additional comments	Chronological range
2011	1	1		Rim	Pithos		Unclear
2011	1	2		Handle	Unclear		Unclear
2011	1	3	Middle-Late Roman Coarse Ware	Rim	Open vessel		Middle Roman–Late Roman
2011	1	4	Middle-Late Roman Coarse Ware	Rim	Unclear		Middle Roman–Late Roman
2011	1	5		Handle	Unclear		Unclear
2011	1	6		Body	Unclear		Unclear
2011	1	7		Rim	Bowl		Middle Roman–Late Roman
2011	13	1		Body			Late Medieval–Modern
2011	13	2		Toe	Unclear		Late Medieval–Modern
2011	14	1		Base	Basin		Late Medieval–Modern

2011	14	2	Unglazed Domestic Ware with Slipped Exterior	Body	Jug		Late Medieval– Modern
2011	16	1		Base	Jar		Late Medieval (– Ottoman)
2011	17	1		Body	Unclear		Late Medieval– Modern
2011	17	2		Handle			Late Medieval– Modern
2011	20	1		Handle - Body	Unclear		Late Medieval– Modern
2011	20	2		Rim	Unclear	Rim too small to determine diameter	Late Lydian
2011	20	3		Body	Unclear		Early Roman– Middle Roman
2011	20	4		Foot	Unclear		Late Lydian
2011	20	5		Handle	Unclear		Late Lydian
2011	20	6		Handle - Body	Unclear		Late Medieval– Modern
2011	20	7		Rim	Unclear		Late Lydian

2011	20	8		Base	Unclear		Late Medieval– Modern
2011	20	9		Base	Unclear		Late Lydian
2011	20	10		Foot	Unclear		Early Roman– Middle Roman
2011	20	11		Rim	Cup		Late Lydian
2011	20	12		Body	Unclear		Early Roman– Middle Roman
2011	20	13		Body	Unclear		Unclear
2011	20	14		Rim	Unclear		Late Medieval– Modern
2011	20	15		Rim	Open vessel		Late Medieval– Modern
2011	20	16		Rim	Open vessel		Late Medieval– Modern
2011	21	1		Rim	Cup	A. Berlin: prelim. dating 1st-2nd c. CE [06.30.2011]	Early Roman– Middle Roman
2011	21	2		Body	Unclear	A. Berlin: prelim. dating Later (Medieval) [06.30.2011]	Late Medieval– Modern

2011	21	3		Foot - Body	Plate	A. Berlin: prelim. dating 1st-2nd c. CE [06.30.2011]	Early Roman– Middle Roman
2011	21	4		Base	Jug	A. Berlin: prelim. dating 6th-4th c. BCE [06.30.2011]	Late Lydian
2011	21	5		Rim	Crater	A. Berlin: prelim. dating 6th-4th c. BCE [06.30.2011]	Late Lydian
2011	21	6		Handle	Unclear		Late Medieval– Modern
2011	21	7		Body	Skyphos	A. Berlin: prelim. dating 6th-4th c. BCE [06.30.2011]	Late Lydian
2011	21	8		Handle	Unclear	A. Berlin: prelim dating 1st-2nd c. CE	Early Roman– Middle Roman
2011	21	9		Base	Basin	A. Berlin: prelim. dating 1st-2nd c. CE [06.30.2011]	Early Roman– Middle Roman
2011	21	10		Base		A. Berlin: prelim. dating 1st-2nd c. CE	Early Roman– Middle Roman
2011	21	11		Rim	Amphora	A. Berlin: prelim dating Later (Medieval) [06.30.2011]	Late Medieval– Modern

2011	21	12		Foot - Body	Plate	A. Berlin: prelim. dating 1st-2nd c. CE [06.30.2011]. very low ring foot, almost could be classified as a torus ring	Early Roman– Middle Roman
2011	21	13		Rim	Unclear	A. Berlin: prelim. dating 6th-4th c. BCE [06.30.2011]; not enough rim extant to measure diameter	Late Lydian
2011	21	14		Body	Unclear	A. Berlin: prelim. dating 1st-2nd c. CE [06.30.2011]	Early Roman– Middle Roman
2011	21	15		Rim - Handle	Cooking pot	A. Berlin: prelim. dating Later (Medieval) [06.30.2011]. Probably handmade, lug handled	Late Medieval– Modern
2011	21	16		Rim	Unclear	A. Berlin: prelim dating 6th-4th c. BCE [06.30.2011]. Banded rim; open vessel (?)	Late Lydian
2011	21	17		Rim	Unclear	A. Berlin: prelim. dating 6th-4th c. BCE [06.30.2011]	Late Lydian
2011	21	18		Rim	Plate	A. Berlin: prelim dating 1st-2nd c. CE [06.30.2011]	Early Roman– Middle Roman
2011	21	19		Rim	Skyphos		Late Lydian

2011	21	20		Body	Unclear		Early Roman– Middle Roman
2011	21	21		Rim	Cup		Late Lydian
2011	21	23		Body	Flask	unguentarium without neck	Early Roman– Middle Roman
2011	21	24		Rim - Handle	Jar	banded neck with part of handle remaining	Early Roman– Middle Roman
2011	21	25		Rim - Handle	Jar		Early Roman– Middle Roman
2011	21	26		Foot - Body	Amphora		Late Lydian
2011	21	27		Foot - Body	Amphora		Early Roman– Middle Roman
2011	21	28		Shoulder	Unclear		Early Roman– Middle Roman
2011	21	29		Foot - Body	Amphora	foot ring is quite stocky	Late Lydian
2011	21	30		Rim	Bowl	echinus bowl	Late Lydian
2011	22	1		Foot - Body	Jar	flare of ring foot is shallow	Late Lydian
2011	22	2		Rim	Open vessel		Late Lydian
2011	22	3		Rim	Bowl	Achaemenid bowl	Late Lydian

2011	22	4		Base	Unclear		Late Medieval– Modern
2011	22	5		Lid	Lid	"soapy" texture on both exterior and interior sides of vessel	(Late Medieval–) Modern
2011	22	6		Rim	Unclear	sherd appears to have come from a flanged vessel (difficult to interpret how the sherd would have related to rest of vessel because very little of the body is preserved).	Late Lydian
2011	22	7		Handle	Unclear		Late Medieval– Modern
2011	22	8		Rim	Unclear		Late Medieval– Modern
2011	22	9		Base	Jar		Late Medieval– Modern
2011	22	10		Rim	Open vessel	Rim diameter cannot be determined.	Late Medieval– Modern
2011	22	11		Body	Unclear		Late Medieval– Modern

2011	22	12		Base	Unclear		Late Medieval– Modern
2011	22	13		Foot	Unclear		Late Medieval– Modern
2011	22	14		Handle	Unclear	possibly some slip on handle; ephemeral, could just be encrustations	Late Lydian
2011	22	15		Handle	Crater		Late Lydian
2011	22	16			Unclear		Late Lydian
2011	22	17		Rim	Jug		Late Lydian
2011	22	18		Handle	Unclear		Late Lydian
2011	25	1		Rim			Early Roman– Middle Roman
2011	25	2		Body	Cooking pot		Late Medieval– Modern
2011	25	3		Rim			Late Medieval– Modern

2011	26	1	Unglazed Domestic Ware with Slipped Exterior	Base	Jar		Late Medieval–Modern
2011	26	2		Body			Late Medieval–Modern
2011	27	1	Unglazed Domestic Ware with Slipped Exterior	Body			Modern
2011	28	1		Base	Jar	base is poorly preserved – diameter unclear.	Late Medieval–Modern
2011	30	1	Slip-Painted Ware	Body			Late Medieval–Ottoman
2011	31	1		Base			Late Medieval–Modern
2011	31	2	Unglazed Domestic Ware with Slipped Exterior	Body			Ottoman–Modern

2011	32	1	Unglazed Domestic Ware with Slipped Exterior	Handle			Ottoman–Modern
2011	32	2	Unglazed Domestic Ware with Slipped Exterior	Handle			Ottoman–Modern
2011	32	3		Handle - Body			Late Medieval–Modern
2011	34	1		Handle			Late Medieval–Modern
2011	34	2		Rim	Open vessel		Late Medieval–Modern
2011	34	3		Handle - Body			Late Medieval–Modern
2011	34	4		Body			Late Medieval–Modern
2011	37	1	Glazed Ware, Monochrome (green)	Rim	Open vessel	somewhat difficult to obtain rim diameter because of steep profile	Late Medieval–Ottoman

						of flare.	
2011	37	2	Unglazed Domestic Ware with Red Slip Exterior	Base	Jug		Late Medieval–Modern
2011	37	3	Unglazed Domestic Ware with Red Slip Exterior	Base	Unclear		Late Medieval–Modern
2011	37	4	Unglazed Domestic Ware with Red Slip Exterior	Spout	Jug, spouted		Ottoman
2011	37	5	Slip-Painted Ware	Shoulder	Jug		Late Medieval–Modern
2011	37	6	Unglazed Domestic Ware with Slip-Painted Decoration	Foot	Unclear		(Late Medieval–) Ottoman
2011	37	7	Unglazed Coarse Ware with Mica Slip Exterior	Rim		"soapy" feel to micaceous wash	Modern

2011	37	8	Unglazed Domestic Ware with Slip-Painted Decoration	Handle - Body	Unclear		Late Medieval–Modern
2011	37	9	Glazed Ware, Monochrome (ochre-yellow)	Foot - Body	Open vessel		Late Medieval–Ottoman
2011	37	10	Glazed Ware, Monochrome (olive-green)	Body	Open vessel		Ottoman–Modern
2011	37	11	Unglazed Domestic Ware with Slip-Painted Decoration	Body	Unclear		Late Medieval–Modern
2011	37	12	Lustre Ware	Body	Open vessel		Late Medieval
2011	37	13	Unglazed Domestic Ware with Red Slip Exterior	Body	Unclear		(Ottoman)–Modern
2011	37	14	Unglazed Domestic Ware	Body	Unclear		Ottoman–Modern
2011	37	15	Glazed Ware, Monochrome (green)	Handle	Unclear		Late Medieval–Ottoman

2011	37	16	Miletus Ware	Foot	Open vessel		Late Medieval/Ottoman
2011	37	17	Sgraffito Ware, Polychrome	Body	Open vessel		Late Medieval (– Ottoman)
2011	37	18	Sgraffito Ware, Polychrome	Rim	Open vessel	tappered round rim	Late Medieval (– Ottoman)
2011	37	19	Painted Ware, Polychrome	Body	Open vessel	sherd seems to be the bottom portion of an open vessel, which would have been located right above a vertical (flaring?) foot.	Late Medieval–Ottoman
2011	37	20	Painted Ware, Polychrome	Rim	Unclear		Late Medieval–Ottoman
2011	37	21	Painted Ware, Polychrome	Rim	Bowl	shallow flaring rim, indicative of bowl table ware	Late Medieval–Ottoman
2011	37	22	Sgraffito Ware, Polychrome	Base	Unclear	glazed ware abraded (?)	Late Medieval (– Ottoman)
2011	37	23	Unglazed Domestic Ware with Red Slip Exterior	Spout	Jug, spouted		Ottoman
2011	37	24	Unglazed Coarse Ware with Mica Slip Exterior	Rim	Plate	"soapy" exterior feel	(Late Medieval–) Modern

2011	37	25	Unglazed Coarse Ware with Mica Slip Exterior	Rim	Unclear	"soapy" exterior feel	(Late Medieval–) Modern
2011	37	26	Glazed Ware, Monochrome (green)	Body	Open vessel		(Late Medieval–) Ottoman
2011	37	27	Miletus Ware	Body	Open vessel		Late Medieval–Ottoman
2011	37	28	Unglazed Coarse Ware with Mica Slip Exterior	Handle	Unclear		(Late Medieval–) Modern
2011	37	29		Handle	Unclear		Early Roman–Late Roman
2011	37	30	Sgraffito Ware, Polychrome	Rim	Open vessel	probably a shallow dish or bowl	Late Medieval (– Ottoman)
2011	37	31		Handle	Unclear		Early Roman–Late Roman
2011	37	32	Miletus Ware	Body	Unclear		Late Medieval/Ottoman
2011	37	33	Glazed Ware, Monochrome (green)	Rim	Open vessel	shallow flared rim	(Late Medieval–) Ottoman

2011	37	34	Glazed Ware, Monochrome (green)	Rim			Ottoman
2011	37	35	Sgraffito Ware, Polychrome	Body	Open vessel		Late Medieval/Ottoman
2011	37	36	Sgraffito Ware, Polychrome	Shoulder	Unclear	closed vessel, possibly spouted jug	Late Medieval (– Ottoman)
2011	37	37		Neck	Jug		Early Roman–Late Roman
2011	37	38	Unglazed Domestic Ware with Slip-Painted Decoration	Rim		small size of rim makes diameter difficult to measure accurately, probably between 7-9 cm	Late Medieval– Ottoman
2011	37	39		Rim	Jug		Early Roman–Late Roman
2011	37	40	Glazed Ware, Monochrome (green)	Rim	Open vessel		Late Medieval– Ottoman
2011	37	41	Miletus Ware	Body	Open vessel		Late Medieval/Ottoman
2011	37	42	Sgraffito Ware, Polychrome	Body	Open vessel		Late Medieval (– Ottoman)

2011	37	43	Sgraffito Ware, Polychrome	Body	Open vessel	maybe "green and brown painted ware" (as in Vroom 2005)? fabric type and glaze colors are close, but sgraffito patterns seem different	Late Medieval (– Ottoman)
2011	37	44	Glazed Ware, Monochrome (brown)	Body	Open vessel		Late Medieval– Ottoman
2011	37	45		Rim	Cup		Early Roman–Late Roman
2011	37	46	Glazed Ware, Monochrome (green)	Rim	Open vessel	sherd is too small to get accurate rim diameter, could be 12-20 cm	Ottoman
2011	37	47	Sgraffito Ware, Monochrome (green)	Body	Open vessel		(Late Medieval–) Ottoman
2011	38	1		Shoulder			Unclear
2011	38	2		Handle			Late Medieval– Modern
2011	38	3		Rim			Late Medieval– Modern
2011	38	4		Foot - Body	Open vessel		Late Medieval– Ottoman

2011	38	5	Painted Ware, Polychrome	Body			Late Medieval– Ottoman
2011	38	6	Glazed Ware, Monochrome (olive-green)	Body			Late Medieval– Ottoman
2011	38	7	Slip-Painted Ware	Body			Late Medieval– Ottoman
2011	39	1	Glazed Ware, Monochrome (green)	Rim	Open vessel	size and irregularities in shape of rim makes it difficult to measure accurate diameter	Late Medieval– Ottoman
2011	75	1		Rim	Open vessel	damage to rim makes it difficult to accurately measure diameter. A. Berlin: prelim dating Hellenistic - Roman Cooking pot or jug; Roman (?) not earlier than Hellenistic [07.02.2011]	Roman
2011	85	1	Late Roman C	Rim	Plate	A. Berlin: LRC 3	Late Roman
2011	85	2		Body	Unclear	Late Lydian table amphora or Hydria	Late Lydian
2011	85	3		Body	Unclear		Late Roman

						Best guess is a plate rather than an upright vessel. A. Berlin: prelim. dating 5th - 3rd BCE cooking/cassrole dish [07.02.2011].	
2011	86	1		Rim	Open vessel		Late Lydian I–Early Hellenistic
2011	140	1		Base	Jug		Modern
2011	166	1		Body	Jug, spouted		
2011	166	2		Shoulder	Jug, spouted		
2011	166	3		Spout	Jug, spouted		
2011	166	4		Body			
2011	166	5		Body			
2011	166	6		Handle - Body	Amphora		

Table 5.3: Calculations of marble removed from the five quarries for which a DEM was created.

Quarry Name	POI Number	SU Number	Raw Calculations	Estimated Volume of Cut Stone
Haciveliler 1	POI06.12	SU11.3	466.22m ³	140-185m ³
Haciveliler 2	POI06.16	SU11.2	2,953.06m ³	885-1180m ³
Yeniköy 1	POI09.08a	SU11.6	5,879.34m ³	1760-2350m ³
Yeniköy 2	POI09.08b	SU11.7	10,364.33m ³	3100-4145m ³
Yeniköy 6	POI09.08f	SU11.11	3,712.75m ³	1115-1485m ³

Table 5.4: Stable Isotope Analysis Results

Identifier	δ 13C/12C ‰VPDB	δ 13C/12C Std Dev	δ 18O/16O ‰VPDB	δ 18O/16O Std Dev	Suspect
FS11.1	2.398	0.013	-3.896	0.021	
FS11.2	0.517	0.018	-5.106	0.024	
FS11.3	4.458	0.051	-5.77	1.473	stdev
FS11.3	4.388	0.023	-5.013	0.022	
FS11.4	4.215	0.026	-11.597	0.019	
FS11.5	4.691	0.027	-7.286	0.026	
POI05.40B.1	4.972	0.005	-4.203	0.019	
POI05.40B.2	4.762	0.009	-4.761	0.041	
POI05.40B.3	4.721	0.012	-4.854	0.026	
SU11.10.1	0.764	0.013	-5.216	0.014	
SU11.10.10	0.96	0.007	-4.905	0.03	
SU11.10.11	0.723	0.019	-5.467	0.026	
SU11.10.12	0.937	0.017	-5.451	0.034	
SU11.10.13	0.752	0.008	-5.439	0.025	
SU11.10.14	0.94	0.016	-5.132	0.016	
SU11.10.15	0.73	0.012	-5.216	0.023	
SU11.10.16	0.733	0.02	-5.347	0.028	
SU11.10.17	0.859	0.013	-5.394	0.029	
SU11.10.18	0.786	0.014	-5.348	0.032	
SU11.10.19	0.72	0.005	-5.342	0.016	
SU11.10.2	0.64	0.013	-4.917	0.014	
SU11.10.20	0.658	0.019	-5.278	0.024	
SU11.10.21	0.608	0.018	-5.715	0.011	
SU11.10.22	0.38	0.012	-5.445	0.029	
SU11.10.23	0.459	0.018	-5.672	0.053	
SU11.10.24	0.703	0.02	-5.372	0.026	
SU11.10.3	0.871	0.018	-4.874	0.036	
SU11.10.4	0.944	0.016	-5.831	0.021	
SU11.10.5	0.85	0.015	-4.965	0.011	
SU11.10.6	0.787	0.007	-5.241	0.02	
SU11.10.8	0.962	0.015	-5.709	0.029	
SU11.10.9	0.286	0.024	-7.889	0.016	
SU11.10.9A	0.526	0.015	-7.924	0.021	
SU11.10.9B	0.569	0.02	-7.664	0.03	
SU11.11.1	0.685	0.01	-5.443	0.029	
SU11.11.10	0.867	0.019	-7.173	0.026	
SU11.11.11	0.888	0.014	-4.811	0.044	
SU11.11.12	0.773	0.006	-6.597	0.025	
SU11.11.13	0.453	0.028	-6.873	0.023	
SU11.11.14	0.938	0.014	-6.874	0.012	
SU11.11.15	0.628	0.028	-5.124	0.027	
SU11.11.16	-0.064	0.024	-5.416	0.019	
SU11.11.17	0.492	0.012	-7.372	0.026	
SU11.11.18	0.232	0.016	-5.418	0.048	

SU11.11.19	0.841	0.013	-7.033	0.031	
SU11.11.2	0.712	0.016	-5.829	0.026	
SU11.11.20	0.55	0.011	-6.943	0.025	
SU11.11.21	0.64	0.026	-7.275	0.021	
SU11.11.22	0.545	0.02	-6.397	0.021	
SU11.11.23	0.813	0.023	-5.979	0.017	
SU11.11.24	0.738	0.021	-6.287	0.021	
SU11.11.25	0.804	0.021	-5.913	0.016	
SU11.11.3	0.413	0.012	-6.803	0.015	
SU11.11.4	0.832	0.01	-5.935	0.026	
SU11.11.5	0.57	0.021	-6.895	0.02	
SU11.11.6	1.067	0.02	-6.212	0.035	
SU11.11.7	0.335	0.017	-6.614	0.032	
SU11.11.8	0.1	0.019	-6.268	0.031	
SU11.11.9	0.294	0.027	-5.426	0.034	
SU11.12.1	0.139	0.021	-7.251	0.028	
SU11.12.10	0.777	0.014	-2.838	0.031	
SU11.12.11	0.66	0.017	-2.837	0.025	
SU11.12.12	0.217	0.022	-7.498	0.021	
SU11.12.13	0.155	0.023	-8.58	0.049	
SU11.12.14	1.207	0.014	-7.754	0.023	
SU11.12.15	-1.698	0.016	-13.239	0.008	
SU11.12.16	-0.745	0.015	-13.741	0.019	
SU11.12.17	0.259	0.017	-8.096	0.037	
SU11.12.18	-2.887	0.025	-5.738	0.048	
SU11.12.19	2.164	0.013	-6.618	0.046	
SU11.12.2	3.267	0.021	-3.414	0.022	
SU11.12.20	2.638	0.019	-4.34	0.014	
SU11.12.3	0.202	0.015	-8.04	0.023	
SU11.12.4	1.968	0.013	-3.212	0.031	
SU11.12.5	3.282	0.012	-2.028	0.026	
SU11.12.6	3.451	0.01	-1.773	0.021	
SU11.12.7	3.525	0.03	-2.453	0.012	
SU11.12.8	3.375	0.02	-2.67	0.014	
SU11.12.9	1.837	0.011	-3.427	0.028	
SU11.12.2A	3.155	0.009	-4.135	0.025	
SU11.12.2B	-1.109	0.015	-8.36	0.022	
SU11.12.15A	-1.708	0.016	-13.333	0.022	
SU11.12.15B	-1.742	0.028	-13.261	0.026	
SU11.2.1	1.54	0.021	-4.669	0.028	
SU11.2.10	1.123	0.016	-4.897	0.034	
SU11.2.11	1.199	0.031	-3.867	0.016	
SU11.2.12	1.438	0.01	-5.006	0.034	
SU11.2.13	0.936	0.012	-5.832	0.017	
SU11.2.14	0.613	0.018	-5.261	0.046	
SU11.2.15	1.027	0.004	-4.85	0.033	
SU11.2.16	0.86	0.013	-5.766	0.036	

SU11.2.17	-0.003	0.007	-7.429	0.024	
SU11.2.18	0.932	0.022	-5.544	0.044	
SU11.2.19	0.505	0.012	-6.349	0.025	
SU11.2.2	0.634	0.016	-4.758	0.027	
SU11.2.20	0.811	0.012	-6.256	0.026	
SU11.2.21	1.06	0.022	-5.864	0.019	
SU11.2.22	0.062	0.026	-4.712	0.031	
SU11.2.23	1.156	0.02	-5.397	0.021	
SU11.2.24	0.964	0.011	-6.014	0.016	
SU11.2.25	0.739	0.014	-6.31	0.025	
SU11.2.26	1.304	0.019	-6.094	0.049	
SU11.2.27	1.179	0.011	-4.288	0.021	
SU11.2.28	1.044	0.012	-5.397	0.025	
SU11.2.29	0.899	0.01	-5.151	0.033	
SU11.2.3	0.637	0.016	-4.475	0.009	
SU11.2.30	0.625	0.019	-6.322	0.047	
SU11.2.31	1.213	0.013	-5.864	0.02	
SU11.2.32	0.259	0.019	-6.302	0.037	
SU11.2.4	0.276	0.015	-5.199	0.048	
SU11.2.5	-0.075	0.019	-5.101	0.037	
SU11.2.6	1.442	0.014	-4.647	0.022	
SU11.2.7	0.906	0.01	-4.709	0.009	
SU11.2.8	1.026	0.023	-4.935	0.036	
SU11.2.9	0.462	0.015	-5.011	0.026	
SU11.2.17A	-0.278	0.022	-7.197	0.025	
SU11.2.17B	0.152	0.021	-7.125	0.024	
SU11.2.17C	0.06	0.024	-7.327	0.036	
SU11.3.1	1.179	0.01	-4.912	0.038	
SU11.3.2	0.989	0.026	-4.587	0.022	
SU11.3.3	1.007	0.01	-4.517	0.017	
SU11.3.4	2.61	0.01	-3.612	0.036	
SU11.3.5	2.001	0.009	-3.434	0.027	
SU11.3.6	-0.103	0.017	-3.618	0.034	
SU11.3.7	2.195	0.017	-3.524	0.037	
SU11.3.8	1.005	0.018	-4.033	0.022	
SU11.4.1	-1.493	0.03	-9.082	0.038	
SU11.4.2	0.535	0.02	-6.925	0.022	
SU11.4.3	-8.074	0.004	-8.138	0.025	
SU11.5.1	1.487	0.03	-7.726	0.046	
SU11.5.2	1.349	0.019	-5.577	0.042	
SU11.5.3	1.717	0.024	-4.576	0.031	
SU11.5.4	1.266	0.021	-6.787	0.041	
SU11.5.5	1.359	0.016	-5.413	0.02	
SU11.5.1A	1.628	0.014	-8.125	0.03	
SU11.5.1B	1.644	0.013	-8.086	0.034	
SU11.5.1C	1.605	0.01	-8.135	0.017	
SU11.6.1	0.123	0.009	-5.458	0.024	

SU11.6.10	0.574	0.015	-4.959	0.023	
SU11.6.11	0.451	0.01	-5.154	0.033	
SU11.6.12	0.022	0.015	-5.619	0.02	
SU11.6.13	0.535	0.017	-6.288	0.018	
SU11.6.14	0.2	0.018	-5.532	0.025	
SU11.6.15	0.088	0.012	-5.941	0.031	
SU11.6.2	0.257	0.021	-5.217	0.026	
SU11.6.3	0.302	0.021	-5.973	0.032	
SU11.6.4	0.672	0.027	-5.32	0.026	
SU11.6.5	-1.719	0.006	-5.721	0.037	
SU11.6.6	0.727	0.025	-5.456	0.031	
SU11.6.7	0.453	0.023	-5.46	0.011	
SU11.6.8	0.432	0.023	-5.372	0.025	
SU11.6.9	0.438	0.025	-5.384	0.022	
SU11.6.5A	0.73	0.007	-5.215	0.012	
SU11.6.5B	0.797	0.012	-5.211	0.036	
SU11.6.5C	0.833	0.02	-5.208	0.051	
SU11.6.1B	2.196	0.022	-10.035	0.033	
SU11.6.8B	2.551	0.021	-4.221	0.026	
SU11.6.10B	-1.424	0.019	-7.293	0.025	
SU11.6.13B	0.178	0.017	-5.452	0.022	
SU11.6.15B	0.386	0.022	-5.501	0.024	
SU11.7.1	0.847	0.02	-5.819	0.029	
SU11.7.10	0.771	0.012	-5.565	0.028	
SU11.7.11	0.742	0.012	-5.462	0.022	
SU11.7.12	0.725	0.006	-5.239	0.029	
SU11.7.13	0.628	0.008	-5.26	0.033	
SU11.7.2	0.72	0.017	-5.288	0.032	
SU11.7.3	0.881	0.016	-5.581	0.019	
SU11.7.4	0.74	0.013	-5.82	0.032	
SU11.7.5	0.897	0.006	-5.296	0.015	
SU11.7.6	0.711	0.018	-5.695	0.014	
SU11.7.7	0.797	0.022	-5.459	0.011	
SU11.7.8	0.835	0.017	-5.078	0.032	
SU11.7.9	0.908	0.028	-4.999	0.051	
SU11.8.1	0.633	0.016	-5.161	0.021	
SU11.8.10	0.728	0.011	-5.419	0.015	
SU11.8.11	1.011	0.019	-4.835	0.031	
SU11.8.12	0.972	0.022	-5.783	0.032	
SU11.8.2	0.872	0.01	-5.015	0.021	
SU11.8.3	0.197	0.028	-5.32	0.03	
SU11.8.4	0.383	0.011	-5.32	0.041	
SU11.8.5	0.717	0.017	-6.494	0.052	
SU11.8.6	0.372	0.014	-5.172	0.042	
SU11.8.7	0.464	0.026	-7.136	0.025	
SU11.8.8	0.538	0.02	-4.982	0.022	
SU11.8.9	0.71	0.007	-6.369	0.028	

SU11.9.1	0.794	0.007	-5.239	0.021	
SU11.9.2	0.592	0.009	-5.109	0.036	
SU11.9.3	0.549	0.016	-5.253	0.039	
SU11.9.4	0.546	0.015	-6.101	0.026	
SU11.9.5	0.605	0.02	-4.996	0.034	
SU11.9.6	0.461	0.012	-6.127	0.017	
SU11.9.7	0.497	0.017	-5.359	0.036	
SU11.9.8	0.859	0.009	-4.77	0.014	
SU11.9.9	0.949	0.016	-4.899	0.038	
T09.3.1	1.763	0.023	-3.349	0.029	
T09.3.2	0.585	0.018	-5.424	0.017	
T09.3.3	2.253	0.01	-4.306	0.028	
T09.3.4	1.769	0.007	-4.085	0.026	
T09.3.5	1.783	0.023	-4.375	0.025	
T09.03.6	1.982	0.02	-4.197	0.018	
T09.03.7	1.647	0.019	-3.911	0.03	
T09.03.8	0.803	0.014	-5.373	0.042	
AT.1	0.592	0.023	-5.063	0.04	
AT.2	0.329	0.014	-6.468	0.027	
AT.3	0.122	0.022	-6.087	0.019	

Table 5.5: XRF Results.

ID	Quarry	K	K +/-	Ca	Ca +/-	Mn	Mn +/-	Fe	Fe +/-
SU11.6.5	SU11.6	0	1144	671372	10289	39	7	147	11
SU11.6.1	SU11.6	0	1149	702074	10705	38	7	171	11
SU11.6.2	SU11.6	0	1120	622438	9494	59	8	171	11
SU11.6.3	SU11.6	0	1189	628307	10250	69	9	185	13
SU11.6.4	SU11.6	0	1135	669514	10259	62	8	184	12
SU11.6.6	SU11.6	0	1124	653716	10052	53	8	372	15
SU11.6.7	SU11.6	0	1114	645406	9724	94	8	584	18
SU11.6.8	SU11.6	0	1139	654660	10296	53	8	179	12
SU11.6.9	SU11.6	0	1138	683068	10503	48	7	167	12
SU11.6.10	SU11.6	0	1093	655960	9827	58	8	185	11
SU11.6.11	SU11.6	4346	389	587450	8680	78	8	698	19
SU11.6.12	SU11.6	0	1084	666434	9989	48	7	140	11
SU11.6.13	SU11.6	0	1091	676062	10051	62	7	229	12
SU11.6.14	SU11.6	0	1129	626642	9692	40	7	182	12
SU11.6.15	SU11.6	0	1143	598599	9760	46	8	188	13
SU11.12.1	SU11.12	0	1094	688895	10082	340	13	740	20
SU11.12.2	SU11.12	1266	378	670065	9920	89	8	391	14
SU11.12.3	SU11.12	0	1128	631607	9963	52	8	206	12
SU11.12.4	SU11.12	0	1103	554713	8931	88	9	755	21

SU11.12.5	SU11.12	0	1138	651829	10124	64	8	309	14
SU11.12.6	SU11.12	0	1119	607778	9715	63	8	226	13
SU11.12.7	SU11.12	0	1062	646752	9654	64	8	208	12
SU11.12.8	SU11.12	0	1160	657086	10288	104	9	840	22
SU11.12.9	SU11.12	0	1153	655332	10175	46	8	271	13
SU11.12.10	SU11.12	0	1143	613118	9674	130	10	1113	27
SU11.12.11	SU11.12	0	1148	689155	10731	33	7	249	13
SU11.12.12	SU11.12	0	1155	650360	10024	44	7	473	16
SU11.12.13	SU11.12	0	1128	678205	10355	51	7	174	12
SU11.12.14	SU11.12	0	1176	618498	10097	75	9	632	20
SU11.12.15	SU11.12	0	1168	636817	10190	62	8	684	20
SU11.12.16	SU11.12	0	1106	629735	9763	41	7	195	12
SU11.12.16	SU11.12	0	1149	649988	10281	54	8	392	15
SU11.12.17	SU11.12	0	1105	676981	10161	84	8	639	18
SU11.12.18	SU11.12	0	1103	664640	10100	32	7	225	12
SU11.12.19	SU11.12	0	1125	638724	9913	66	8	195	12
SU11.12.20	SU11.12	0	1167	636232	10061	69	8	556	18
SU11.7.1	SU11.7	0	1134	668034	10286	48	7	180	12
SU11.7.2	SU11.7	0	1173	649918	10286	53	8	283	14
SU11.7.3	SU11.7	0	1152	697569	10660	57	8	130	11

SU11.7.4	SU11.7	0	1138	665783	10378	53	8	176	12
SU11.7.5	SU11.7	0	1122	685888	10325	55	7	188	12
SU11.7.6	SU11.7	0	1127	688327	10375	57	8	184	12
SU11.7.7	SU11.7	0	1092	680151	10219	54	7	146	11
SU11.7.8	SU11.7	0	1133	687285	10463	56	8	158	11
SU11.7.9	SU11.7	0	1875	656994	15982	63	12	180	18
SU11.7.10	SU11.7	0	1137	648113	10002	57	8	195	12
SU11.7.11	SU11.7	0	1220	664307	11033	41	8	208	13
SU11.7.12	SU11.7	0	1096	672398	10072	42	7	159	11
SU11.7.13	SU11.7	0	1192	590441	10123	55	9	175	13
SU11.5.1	SU11.5	0	666	292410	3894	384	12	3726	56
SU11.5.2	SU11.5	0	686	298208	4001	508	14	5356	78
SU11.5.3	SU11.5	0	686	283258	3853	357	12	3093	49
SU11.5.4	SU11.5	0	691	306112	4128	442	13	5800	84
SU11.5.5	SU11.5	0	679	298333	4082	285	11	2996	48
SU11.2.1	SU11.2	0	1114	669385	10017	34	7	165	11
SU11.2.2	SU11.2	1526	448	567248	10619	65	10	229	16
SU11.2.3	SU11.2	1521	394	598311	9629	125	10	411	16
SU11.2.4	SU11.2	1942	442	591425	10612	65	10	222	15
SU11.2.5	SU11.2	0	1111	600679	9369	40	7	459	16

SU11.2.6	SU11.2	0	1132	650965	9833	43	7	180	11
SU11.2.7	SU11.2	0	1239	621310	10642	43	8	294	15
SU11.2.8	SU11.2	0	1143	676254	10129	35	7	199	12
SU11.2.9	SU11.2	0	1141	662250	10037	44	7	210	12
SU11.2.10	SU11.2	1442	417	567099	9898	48	9	287	15
SU11.2.11	SU11.2	0	1248	610949	10430	65	9	439	17
SU11.2.12	SU11.2	0	696	302877	4034	58	6	389	13
SU11.2.13	SU11.2	2354	665	570193	15416	76	16	233	24
SU11.2.14	SU11.2	0	1165	685312	10451	35	7	317	14
SU11.2.15	SU11.2	0	1154	673354	10418	48	8	217	12
SU11.2.16	SU11.2	0	1149	649338	9972	52	8	283	13
SU11.2.17	SU11.2	0	881	451773	6473	88	8	701	18
SU11.2.18	SU11.2	0	1128	629876	9791	58	8	529	17
SU11.2.19	SU11.2	0	1119	590198	9500	50	8	420	16
SU11.2.20	SU11.2	3317	418	605623	9792	73	9	1652	36
SU11.2.21	SU11.2	799	256	320747	4463	184	10	3804	60
SU11.2.22	SU11.2	4878	307	321307	4480	253	11	7900	116
SU11.2.23	SU11.2	0	1127	647182	9919	61	8	882	22
SU11.2.24	SU11.2	0	1136	668037	10213	80	8	1022	24
SU11.2.25	SU11.2	0	1099	647823	9788	68	8	735	20

SU11.2.26	SU11.2	0	1142	633867	9861	49	8	457	16
SU11.2.27	SU11.2	0	1134	669449	10037	49	7	241	12
SU11.2.28	SU11.2	0	1153	662068	10078	123	9	1291	28
SU11.2.29	SU11.2	0	1123	670701	10090	45	7	260	13
SU11.2.30	SU11.2	0	1127	669421	10091	105	9	715	20
SU11.2.31	SU11.2	0	1157	655629	10205	38	7	252	13
SU11.2.32	SU11.2	0	1160	665193	10314	78	8	662	19
SU11.4.1	SU11.4	7426	355	315993	4641	648	18	4016	66
SU11.4.2	SU11.4	0	1167	651449	10348	32	7	153	12
SU11.4.3	SU11.4	0	1001	504904	7617	421	15	1151	26
SU11.3.1	SU11.3	0	799	365820	5126	98	8	776	19
SU11.3.2	SU11.3	0	1160	659831	10388	32	7	142	11
SU11.3.3	SU11.3	0	1186	617901	10152	40	8	188	13
SU11.3.4	SU11.3	0	973	480388	7283	85	8	269	13
SU11.3.5	SU11.3	0	1121	558465	9139	73	9	242	14
SU11.3.5	SU11.3	0	921	478441	6876	80	8	390	14
SU11.3.6	SU11.3	1256	383	656226	9932	196	11	1945	38
SU11.3.7	SU11.3	0	1167	682064	10568	54	8	187	12
SU11.3.8	SU11.3	0	1138	670315	10241	53	8	148	11
SU11.8.1	SU11.8	0	1194	665212	10625	62	8	407	16

SU11.8.2	SU11.8	0	1169	634569	10262	34	8	240	13
SU11.8.3	SU11.8	0	1118	648001	9992	43	7	176	12
SU11.8.4	SU11.8	0	1115	651974	9850	46	7	227	12
SU11.8.5	SU11.8	0	1125	686119	10419	51	7	234	12
SU11.8.6	SU11.8	0	1142	696210	10570	38	7	186	12
SU11.8.7	SU11.8	0	1126	642329	9757	83	8	336	14
SU11.8.8	SU11.8	0	1129	661483	10012	56	8	242	12
SU11.8.9	SU11.8	0	1127	662566	10065	72	8	203	12
SU11.8.10	SU11.8	0	1154	693690	10489	51	7	225	12
SU11.8.11	SU11.8	0	1110	671587	9991	61	7	238	12
SU11.8.12	SU11.8	1382	393	673644	10320	60	8	540	17
SU11.9.1	SU11.9	0	1145	641504	10045	84	8	208	12
SU11.9.2	SU11.9	0	1134	686255	10337	45	7	170	11
SU11.9.3	SU11.9	0	1149	648460	9966	57	8	183	12
SU11.9.4	SU11.9	0	1145	671885	10416	55	8	232	13
SU11.9.5	SU11.9	0	1148	642213	9994	51	8	145	11
SU11.9.6	SU11.9	0	1105	680653	10182	48	7	188	11
SU11.9.7	SU11.9	0	1130	680013	10156	60	7	185	11
SU11.9.8	SU11.9	0	1144	697300	10530	48	7	173	11
SU11.9.9	SU11.9	0	1140	646681	10016	46	7	183	12

SU11.10.1	SU11.10	0	1135	688124	10394	52	7	201	12
SU11.10.2	SU11.10	0	1142	686512	10353	42	7	152	11
SU11.10.3	SU11.10	0	1143	668580	10281	61	8	155	11
SU11.10.4	SU11.10	0	1128	681002	10205	44	7	239	12
SU11.10.5	SU11.10	0	1161	634285	9991	53	8	208	12
SU11.10.6	SU11.10	0	1160	668324	10575	47	8	235	13
SU11.10.7	SU11.10	0	1111	692481	10391	59	7	168	11
SU11.10.8	SU11.10	0	1151	651441	10090	38	7	285	13
SU11.10.9	SU11.10	1594	384	646332	9794	93	8	750	20
SU11.10.10	SU11.10	1502	387	609474	9554	73	9	2331	45
SU11.10.11	SU11.10	0	1176	642687	10221	55	8	596	19
SU11.10.12	SU11.10	0	1150	637359	10064	72	8	446	16
SU11.10.13	SU11.10	0	1144	661785	10321	46	8	171	12
SU11.10.14	SU11.10	0	1118	666282	10068	38	7	270	13
SU11.10.15	SU11.10	0	1161	648255	10144	91	9	1010	25
SU11.10.16	SU11.10	1221	403	621321	10144	60	8	397	16
SU11.10.17	SU11.10	0	1124	640571	9956	47	8	389	15
SU11.10.18	SU11.10	0	1114	661475	10104	65	8	271	13
SU11.10.19	SU11.10	0	1121	664475	10188	45	7	173	12
SU11.10.20	SU11.10	0	1158	587909	9809	59	9	724	22

SU11.10.21	SU11.10	0	1105	627203	9806	64	8	214	12
SU11.10.22	SU11.10	0	1185	654412	10381	44	8	151	12
SU11.10.23	SU11.10	0	1125	620250	9773	60	8	749	21
SU11.10.24	SU11.10	0	1081	654202	9771	46	7	186	11
SU11.11.1	SU11.11	0	1144	638478	9981	52	8	204	12
SU11.11.2	SU11.11	0	1231	528843	9753	83	10	219	15
SU11.11.3	SU11.11	0	1118	686520	10466	38	7	181	12
SU11.11.4	SU11.11	0	1101	639779	9690	40	7	183	12
SU11.11.5	SU11.11	0	1139	615943	9889	48	8	228	13
SU11.11.6	SU11.11	0	1126	612748	9576	67	8	779	21
SU11.11.7	SU11.11	0	1358	518362	10608	102	12	326	19
SU11.11.8	SU11.11	0	1118	647686	9963	33	7	286	13
SU11.11.9	SU11.11	0	1137	628807	10035	43	8	166	12
SU11.11.10	SU11.11	0	1137	635148	9953	46	8	310	14
SU11.11.11	SU11.11	0	1129	657406	10215	40	7	191	12
SU11.11.12	SU11.11	0	1099	648790	9990	37	7	239	13
SU11.11.13	SU11.11	0	1075	653413	9927	72	8	224	12
SU11.11.14	SU11.11	0	1209	620221	10471	36	8	169	13
SU11.11.15	SU11.11	0	1126	668028	10166	199	11	278	13
SU11.11.16	SU11.11	0	1092	646723	9821	48	7	166	11

SU11.11.17	SU11.11	0	1202	626274	10436	118	10	356	16
SU11.11.18	SU11.11	0	1139	635678	10091	45	8	165	12
SU11.11.19	SU11.11	0	1170	661538	10329	46	8	573	18
SU11.11.20	SU11.11	0	1144	614847	9985	50	8	229	13
SU11.11.21	SU11.11	0	1132	646782	10014	54	8	235	13
SU11.11.22	SU11.11	0	1155	604077	9887	92	9	474	17
SU11.11.23	SU11.11	0	1218	557949	9897	71	10	615	21
SU11.11.24	SU11.11	0	1128	645194	10151	49	8	191	12
SU11.11.25	SU11.11	0	1175	601522	9885	52	8	303	15

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ID	Quarry	Ni	Ni +/-	Sr	Sr +/-	Zr	Zr +/-	I	I +/-
SU11.6.5	SU11.6	38	11	65	2	7	2	4977	566
SU11.6.1	SU11.6	55	11	45	2	9	2	5194	577
SU11.6.2	SU11.6	34	11	72	3	8	2	4767	543
SU11.6.3	SU11.6	47	12	47	2	10	2	4906	579
SU11.6.4	SU11.6	44	11	63	2	8	2	5456	568
SU11.6.6	SU11.6	0	32	74	3	10	2	4033	556
SU11.6.7	SU11.6	0	31	85	3	8	2	5203	548
SU11.6.8	SU11.6	33	11	75	3	9	2	3762	567
SU11.6.9	SU11.6	0	32	44	2	9	2	4895	572

SU11.6.10	SU11.6	0	29	69	2	9	2	4617	547
SU11.6.11	SU11.6	41	11	68	2	11	2	3812	509
SU11.6.12	SU11.6	32	11	90	3	8	2	4180	549
SU11.6.13	SU11.6	0	31	96	3	9	2	3278	546
SU11.6.14	SU11.6	43	11	69	2	0	6	3461	545
SU11.6.15	SU11.6	50	12	56	2	11	2	4544	563
SU11.12.1	SU11.12	38	11	144	3	8	2	5796	554
SU11.12.2	SU11.12	47	11	202	4	8	2	4578	547
SU11.12.3	SU11.12	0	32	210	4	13	2	4445	561
SU11.12.4	SU11.12	0	34	167	4	13	2	3017	530
SU11.12.5	SU11.12	0	33	270	5	13	2	4546	563
SU11.12.6	SU11.12	44	12	187	4	9	2	4353	557
SU11.12.7	SU11.12	0	31	176	4	9	2	4841	543
SU11.12.8	SU11.12	40	11	234	5	8	2	4373	569
SU11.12.9	SU11.12	33	11	332	6	9	2	5165	567
SU11.12.10	SU11.12	0	32	202	4	10	2	4949	556
SU11.12.11	SU11.12	0	32	211	4	7	2	5343	583
SU11.12.12	SU11.12	0	31	240	5	8	2	5728	565
SU11.12.13	SU11.12	35	11	223	5	11	2	4902	567
SU11.12.14	SU11.12	0	35	176	4	12	2	4111	571
SU11.12.15	SU11.12	36	11	173	4	10	2	4018	569

SU11.12.16	SU11.12	0	31	156	4	11	2	3376	547
SU11.12.16	SU11.12	0	30	139	4	13	2	3886	568
SU11.12.17	SU11.12	0	31	180	4	7	2	5687	561
SU11.12.18	SU11.12	0	32	45	2	7	2	4651	558
SU11.12.19	SU11.12	0	32	230	5	9	2	3650	553
SU11.12.20	SU11.12	0	32	231	5	16	2	3921	562
SU11.7.1	SU11.7	47	11	44	2	0	6	5645	570
SU11.7.2	SU11.7	46	11	69	3	9	2	4710	573
SU11.7.3	SU11.7	41	11	58	2	0	6	5095	576
SU11.7.4	SU11.7	0	32	51	2	6	2	4569	571
SU11.7.5	SU11.7	43	11	56	2	9	2	4944	563
SU11.7.6	SU11.7	38	11	47	2	8	2	5602	567
SU11.7.7	SU11.7	33	11	50	2	8	2	5912	564
SU11.7.8	SU11.7	0	32	83	3	15	2	5987	574
SU11.7.9	SU11.7	0	48	88	5	0	10	4144	917
SU11.7.10	SU11.7	0	31	56	2	14	2	5054	563
SU11.7.11	SU11.7	0	32	51	2	9	2	4981	605
SU11.7.12	SU11.7	37	11	60	2	10	2	5994	560
SU11.7.13	SU11.7	0	36	73	3	10	2	2866	577
SU11.5.1	SU11.5	0	27	317	5	11	2	2865	325
SU11.5.2	SU11.5	0	28	250	4	8	2	3022	332

SU11.5.3	SU11.5	0	28	230	4	9	2	3301	329
SU11.5.4	SU11.5	0	29	205	4	6	2	3134	338
SU11.5.5	SU11.5	0	27	248	4	10	2	3267	339
SU11.2.1	SU11.2	37	11	111	3	7	2	2749	544
SU11.2.2	SU11.2	0	38	140	4	12	3	0	1808
SU11.2.3	SU11.2	0	33	126	3	9	2	2840	549
SU11.2.4	SU11.2	0	34	125	4	0	7	3140	602
SU11.2.5	SU11.2	0	33	61	2	8	2	3040	536
SU11.2.6	SU11.2	0	30	139	3	8	2	3150	543
SU11.2.7	SU11.2	0	35	99	3	11	2	2897	591
SU11.2.8	SU11.2	0	32	141	3	11	2	3024	549
SU11.2.9	SU11.2	0	29	188	4	11	2	2934	548
SU11.2.10	SU11.2	0	36	127	4	11	2	3356	577
SU11.2.11	SU11.2	41	12	130	4	10	2	3457	587
SU11.2.12	SU11.2	32	9	66	2	5	2	3013	331
SU11.2.13	SU11.2	0	50	172	6	11	3	3654	834
SU11.2.14	SU11.2	48	11	155	4	10	2	3945	565
SU11.2.15	SU11.2	34	11	141	4	9	2	4104	568
SU11.2.16	SU11.2	0	32	152	4	8	2	3832	553
SU11.2.17	SU11.2	0	29	107	3	7	2	3138	432
SU11.2.18	SU11.2	0	32	142	4	9	2	3393	549

SU11.2.19	SU11.2	0	33	141	4	9	2	2053	542
SU11.2.20	SU11.2	41	12	137	4	12	2	3219	557
SU11.2.21	SU11.2	0	30	147	3	8	2	2187	352
SU11.2.22	SU11.2	38	11	163	3	13	2	2956	357
SU11.2.23	SU11.2	0	31	136	3	8	2	3018	548
SU11.2.24	SU11.2	37	11	159	4	14	2	2407	553
SU11.2.25	SU11.2	0	31	133	3	9	2	4301	547
SU11.2.26	SU11.2	0	31	176	4	11	2	2858	549
SU11.2.27	SU11.2	36	11	182	4	11	2	4583	553
SU11.2.28	SU11.2	0	29	119	3	12	2	4150	556
SU11.2.29	SU11.2	59	12	225	5	14	2	2865	548
SU11.2.30	SU11.2	0	30	190	4	8	2	2458	547
SU11.2.31	SU11.2	39	11	292	5	9	2	3496	561
SU11.2.32	SU11.2	0	31	170	4	9	2	2792	560
SU11.4.1	SU11.4	56	12	196	4	24	2	2818	372
SU11.4.2	SU11.4	34	11	99	3	11	2	3109	567
SU11.4.3	SU11.4	35	11	301	5	15	2	3667	480
SU11.3.1	SU11.3	0	28	80	2	0	5	2768	380
SU11.3.2	SU11.3	0	31	122	3	10	2	3420	568
SU11.3.3	SU11.3	0	31	140	4	10	2	4579	576
SU11.3.4	SU11.3	0	29	82	3	9	2	3642	471

SU11.3.5	SU11.3	36	11	105	3	10	2	3705	542
SU11.3.5	SU11.3	0	28	79	2	6	2	3421	447
SU11.3.6	SU11.3	33	11	136	3	14	2	3220	547
SU11.3.7	SU11.3	47	11	73	3	7	2	4191	573
SU11.3.8	SU11.3	0	30	120	3	7	2	2548	554
SU11.8.1	SU11.8	0	33	75	3	12	2	3772	579
SU11.8.2	SU11.8	40	11	68	3	10	2	3438	571
SU11.8.3	SU11.8	41	11	76	3	8	2	3410	553
SU11.8.4	SU11.8	34	11	67	2	10	2	3683	545
SU11.8.5	SU11.8	44	11	70	2	10	2	5393	570
SU11.8.6	SU11.8	36	11	82	3	6	2	3684	566
SU11.8.7	SU11.8	37	11	87	3	8	2	4295	547
SU11.8.8	SU11.8	32	11	78	3	9	2	3898	551
SU11.8.9	SU11.8	0	32	95	3	11	2	3199	550
SU11.8.10	SU11.8	32	11	60	2	6	2	4202	565
SU11.8.11	SU11.8	50	11	86	3	12	2	4432	549
SU11.8.12	SU11.8	33	11	88	3	12	2	4124	563
SU11.9.1	SU11.9	0	32	58	2	6	2	4081	560
SU11.9.2	SU11.9	0	31	69	2	12	2	4054	560
SU11.9.3	SU11.9	39	11	83	3	10	2	3583	552
SU11.9.4	SU11.9	46	11	90	3	9	2	4368	570

SU11.9.5	SU11.9	48	11	59	2	11	2	4612	560
SU11.9.6	SU11.9	40	11	80	3	0	6	4745	557
SU11.9.7	SU11.9	0	31	59	2	11	2	5631	560
SU11.9.8	SU11.9	0	31	76	3	9	2	3614	564
SU11.9.9	SU11.9	0	32	92	3	11	2	3697	555
SU11.10.1	SU11.10	34	11	69	2	6	2	4221	563
SU11.10.2	SU11.10	0	31	62	2	11	2	5357	566
SU11.10.3	SU11.10	0	31	69	3	9	2	4910	566
SU11.10.4	SU11.10	0	31	81	3	7	2	5407	561
SU11.10.5	SU11.10	34	11	73	3	8	2	3699	558
SU11.10.6	SU11.10	0	33	81	3	14	2	3754	576
SU11.10.7	SU11.10	0	31	69	2	0	6	5800	568
SU11.10.8	SU11.10	41	11	72	3	9	2	4126	559
SU11.10.9	SU11.10	40	11	110	3	7	2	3738	545
SU11.10.10	SU11.10	36	11	60	2	0	6	4860	551
SU11.10.11	SU11.10	0	33	61	2	11	2	4395	570
SU11.10.12	SU11.10	51	12	64	2	8	2	4451	564
SU11.10.13	SU11.10	56	12	53	2	8	2	6426	578
SU11.10.14	SU11.10	0	31	64	2	10	2	3816	552
SU11.10.15	SU11.10	0	32	54	2	7	2	5534	570
SU11.10.16	SU11.10	0	32	53	2	9	2	3220	568

SU11.10.17	SU11.10	0	32	55	2	10	2	4625	559
SU11.10.18	SU11.10	32	11	47	2	7	2	4887	560
SU11.10.19	SU11.10	47	11	69	2	9	2	4347	561
SU11.10.20	SU11.10	0	35	55	2	7	2	4294	569
SU11.10.21	SU11.10	0	32	54	2	7	2	5251	559
SU11.10.22	SU11.10	40	11	55	2	10	2	3883	571
SU11.10.23	SU11.10	54	12	70	3	7	2	4468	556
SU11.10.24	SU11.10	0	30	84	3	0	6	3816	541
SU11.11.1	SU11.11	0	32	70	3	0	6	4465	560
SU11.11.2	SU11.11	0	38	56	3	11	2	4705	592
SU11.11.3	SU11.11	0	31	66	2	8	2	4040	566
SU11.11.4	SU11.11	55	11	60	2	0	6	3937	543
SU11.11.5	SU11.11	0	34	79	3	8	2	4437	563
SU11.11.6	SU11.11	0	31	91	3	0	6	3755	546
SU11.11.7	SU11.11	0	37	73	3	0	8	2333	627
SU11.11.8	SU11.11	59	12	56	2	9	2	4689	557
SU11.11.9	SU11.11	0	33	65	3	8	2	3692	562
SU11.11.10	SU11.11	0	32	86	3	8	2	4509	560
SU11.11.11	SU11.11	35	11	85	3	0	6	3662	561
SU11.11.12	SU11.11	0	32	72	3	0	6	4220	556
SU11.11.13	SU11.11	36	11	83	3	8	2	4728	553

SU11.11.14	SU11.11	0	33	73	3	8	2	4396	590
SU11.11.15	SU11.11	34	11	67	2	8	2	4891	561
SU11.11.16	SU11.11	0	31	72	3	0	6	4386	549
SU11.11.17	SU11.11	0	34	99	3	0	7	3364	582
SU11.11.18	SU11.11	0	32	56	2	7	2	4080	564
SU11.11.19	SU11.11	0	32	80	3	10	2	4138	568
SU11.11.20	SU11.11	36	12	89	3	7	2	4373	568
SU11.11.21	SU11.11	0	31	92	3	7	2	3645	555
SU11.11.22	SU11.11	0	34	67	3	9	2	2990	561
SU11.11.23	SU11.11	43	12	57	3	7	2	3734	582
SU11.11.24	SU11.11	0	32	76	3	9	2	3860	563
SU11.11.25	SU11.11	0	32	82	3	12	2	3939	566

Table 5.5: Ammended XRF data table – variation causing elements.

ID	Quarry	Mn	Fe	Ni	Sr	Zr
SU11.6.5	SU11.6	39	147	38	65	7
SU11.6.1	SU11.6	38	171	55	45	9
SU11.6.2	SU11.6	59	171	34	72	8
SU11.6.3	SU11.6	69	185	47	47	10
SU11.6.4	SU11.6	62	184	44	63	8
SU11.6.6	SU11.6	53	372	0	74	10
SU11.6.7	SU11.6	94	584	0	85	8
SU11.6.8	SU11.6	53	179	33	75	9
SU11.6.9	SU11.6	48	167	0	44	9
SU11.6.10	SU11.6	58	185	0	69	9
SU11.6.11	SU11.6	78	698	41	68	11
SU11.6.12	SU11.6	48	140	32	90	8
SU11.6.13	SU11.6	62	229	0	96	9
SU11.6.14	SU11.6	40	182	43	69	0
SU11.6.15	SU11.6	46	188	50	56	11
	MEAN	56.466 666	252.133 333	27.8	67.86666 6	8.4
SU11.12.1	SU11.12	340	740	38	144	8
SU11.12.2	SU11.12	89	391	47	202	8
SU11.12.3	SU11.12	52	206	0	210	13
SU11.12.4	SU11.12	88	755	0	167	13
SU11.12.5	SU11.12	64	309	0	270	13
SU11.12.6	SU11.12	63	226	44	187	9
SU11.12.7	SU11.12	64	208	0	176	9
SU11.12.8	SU11.12	104	840	40	234	8
SU11.12.9	SU11.12	46	271	33	332	9
SU11.12.10	SU11.12	130	1113	0	202	10
SU11.12.11	SU11.12	33	249	0	211	7
SU11.12.12	SU11.12	44	473	0	240	8
SU11.12.13	SU11.12	51	174	35	223	11

SU11.12.14	SU11.12	75	632	0	176	12
SU11.12.15	SU11.12	62	684	36	173	10
SU11.12.16	SU11.12	41	195	0	156	11
SU11.12.16	SU11.12	54	392	0	139	13
SU11.12.17	SU11.12	84	639	0	180	7
SU11.12.18	SU11.12	32	225	0	45	7
SU11.12.19	SU11.12	66	195	0	230	9
SU11.12.20	SU11.12	69	556	0	231	16
	MEAN	78.619 047	451.095 238	13	196.5714 2	10.047 619
SU11.7.1	SU11.7	48	180	47	44	0
SU11.7.2	SU11.7	53	283	46	69	9
SU11.7.3	SU11.7	57	130	41	58	0
SU11.7.4	SU11.7	53	176	0	51	6
SU11.7.5	SU11.7	55	188	43	56	9
SU11.7.6	SU11.7	57	184	38	47	8
SU11.7.7	SU11.7	54	146	33	50	8
SU11.7.8	SU11.7	56	158	0	83	15
SU11.7.9	SU11.7	63	180	0	88	0
SU11.7.10	SU11.7	57	195	0	56	14
SU11.7.11	SU11.7	41	208	0	51	9
SU11.7.12	SU11.7	42	159	37	60	10
SU11.7.13	SU11.7	55	175	0	73	10
	MEAN	53.153 846	181.692 307	21.9230 76	60.46153 8	7.5384 615
SU11.5.1	SU11.5	384	3726	0	317	11
SU11.5.2	SU11.5	508	5356	0	250	8
SU11.5.3	SU11.5	357	3093	0	230	9
SU11.5.4	SU11.5	442	5800	0	205	6
SU11.5.5	SU11.5	285	2996	0	248	10
	MEAN	395.2	4194.2	0	250	8.8
SU11.2.1	SU11.2	34	165	37	111	7
SU11.2.2	SU11.2	65	229	0	140	12

SU11.2.3	SU11.2	125	411	0	126	9
SU11.2.4	SU11.2	65	222	0	125	0
SU11.2.5	SU11.2	40	459	0	61	8
SU11.2.6	SU11.2	43	180	0	139	8
SU11.2.7	SU11.2	43	294	0	99	11
SU11.2.8	SU11.2	35	199	0	141	11
SU11.2.9	SU11.2	44	210	0	188	11
SU11.2.10	SU11.2	48	287	0	127	11
SU11.2.11	SU11.2	65	439	41	130	10
SU11.2.12	SU11.2	58	389	32	66	5
SU11.2.13	SU11.2	76	233	0	172	11
SU11.2.14	SU11.2	35	317	48	155	10
SU11.2.15	SU11.2	48	217	34	141	9
SU11.2.16	SU11.2	52	283	0	152	8
SU11.2.17	SU11.2	88	701	0	107	7
SU11.2.18	SU11.2	58	529	0	142	9
SU11.2.19	SU11.2	50	420	0	141	9
SU11.2.20	SU11.2	73	1652	41	137	12
SU11.2.21	SU11.2	184	3804	0	147	8
SU11.2.22	SU11.2	253	7900	38	163	13
SU11.2.23	SU11.2	61	882	0	136	8
SU11.2.24	SU11.2	80	1022	37	159	14
SU11.2.25	SU11.2	68	735	0	133	9
SU11.2.26	SU11.2	49	457	0	176	11
SU11.2.27	SU11.2	49	241	36	182	11
SU11.2.28	SU11.2	123	1291	0	119	12
SU11.2.29	SU11.2	45	260	59	225	14
SU11.2.30	SU11.2	105	715	0	190	8
SU11.2.31	SU11.2	38	252	39	292	9
SU11.2.32	SU11.2	78	662	0	170	9
	MEAN	71.187	814.281	13.8125	146.625	9.5

		5	25			
SU11.4.1	SU11.4	648	4016	56	196	24
SU11.4.2	SU11.4	32	153	34	99	11
SU11.4.3	SU11.4	421	1151	35	301	15
	MEAN	367	1773.33 333	41.6666 66	198.6666 6	16.666 666
SU11.3.1	SU11.3	98	776	0	80	0
SU11.3.2	SU11.3	32	142	0	122	10
SU11.3.3	SU11.3	40	188	0	140	10
SU11.3.4	SU11.3	85	269	0	82	9
SU11.3.5	SU11.3	73	242	36	105	10
SU11.3.5	SU11.3	80	390	0	79	6
SU11.3.6	SU11.3	196	1945	33	136	14
SU11.3.7	SU11.3	54	187	47	73	7
SU11.3.8	SU11.3	53	148	0	120	7
	MEAN	79	476.333 333	12.8888 88	104.1111 1	8.1111 111
SU11.8.1	SU11.8	62	407	0	75	12
SU11.8.2	SU11.8	34	240	40	68	10
SU11.8.3	SU11.8	43	176	41	76	8
SU11.8.4	SU11.8	46	227	34	67	10
SU11.8.5	SU11.8	51	234	44	70	10
SU11.8.6	SU11.8	38	186	36	82	6
SU11.8.7	SU11.8	83	336	37	87	8
SU11.8.8	SU11.8	56	242	32	78	9
SU11.8.9	SU11.8	72	203	0	95	11
SU11.8.10	SU11.8	51	225	32	60	6
SU11.8.11	SU11.8	61	238	50	86	12
SU11.8.12	SU11.8	60	540	33	88	12
	MEAN	54.75	271.166 666	31.5833 33	77.66666 6	9.5
SU11.9.1	SU11.9	84	208	0	58	6
SU11.9.2	SU11.9	45	170	0	69	12

SU11.9.3	SU11.9	57	183	39	83	10
SU11.9.4	SU11.9	55	232	46	90	9
SU11.9.5	SU11.9	51	145	48	59	11
SU11.9.6	SU11.9	48	188	40	80	0
SU11.9.7	SU11.9	60	185	0	59	11
SU11.9.8	SU11.9	48	173	0	76	9
SU11.9.9	SU11.9	46	183	0	92	11
	MEAN	54.888 888	185.222 222	19.2222 22	74	8.7777 777
SU11.10.1	SU11.10	52	201	34	69	6
SU11.10.2	SU11.10	42	152	0	62	11
SU11.10.3	SU11.10	61	155	0	69	9
SU11.10.4	SU11.10	44	239	0	81	7
SU11.10.5	SU11.10	53	208	34	73	8
SU11.10.6	SU11.10	47	235	0	81	14
SU11.10.7	SU11.10	59	168	0	69	0
SU11.10.8	SU11.10	38	285	41	72	9
SU11.10.9	SU11.10	93	750	40	110	7
SU11.10.10	SU11.10	73	2331	36	60	0
SU11.10.11	SU11.10	55	596	0	61	11
SU11.10.12	SU11.10	72	446	51	64	8
SU11.10.13	SU11.10	46	171	56	53	8
SU11.10.14	SU11.10	38	270	0	64	10
SU11.10.15	SU11.10	91	1010	0	54	7
SU11.10.16	SU11.10	60	397	0	53	9
SU11.10.17	SU11.10	47	389	0	55	10
SU11.10.18	SU11.10	65	271	32	47	7
SU11.10.19	SU11.10	45	173	47	69	9
SU11.10.20	SU11.10	59	724	0	55	7
SU11.10.21	SU11.10	64	214	0	54	7
SU11.10.22	SU11.10	44	151	40	55	10

SU11.10.23	SU11.10	60	749	54	70	7
SU11.10.24	SU11.10	46	186	0	84	0
	MEAN	56.416 666	436.291 666	19.375	66	7.5416 666
SU11.11.1	SU11.11	52	204	0	70	0
SU11.11.2	SU11.11	83	219	0	56	11
SU11.11.3	SU11.11	38	181	0	66	8
SU11.11.4	SU11.11	40	183	55	60	0
SU11.11.5	SU11.11	48	228	0	79	8
SU11.11.6	SU11.11	67	779	0	91	0
SU11.11.7	SU11.11	102	326	0	73	0
SU11.11.8	SU11.11	33	286	59	56	9
SU11.11.9	SU11.11	43	166	0	65	8
SU11.11.10	SU11.11	46	310	0	86	8
SU11.11.11	SU11.11	40	191	35	85	0
SU11.11.12	SU11.11	37	239	0	72	0
SU11.11.13	SU11.11	72	224	36	83	8
SU11.11.14	SU11.11	36	169	0	73	8
SU11.11.15	SU11.11	199	278	34	67	8
SU11.11.16	SU11.11	48	166	0	72	0
SU11.11.17	SU11.11	118	356	0	99	0
SU11.11.18	SU11.11	45	165	0	56	7
SU11.11.19	SU11.11	46	573	0	80	10
SU11.11.20	SU11.11	50	229	36	89	7
SU11.11.21	SU11.11	54	235	0	92	7
SU11.11.22	SU11.11	92	474	0	67	9
SU11.11.23	SU11.11	71	615	43	57	7
SU11.11.24	SU11.11	49	191	0	76	9
SU11.11.25	SU11.11	52	303	0	82	12
	MEAN	62.44	291.6	11.92	74.08	5.76

Chapter 6

Governmentality, Quarries and the Marmara Lake Basin

Introduction

The eleven quarries presented in detail in the previous two chapters offer a study that few marble studies undertake. Here, I deliberately differentiate between quarry studies and marble studies: the former tends to offer some form of survey, while the latter has a far more limited set of concerns. Beginning with the work of Ward-Perkins, archaeological interest in marble and quarries began to look beyond the identification of stone, realizing that an understanding of the stone *industry* can offer insight into economic practices and economic decisions. This is still the primary objective of most studies, and indeed this project does not stray too far from similar concerns. Gradually scholars are beginning to suggest that, as Russell (2009a; 2009b) notes, discussions of marble quarries as part of a broad system are misleading: far more diversity exists than is often expected, with the resulting models of economic activity struggling to incorporate such small-scale data. The opportunity referred to above is to ask slightly different questions. Instead of wondering how economic models can explain the pattern of quarry activity in the past, this chapter, beginning with the suggestion that local context matters, asks: How do these sites fit in with broader changes in social life? In other words, what else do changes in industrial activity suggest? How can integrating resource studies into

broader discourses about the fluid nature of social life impact our interpretation of the entire landscape?

This chapter develops the results from the previous chapter by turning to big-picture geopolitical concerns affecting this part of western Anatolia over time. Such issues are placed against the results from the regional survey and the quarry survey, with the incorporation of geological data and settlement data providing greater texture for interpretive efforts. The chapter then addresses traditional models for explaining the pattern detected in Lydia before expanding on such approaches through the consideration of broader changes to social memory and place, issues that transcend the strict boundaries of an economics-based perspective on choice as it pertains to quarried stone.

Technological considerations will also be discussed, as will the concept of place as experienced, or place as human activity. The resulting conclusions are therefore rooted first in physical interactions with the material attributes of places in the landscape, resulting in an array of alternative ways to understand the significance of changing settlement and industrial practices in the central Lydian landscape. Sites of industry, I conclude, are always social in nature, contributing as they do to perceptions of the landscape and adding dimensions of place to any discussion of economic process.

Expanding on Russell's suggestion that local motivations are numerous, and that quarries are therefore subject to regionally specific uses and production patterns, I additionally suggest that resource sites of all kinds are never free of the same society-constructing rhythms that create economic policies and practices.

All of this is tied back to the concept of governmentality through the assessment of social and economic spheres of activity. More so than drawing conclusions about how

Roman governance was asserted in small quarries, this chapter looks at how an investigation of small quarries reveals how Roman governance was modified by daily practices. Patterns of control as expressed by the state are shown in this chapter to atomize once those expressions are actualized on the ground through existing systems of social communication and behavior. Exploring the quarries of the Marmara Lake Basin in this way provides new insight into the significance of the small-scale on a large-scale polity.

A Review of the Quarry Data

As described in detail in Chapter 5, the evidence from the quarries points to several distinct patterns and processes underway in the region of central Lydia. Broadly speaking, the survey, mapping, and sampling program reveals that extensive quarrying took place during the Lydian-Late Lydian periods north of Marmara Gölü. These quarries were worked with the heavy iron pick in a very regular pattern, yielding uniform block sizes and shapes that were, at least in part, used in constructing one of the tumuli located in Bin Tepe. There are no associated habitation sites dating to the centuries contemporary with stone extraction at these quarries. This evidence indicates that work was conducted for specific projects, negating the need for permanent settlement in the immediate vicinity of the quarries.

It should be noted that this happened in a period (the Iron Age) that followed a significant caesura after the Bronze Age reordering of social and political structures that resulted in a southward shift in settlement activity towards the Tmolus mountains and Sardis. By the Iron Age, the lake basin held a different social significance, now as a

commemorative landscape rooted in environmental features and solidified through monumental attachments (Luke and Roosevelt forthcoming; see also Bradley 1993; 1998). This relationship between resource sites and settlements contrasts with data for the Roman period, which indicates less intensive quarrying, yet stronger ties between the communities living in the region surrounding the lake and the quarries themselves. Aggregate counts of rural settlement in the Roman period are higher than they were in the preceding Lydian-Late Lydian periods, and there was close spatial proximity between quarries and settlements. New quarries were opened on the northwest side of the lake, while some quarrying continued north of the lake, as well in Iron Age quarries. Roman settlement is attested in both areas.

The subsequent chronological periods are more difficult to discern in the quarries themselves. This is in part because little effort has gone into differentiating Medieval-Ottoman quarry technology from its more prominent Hellenistic-Roman counterparts. Some notable patterns do emerge when the data are carefully considered, which help to reveal changing patterns of extraction over time. Different sets of tool marks appear in several of the quarries, suggesting that a different tool-kit was used during the Medieval-Ottoman periods. Although the dating of tool marks is not refined enough to distinguish specific dates within this chronological range, they can be distinguished from the earlier tool marks in several ways. First, the angle of the tool is more regularly diagonal for the later periods, as indicated in a comparison of tool marks at Haciveliler 2. Here, very angular markings appear in obviously later use than the traditional classical examples of sweeping, curving lines. Additionally, the classical markings appear in conjunction with larger quarry surfaces, which suggests that deeper veins of marble were followed for

extraction in the Classical period than in the Medieval-Ottoman periods. In the later examples, tool marks are invariably associated with easily-struck, outward-jutting, exposed marble, resulting in a less regular pattern of extraction, both in the size of cut blocks and in the progression of extractive activities. The concerted efforts to remove layers of marble that characterize Classical quarrying are not witnessed in the examples of Medieval-Ottoman quarrying, which appears more opportunistic in nature. Settlement data from these periods is similar to the Roman data in that habitation sites are usually in close proximity to quarries. Many more Medieval-Ottoman sites in Bin Tepe are not associated with marble quarries in any way, though limestone was much more readily available in this region.

In general, the quarry data fit nicely into the overarching narrative described through the historical documents and the survey data. Of particular significance are the indications that multiple strategies of extracting stone were in use in the Roman period of central Lydia. Furthermore, the existence of multiple extraction strategies parallels a substantial difference in organizational structures related to stone-working, suggesting multiple strategies of control. Stable isotope data suggest different distribution patterns for marble from the rural quarries north of the lake and the marble from the major source at Mağara Deresi. Rather than suggesting, minimally, that these broad level trends of cultural change over time explain the different patterns in marble extraction, the remainder of this chapter seeks to demonstrate how the material interactions with quarries and with stone are part of a complicated network of interactions that simultaneously create social norms while they themselves are subject to new social norms. Whereas most

existing scholarship attempts to explain changes in technological practice as the prerogative of changing political-economic institutions, the evidence from central Lydia points to a more inclusive, participatory composition of the regional political and economic authority, dependent on divergent markets and divergent practices related to material acquisition and production. The remainder of the chapter will explore the significance of such a suggestion by supplementing how economic models explain these phenomena with a look at how Lydia and the non-imperially owned marble quarries in the lake basin fit within Roman practices of governmentality that were rooted in landscapes and places. Ultimately, I suggest that new insights can be gained through a fine-grained study like the one undertaken here.

Extraction, Explanation, and Economy

The evidence for multiple strategies of engagement with marble quarries in central Lydia is, in its own right, lacking in explanatory power. The evidence for, in particular, production-based practices has been inserted into numerous models that were developed to account for both changing techno-economic practices and the growing evidence for multiple strategies related in particular to extra-urban networks of trade and communication. As will be shown, most of these models overemphasize the dominance of a single political or economic structure without accounting for variety. These are, in effect, efforts to explain centrally derived policies rather than the actual composition of the polity and the reasons behind its form. Those that do account for variation in practice do so from the perspective of the dominant social, political and economic institutions, with the result that only officially sanctioned practices receive scholarly attention. In such

an example, Roman economics would be those sanctioned by officials of state, whereas deviant economies or informal economies would be those that do not participate in officially sanctioned practices. Close examination of the networks within which both extremes of economy participate suggests, however, that they both serve in the creation of a whole in the context of the Roman empire, particularly when we follow the notion of governmentality as effort to produce something, realizing that the ideal is always incomplete and subject to change. What follows is an attempt to move from the specific evidence described for the quarries above to the landscape context within which the quarries are situated. Ultimately I suggest that the lake district participated in predominantly rural socio-economic networks, and that rural quarries provided material for local use, such as dams and rural shrines.

Who Controlled the Quarries?

The most appropriate starting point is the most basic observation to come from this research: the Roman empire did not run a monolithic marble extraction industry. This observation is not unique in the field of marble studies. Following early observations by Ward-Perkins (1973), Fant (1988) and Dodge (1991) that marble was at times produced within an imperial system of large-scale export commoditization, and that imperial wage and labor controls for some sectors of this portion of the Roman economy were far-reaching and remarkably uniform (Fant 1988; Cuvigny 1989; Hirt 2010), recent fieldwork has demonstrated unexpected levels of diversity. Russell (2009a; 2009b) has, for example, shown that no single model for marble extraction accounts for differential investment in stone that was readily available in certain locations. His primary example

of Aphrodisias reveals aspects of production that depended far more on the vagaries of local patterns of consumption than on any kind of centralized mechanism for controlling the volume of extraction or the kinds of finished products that would be carved from the material. Similar testaments to the production of stone goods with an eye on different markets is seen at Byzantine Germia and Late Roman Fasillar, where goods produced for local tastes were crafted alongside exported and imported pieces (Niewöhner and Prochaska 2009). The standard dichotomy, which views Rome as having a centralized, state-run control mechanism that departed from earlier Greek models of private ownership and control seems insufficient to explain Lydian small-scale quarrying.

Patterns of consumption and patterns of production (or extraction, in this instance) are not independent of each other. Russell's evidence for regionally distinctive sculptural production around Aphrodisias (2009) follows evidence for local consumption patterns in Palestine (Fischer 1998) and in the western Mediterranean (Braemer 1984; 1986) where a mixture of local and imported styles prevail. Crucially, Russell (2009a) notes that the evidence from Aphrodisias reveals different methods of manufacture as well, suggesting that differences in style parallel differences in acquisition practices. Stockpiles of pre-formed blocks, which comprise the dominant evidence for systematized empire-wide quarrying, do not appear in the archaeological evidence for Aphrodisias or in the quarries of central Lydia. This information suggests that quarrying during the Roman imperial period was not uniformly enacted. Instead of standardized blocks of marble shipped throughout the empire, which were then sculpted into the object of a consumer's desire, the acquisition of marble was performed as needed, often resulting in blocks of variable size to fit the specific project.

Arguably, a similar pattern exists for the Mağara Deresi quarries south of Sardis, which were most utilized from the 2nd century CE through the late 3rd-early 4th centuries CE. During this time Sardis was at its pinnacle of political authority and participation in the region. A proconsul was elected from Sardis in the early 2nd century CE, ushering in a period of prosperity that departed dramatically from the civil unrest of the preceding century (Hanfmann *et al.* 1983: 144-145). It was during this period that Hadrian visited Sardis, which started a steady stream of benefaction towards the city in the form of new monumental construction projects including the Bath-Gymnasium complex and the Marble Court (Yegül 1986; 1987). Such building programs required large quantities of stone, most of which was provided by the Mağara Deresi quarries and potentially by the marble quarry in the hills above Gölarmara. Elite patronage of this type more closely approximates the study conducted by Russell (2009a) of urban building and sculptural programs, showing them to be closely connected to consumerism and consumer taste.

While this pattern is supported by the Roman-period evidence from Sardis and Mağara Deresi, the rural quarries near Sardis also indicate potentially closer overlaps between cut stone and consumption of a different variety. The evidence from the region north of Sardis offers only periodic intersections between patrons and production. During the Roman period, most of the marble quarried in central Lydia came from a series of large quarries south of the city that do exhibit more evidence of standardized tool use. The marble sources near Marmara Gölü, however, reveal a range of associated technological interventions that resulted in blocks of differing size and very few pre-forms. Two of the quarries most clearly connected to the Roman period (Hacıveliler 1 and 2) were closely associated with a large early imperial Roman site. Different marble

products were being produced at different quarries, with greater standardization of those products coming from the larger quarries south of the city. The rural marble quarries produced for local projects exclusively, rather than for a market geared towards urban display.

In particular, the different sizes of block production in the Roman-period quarries in the CLAS survey region suggest project-specific attempts to acquire stone. This evidence is a clear departure from the more standardized production of pre-forms, both in terms of roughly hewn blocks and objects with a standard shape and iconography. Projects rooted in beneficence are typically sculptural and architectural in form. Similar patterns of extraction and production exist for personal consumption, or decorative stone objects placed in residences. Teasing apart these differences has proven difficult, though Long's study of the volume of marble extracted at nine extra-urban quarries at Aphrodisias in comparison to the total volume of marble consumed in the city, suggests these quarries were located and opened for private rather than public construction projects in most cases. Marble from the CLAS survey region seems to be different again, with evidence for more variable extraction: quarrying for private consumption can still employ specialized labor, whereas rural consumption appears to be attached to non-specialist labor practices as indicated by its variability.

Inscriptional evidence from central Lydia offers support for the notion of different, regional and rural markets as well. The existence of small-scale markets, usually held with less regularity than their urban counterparts, are attested throughout the Roman world (Schuler 1998; De Ligt 1993; Mitchell 2005). As the total number of known markets orchestrated by rural towns grows, so too does the awareness of their

significance within the Roman imperial economy as a whole. Although the precise location is not yet identified with physical remains, the inscription from a town called Arhillloi, thought to be located in the foothills north of modern Yeniköy, appears to have been one such small, regional market (Malay 1994). The inscription offers insight into a town with its own temple and with varying levels of integration into both regional and imperial politics. The benefactor of the inscribed stone asserts the town's and region's local authority to hold a market and feast day separate from those held at Sardis, referring to a request sent to an imperial authority.¹⁰⁴ It is precisely this type of local dynamic in which the marble north of the lake was likely to have circulated following the shift of major marble production to the south of the region's urban capital. What explains how this pattern developed are Roman practices of governmentality and the specific landscapes and places involved in Lydian marble extraction?

The small marble quarries and the rural farms and settlements in central Lydia during the Roman period are thereby likely to have found themselves participating within different spheres of social, political, and economic structures than those working around urban quarries in other parts of Asia Minor, with those established by the local towns and

¹⁰⁴ The inscription combines Greek and Latin elements. Translation by Malay (1998: 153-154): "I, son of Metrodorus, hereditary priest of Zeus Driktes and of the people Thamoreitai, who petitioned for a panegyris for the Arillenoï, set up this stele as a vow to Zeus Driktes after having been successful. / T(itus) Aurelius Ful(v)us Boeionius Antoninus, proconsul, says: Metras, son of Metrodorus, and Isidorus, have come to me and petitioned in the name of the villagers of Arhilla (or Arhillloi or -ai) that I should permit (them) to institute and to hold a fair continuing seven days once in a year from the twelfth before the calends of October until the sixth before the same calends. If, concerning this, anyone will intend to say anything against their petition, he should appeal within thirty days to me or to my most honorable successor. I want this to be published. / The people honors Metras, the priest, and his posterity, with a golden wreath. / The people honors Tatia, the priestess, and her posterity, with a golden wreath / Asinius Rufus to the magistrates of the Sardians, greeting: The village of Arillenoï belonging to me from my ancestors, [as you know,] wrote to me and asked me to submit to the emperor the petition concerning [the land? the tribute?] and the public [dues? land?]. Not since it was difficult for me to appeal to the emperor, but because it brought discredit to you that you send to (i.e. frequent) [the other market-days around?] but not to the one [instituted] by [the emperor, he decided?] that this one too should be worthy of the same rights as the others. [I wish that] you (?) and your household are doing well."

villas perhaps the most pertinent to their daily operations. This pattern of overlapping economies is not unique to either the stone industry or to western Anatolia, and scholars have made great strides recently in foregrounding the composition of these regional structures. De Ligt's (1993) and Schuler's (1998) work on markets demonstrates the different rhythms for major regional markets and smaller rural markets, noting their seasonality, the different audiences they reach, and the different protocols and regulations that govern them.¹⁰⁵ Here, more recent work on individual aspects of the Roman economy is informative in demonstrating how local networks of trade and exchange for specific goods within the marketplace functioned in Roman antiquity. Case studies include ceramic production centers,¹⁰⁶ olive production (Mitchell 2005), grain distribution (Mitchell 2005), and the trade in wool and other necessities basic to both urban and rural markets. Each of these goods or commodities is more reliant on local infrastructures and local consumption preferences than on a wider imperial trade in goods.¹⁰⁷ Thus, while wages are standardized across the empire for certain jobs, prices were often established for certain goods, and the distribution for many goods such as amphorae and highly valued marble does spread across the Mediterranean, there are different levels to the Roman economy, with differential participation in each tier dependent on the context of interaction.

The emphasis on the degree of market interaction in various levels of the Roman economy suffers, however, from the inherent limitations placed on regarding interaction

¹⁰⁵ See Grey (2011) for a discussion of rural family and social networks in Late Antiquity.

¹⁰⁶ Remembering that the clay beds used in ceramic production around Sardis changed at roughly the same time as the change in marbles sources was detected (Luke and Roosevelt 2010).

¹⁰⁷ See Poblome (2004) for a discussion of the probability of itinerant craft production in the Roman empire.

with the landscape solely from the perspective of commoditization or economic efficiency. The cost of labor, material, and transportation are certainly important factors in assessing the role of a particular resource or product within Roman society, but they are not the only factors that determine interactions with the environment. For this reason, even the increased emphasis on differential consumption patterns lacks the specific landscape context – both physical and social – for marble quarries in Roman Anatolia. Part of the justification for escaping models based strictly on economic efficiency is the fact that the levels of social, political and economic interaction in the Roman world must necessarily include those practices that do not follow the relatively mature economic policies of the empire, making issues such as cost related to labor and transportation secondary to, or at least on par with, issues of value, memory, proximity, and geology.

While some marble quarries in some of the Roman provinces do fit within consumer-producer models, a great many quarries exist that are of the same scale as those in central Lydia, which do not fit this model for the entirety of their use lives. In the first place, the eleven Lydian quarries investigated here have not been connected with sculpture or other finer arts. The material from the series of marble sources in the Marmara Lake Basin is relatively non-homogenous in its crystal structure. Thus, while the stone is suitable for building programs, it was unlikely to have yielded decorative or finely carved products with widespread appeal. The few decorative stone finds in the survey region that have been subjected to stable isotope analysis do not originate in central Lydia. Only the large blocks employed in the construction of the tumulus of Alyattes correspond isotopically to this region. In general, the evidence points towards

immediately local use during the Roman period, rather than to concerted efforts to acquire stone for artistic purposes, making the consumer a far more elusive character.

Second, the quarries in central Lydia dating to the Roman period are in most cases not new sources of stone. Certainly issues of economic efficiency are relevant to this observation – less time, money, and labor is expended on locating and extracting marble from existing sources than it is from finding new marble sources – but so too are issues of place and memory. These issues become particularly significant when the patterns of landscape interaction are combined with the current state of knowledge about the different social, political and economic networks that existed in central Lydia during this time. I argue that there are differences between the landowner who gets marble for a specific project on his property and an urban patron who purchases stone that is acquired for him through private or state-run channels. Both examples participate in the same overarching social framework, due to the periodic intersections that connect these different life-ways, but they do so in radically different ways. The one suggests that the presence of stone was observed and that marble was utilized because of a physical relationship to the source, while the other suggests a higher degree of separation between location, technological practice, and social decision-making.

Both of these interpretations, however, are firmly rooted in places and in landscapes. This is akin to Ingold's (2000) discussion of increasing layers of technological intervention in the creation of different social outcomes. According to Ingold's argument, the fewer steps there are between the producer and the production process, the more likely it is the production process will have a direct bearing on the resulting social output, since fewer standardized mechanisms will intercede during the

experience of production. In the Roman world, entire social organisms function in a similar way, though Rome was diverse enough to account for multiple systems working at the same time and interacting with each other intimately. Thus, the different practices at work in quarries north of the lake and in the large quarries south of Sardis and above Gölarmara suggest that different social outputs were created routinely. These different outputs, however, were never isolated from each other, though they moved at different rhythms: they still together create the overarching whole.

Memory, Place, and Landscape in Central Lydia

Perhaps the greatest benefit of including a study of marble sources in the context of a landscape archaeology project is the emphasis on diachronicity that it reveals. Communities in western Asia Minor confronted and encountered numerous material indications of past communities, and the present study of quarries provides examples of what people in the Roman period saw and how they responded. Although many competing approaches to the study of the past in the past have been undertaken, each emphasizes to some extent the role played by materials in connecting later communities to an understanding of the past in a given landscape. Thus, Bradley's (1993; 1998) study of Stonehenge addresses continued practices at a monumental site over great stretches of time, while Alcock (2002) demonstrates the use of specific materials in mainland Greece to establish grounded connections to the past in the formation of a sense of belonging and community. Smith (2003) shows how the destruction of material traces of past places and past identities can be deliberately targeted in an effort to sever those long-term and long-

established connections to place. The material remains of the past, though inevitably open to a perpetual process of reinterpretation, constitute a major portion of understandings of place throughout time, and central Lydia is no exception.

As mentioned above, there are numerous historical events – natural, political and social – that transformed the physical settlements in Lydia and impacted later understandings of the Iron Age past. Wars with the Persians and with the Hellenistic successor kings greatly damaged the physical makeup of Sardis’s monumental and household architecture. Natural disasters in the form of earthquakes took their toll on the city as well, resulting in, over time, a distancing of the past in Lydia from the Roman present, such that the legendary status of the city is remembered and cultivated, though not thoroughly understood by the 1st-5th century CE communities living there (Rojas 2010; forthcoming). Nevertheless, there are traces in the material evidence that point to active attempts to incorporate the Lydian Kingdom of the Iron Age into the Roman understanding of the central Lydian landscape, as well as textual evidence that Late Roman individuals were aware of some significance to the monuments in Lydia, even if they did not know exactly who they were intended for or what they were intended to convey.¹⁰⁸ These traces range from poems to curious attempts at anastylosis in the past (Rojas forthcoming), both of which suggest caesura.

Encounters with the past, however, did not happen exclusively with monumental landscape features, but also included many quotidian elements of the landscapes through which people moved and in which they lived. Although we cannot know exactly what

¹⁰⁸ This follows the notion of monumentality put forward by Bradley (1993; 2000). He suggests that although the specific significance of a location changes, monumental and social investment in a place serve to perpetuate its significance. Greenhalgh (2009) has written on this issue for Islamic reuse of Classical marble.

people in the Roman period thought about the more mundane aspects of the past, it is important to include them in a discussion of the role that past materials played in the constitution of subsequent social landscapes in Lydia. Quarries serve as an all too often overlooked, example of these encounters, being intrusive interventions between people and place, with incredible longevity. The documentation of multiple periods of quarrying presents the best way to demonstrate such encounters.

Material Associations

The aspects of place that are relevant to this discussion are the geology/material attributes of the marble quarries; the evidence for infrastructure, and the insights it offers for how people moved within the landscape; the relationship between quarries and other sites; and the evidence for multiple iterations of engagement with marble resource sites. These issues are important insofar as they are archaeologically detectable and they fit the notions of place described by Casey (2001), Massey (2005), and Ingold (1993; 2007b) to varying degrees. Each author notes at least a reciprocal relationship between environment and human understanding of location (Casey's entry into a discussion of place). Massey goes so far as to suggest that the changes to physical topography are significant for both natural and social constitutions of place, while Ingold suggests that the natural and social aspects of place are inseparable, yet the material attributes of locatedness are situationally dependent, often manifesting themselves in traces that build up over time. Other scholars have referred to this as a palimpsest (Binford 1981; Schiffer 1985; Lucas 2005; Bailey 2007). What this suggests is that material places are always subject to constant change, whereas an alternative notion of place, which privileges meaning attributed to location

(Basso 1996) as its defining characteristic, may have more permanence in social contexts that privilege specific kinds of narrative. Recent work on memory (Alcock 2002) and antiquarianism (Rojas forthcoming), however, suggests that even these aspects of how societies remember (to borrow Connerton's [1989] phrase) are malleable. The evidence presented here depends on material juxtapositions and observable encounters with the past.

The eleven surveyed quarries in central Lydia indicate awareness of past material traces in the countryside outside of Sardis that implicates them in issues ranging from regional economies, value, place, and reception of the past. Modern geological analysis of the layers of marble in central Lydia suggest, first and foremost, that past populations were fully aware of the location of marble.¹⁰⁹ Quarries are located in each of the layers of marble, which points minimally to recognition of the geological qualities of marble, and potentially to deliberate efforts to find and at least use sources of marble when they were known. Although grayish-white marble predominates in central western Anatolia, central Lydia has three distinct colors of marble, each of which has been quarried at some point in the landscape's history.¹¹⁰

Questions about resource prospection in antiquity have been addressed by other authors (Hopper 1968; Healy 1978; Hirt 2010), but the Lydian quarries suggest intimate knowledge of the environment rather than concerted efforts to locate specific sources of stone. Whereas prospecting in other regions of the Mediterranean involves shafts and channels that locate the presence, depth, and quality of marble beds, no such features

¹⁰⁹ Geologic data provided by Maden Tetkik ve Arama (MTA).

¹¹⁰ The identification of non-white marble quarries in other portions of western Anatolia marks one of the more pronounced recent advances in the marble studies in the Mediterranean. Blue, yellow and green marble have all been documented (Attanasio *et al.* 2010).

were used in Lydia (Hirt 2010). Instead, the marble quarries in central Lydia appear to have been opened more opportunistically, a pattern that is consistent with the use of other types of stone in Anatolia (cf. Waelkens 1992; Çolak and Lazzarini 2002). With rare exceptions, the quarries are small and shallow and closely related to settlements. The presence of marble in the Roman period would have been well advertised by the Lydian-period quarries near Yeniköy, but the scale of operations in the Roman period was considerably smaller in this part of Lydia, suggesting less dependence on this marble for regional production. The opening of new quarries in the Roman period is more likely the result of landscape knowledge for local and special needs.

Familiarity with the location of marble sources in central Lydia is one of the more visible instances when material from the Iron Age was physically engaged with by the communities living here during the Roman period. Rojas (forthcoming), citing Plutarch, acknowledges that Roman Sardis and its hinterland were but a specter of their former Lydian and Achaemenid selves, with only scattered and a-contextual ruins remaining (Roosevelt 2009; Luke and Roosevelt forthcoming; Greenewalt 1996; Yegül 1986; 1987).¹¹¹ Moreover, one of the primary uses of marble in central Lydia during the Iron Age and Achaemenid periods was in the construction of monumental tumulus architecture. Subsequently, the marble elements of these features were not visible to the majority of the population living there, with the exception of those individuals who participated in the frequent occurrences of tumulus looting (Luke and Roosevelt 2009; Roosevelt and Luke 2006). The indications of Lydia's former glory that were recorded in stone were therefore most prominent in the quarries dating to Lydian periods of

¹¹¹ For general discussions of memory in multiple periods in the Marmara Lake Basin, see Luke (2010) and Luke and Roosevelt (forthcoming).

construction. The formation of a social landscape that engaged with traces of the past was partly constructed through the presence and reuse of Iron Age marble quarries, suggesting that Roman period interactions with marble were not based solely on matters of economy (Figs. 6.1 and 6.2).

From the perspective of place, the marble quarries of central Lydia were one element of the landscape that emphasized connections to the past. Of course, memory, place, and economy do overlap, but the very fact that they overlap is the point that is most often missed by current models. Just as marble has value that affects how far it travels and how much is extracted, agricultural cycles in nearby fields were also part of the economy of this Roman province, each requiring seasonal patterns of behavior. But the location of marble and the most productive agricultural fields participated in Roman society in ways not adequately covered by empire-wide models that explain commodities as divorced from social life. Connections to the past are certainly indicated by the marble quarries in Lydia, which I argue influenced the decision to extract stone in those locations. Connections to the quarries, however, are also not limited to the quarries themselves, visible as they often were. The distribution of marble brought stone into contact with other sites and other rhythms of social life as well.

Movement and Routes

The infrastructure related to quarrying and the distribution of stone served to connect what are otherwise disparate aspects of Roman social life. Although the evidence for quarry-related infrastructure is not extensive, it is possible to extrapolate the likely location of pathways between the quarries and the probable thoroughfares through central

Lydia from the location of the quarries, the natural topography, and current track road systems. The two primary lines of evidence for infrastructure are slip roads (paths from the quarry to other road systems) and the dirt roads themselves. As Figs. 6.3 and 6.4 show, the slip roads recorded for the quarries in Lydia connect to the primary dirt road system through that particular landscape, suggesting longevity in the location of those roads. The roads also closely follow the natural topography, suggesting little intervention in this region for road construction.¹¹² The dirt roads connect to modern paved roads that ring Marmara Gölü; although there are no extant remains of paved roads in the region, the flat area forming the lake's floodplain makes this the likely location for traveling overland. Ratté (2011) mentions the possibility of transporting marble across the lake during the Lydian period to save energy and money, but no physical indications of this shipping method have been reported. Russell (2009a) also notes that shipping by water is not necessarily the most cost-effective way to move material, drawing attention to numerous examples of overland shipment where water transport was possible. Additionally, the preference for shipping by water indicates an assumption that marble was moving south, the direction of Bin Tepe and Sardis. While this is certainly the case in the Iron Age, the movement of stone from this region to the urban center has not yet been proven for the Roman period, whereas other indices point to a shift to principally local use of stone.¹¹³

¹¹² Korres (1994), for instance, mentions elaborate stone road-networks in Attica for Pentelic marble, and French (1981) describes Roman roads in Anatolia as lacking any least-cost path relationship, preferring straight lines to undulating roads that respond to the terrain.

¹¹³ See Luke and Cobb (forthcoming) and Harmanşah (2011) for a similar argument of local movement and senses of place.

Even if the marble from Lydia did not participate in long-distance trade, the stone passed along thoroughfares that brought the material into direct relation with other known settlement sites. The most densely settled areas during the Roman period correspond to the low-lying areas immediately around the lake. Extensive and intensive survey in the mountains surrounding the plain suggest that settlement in the uplands is limited (although further exploration will be undertaken during the 2012 CLAS campaign). Evidence for Roman quarrying suggests only partial standardization of extraction techniques, with consistent tool markings yet differing block sizes and the extraction of stone for specific projects. One indication of this variability is that stonemasons in the countryside north of Sardis were unlikely to be full-time specialists. Rather, they participated in the full range of seasonal cycles that impacted agriculture, pastoralism, and industry. The connection between those who worked the stone, and route-ways for the transportation of stone, is important as an indicator of the way that marble extraction was part of the full development of systems of social life in central Lydia. Marble was transported close to settlements during this time, and it is probable that the masons who worked the stone came, in some instances, from the very settlements that the transported stone passed. Here, the narrative imagined by Korres (1994) for the transportation of one block of stone in Attica, and the fictional narrative developed by Saramago (1987) for the transportation of one massive block of stone through Portugal, are both relevant: spectacle and performance connect social life in the countryside to industry and economy in very tangible ways, even if the spectacle is limited to the gathering of community members for small-scale projects.

Sites and Interconnectivity

To reiterate an earlier point, the quarries were near Roman and Late Roman sites, and indeed, the location of settlements throughout the history of the Marmara Lake Basin appears closely connected to available resources, stone and otherwise. While the lake itself takes pride of place as a focal point for settlement activity, with Roman and Late Roman sites tending to cluster in the fertile flood-plain around it, the proximity to other resources such as stone may have factored into the specific location of settlements in these periods as well, and the lake may have facilitated the movement of material between sites. In the Roman period, the close connection between settlement location and Bronze Age citadels that is seen in the Iron Age (Luke and Roosevelt forthcoming) appears to be a less powerful pull. Sites have moved towards the lake itself, suggesting an altered form of connectivity between Roman populations and the deep past, both Bronze Age and Iron Age.

One possible explanation for this comes from the nature of ceramic evidence for the Roman period. A clear emphasis of utilitarian wares for these rural farmsteads, with reduced proportions of fine wares in the Roman assemblage as compared to the Lydian assemblage, suggests greater emphasis on local productivity and access to smaller markets in the 1st century BCE-5th century CE. Nevertheless, the ceramics appear to come from external markets, based on chemical analysis. Coupled with the general shift in settlement density towards the urban site of Sardis and the Hermus River plain, signs of governance can be seen in a general Roman attraction to cities and the subsequent reordering of rural settlement trends. Although the impact was indirect in the Marmara Lake Basin, this technique of governmentality, and the strong relationship landscapes

have on rural (and, as will be shown in Chapter 7, urban) settlement and society is apparent when the Roman polity is regarded as the entirety of its populations and places.

Places and Economies in Central Lydia

The presentation of the data in this chapter ultimately arrives at two pressing questions: Who controls the resources? And do the practices related to industry give rise to social dynamics, or do social dynamics give rise to industrial practices? The first question is more easily answered than the second, and the evidence presented in this chapter points in a clear direction. While early models for the Roman economy, and for the role of marble within it, dealt with empire-wide trade and monetary structures, new research points to the increasing significance of regional interactions that deviate from imperial norms. With respect to the marble quarries studied in central Lydia, the evidence clearly indicates non-imperial control of resources in the Lydian countryside. Moreover, the proximity to Sardis and the different technological practices utilized in large-scale and small-scale quarries also demonstrates that regional capitals in Asia Minor did not necessarily control the methods of procurement either. Local communities had some autonomy in the procurement of marble in central Lydia.

Although far more difficult to answer, the combination of intensive quarry study, archaeological survey, and textual evidence suggests that technological variation is more than simply a marker of social or cultural difference. Marble in the small quarries of central Lydia was cut differently than marble above Gölmarmara or marble in Mağara Deresi south of Sardis. It circulated through the landscape differently as well, involving the very people who participated in the agricultural, pastoral, and fishing cycles that

provided a life-way in central Lydia, passing hamlets, villages and farmsteads along the way. Finally, the fact that the small towns and villages in central Lydia negotiated their position with the regional capital of Sardis and with imperial authorities to create location-specific policies – even through dialogue that was tilted strongly in one direction as in the examples developed by Foucault for governance and disciplinary structures (Foucault 2006a; 2006b) – suggests to me that social systems are derived, rather than predetermined. In this instance, the Lydian countryside and its different technologies and networks of exchange participated in the production of an interconnected social and economic practice that fed into the entirety of the Roman empire. Rather than Rome merely allowing a diversity of practices, those practices shaped the Roman empire in the same way that informal economies in the modern industrialized world are fully part of the total social and economic practices that comprise it.

The role of technological intervention with the landscape in the production of place and the production of society, as in the model developed by Ingold (1993), is difficult to piece together. Ingold's model begins with something as basic as weaving a basket to suggest that the person who weaves learns skills and techniques through a fundamental interaction with the material, which has specific properties. Those skills are in part learned through communication with other basket weavers, but they are also always dependent on that basic relationship between person and material. The result is ultimately the development of a social system of production that is generated from the ground up. Ingold does leave room for different levels of involvement in the production process, an issue that was taken up by Marx (1970) among others.¹¹⁴ Intervening levels of

¹¹⁴ Pfaffenberger (1992); Latour (2005).

technology that further separate the individual from the producer regulate their behaviors in ways not seen with basket weaving.

In the marble industry in Roman Asia Minor, however, the tools used in large-scale industry and the tools used in small-scale regional projects are more or less the same. What differ are the methods of extraction and the networks within which producers (extractors) work. To some degree, attempting to identify what factors gave rise to Roman models of standardized marble extraction techniques in some quarries but not in others would be an attempt *in medias res*; the social and economic structures are already in place. What we can say, however, is that the return to the Iron Age quarries and the opening of new quarries in the Roman period resulted in central Lydian participation in what was principally a central Lydian social and economic network. What causes the standardization of extraction techniques in imperial quarries is likely the result of ever-expanding networks. These do not necessarily penetrate every aspect of society within the Roman polity, however, enabling the development of different networks rooted in localized, place-based interactions with the landscape that are dependent on memory or traces of the past, specific geology, agricultural cycles, and landscape rhythms.

The enduring qualities of these quarries have a bearing beyond their specific periods of use as well. It has been mentioned elsewhere that the presence of marble in this particular region of Turkey has held great significance not only for the types of activities that were undertaken there in the past, but for notions of self-presentation as well. In the Ottoman period of central Lydia, the present day town of Gölarmara was named Armara, calling attention to the significance of marble to the region. The lake then lost its ancestral name (literally – Gygaean means ancestor in the Lydian language),

called Koloë in the Classical period, in favor of a specific reference to marble: Marmara Gölü (marble lake), named after the town of Marmara (see Roosevelt 2009 for a discussion of names and terminology). The significance of the lake later took precedence, and the town was renamed Gölarmara (marble lake) after the lake – a confusing shift in patterns of reference, self-reference, and external reference. Throughout all of this, however, the quarries of the Lydian and Roman periods persisted in the landscape, and were reopened or engaged with anew for later needs. These same quarries provided stone for Medieval and Ottoman projects, and the naming habits of the times clearly indicate an awareness of the interplay between landscape and social life.

Conclusions

The marble study conducted for the eleven quarries in the northern hinterland of Sardis, in central Lydia, identifies several important factors that point to a more diverse picture of the Roman economy. First, the organizational aspects of labor differ at quarries of different scales, particularly with respect to the techniques employed and the specifics of block size. Second, access to marble was not strictly controlled for all sources of stone through a centralized governing body, enabling some local and regional autonomy in the development of policies and practices related to marble acquisition. Third, economic models for building and sculptural programs in the Roman world are inadequate in how they account for the range of practices, preferring to explain diversity with regard to economic power and efficiency. Other elements of significance include contemporary relationships to past traces of industrial activity, local knowledge of terrain and

topography, and the complex notion of place within society. Of particular significance here is the profound impact of non-economic realities on the economic patterns that other scholars have discussed. By neglecting such material and spatial relationships as they help to formulate the social experience of industry within a given landscape, the contributions of the daily aspects of resource acquisition are removed from the model. This project demonstrates how consideration of such things as interaction with traces of the past, and the enduring legacy of quarries in places have major impacts on social and economic life. Finally, the development of a complex interplay of local, regional, and imperial social, material, political and economic networks should both account for more variation in general while attending to the indications that the methods of interacting with the environment are not merely indices of different social practices: they help to produce them.

Certainly more can be said of these issues with an expanded program of sampling and survey of the marble sources in Lydia. The Mağara Deresi quarries, for instance, could be surveyed systematically and documented thoroughly, and more samples can be collected for scientific analysis. Of perhaps greater need for a more robust study of the varying patterns of marble use in social life within Lydia is a sampling program of structures and monuments within Sardis itself and throughout the countryside where numerous marble finds have been located. Developing a clearer sense of which quarries distributed marble the most extensively will provide better detail for a study of the range and scope of smaller networks of activity in the countryside.

Nevertheless, this study allows a more refined understanding of practices within the Roman imperial system. Importantly, the role of marble within the landscapes of

Roman Anatolia has been altered to include small and seemingly insignificant quarries and networks of communication. That these networks actively engaged with Roman political entities means that they cannot be overlooked when determining the structure of the Roman polity and its social and economic composition. This study also allots greater significance to specific landscapes in the composition of individual, smaller networks, noting that certain material aspects of place have a formative role in the foundation of both microeconomies and the stories and legends that begin to characterize a location over time.

Being specific as it is to central Lydia, however, this argument necessarily requires engagement with other landscapes in order to prove its full utility. The following chapter will therefore develop a series of case studies of other regions well-known for their marble or other stone resources to further implicate local landscapes and small networks into the development of an overarching, yet place-specific, Roman imperial system. Although sometimes lacking in the detailed analysis of the quarries themselves, the case studies presented in the following chapter will merge landscape archaeology with resource locations and distribution models to re-formulate explanatory models. This effort will demonstrate the utility of rethinking models of resource acquisition within the framework of social practices related to industrial structures on an empire-wide level. The object is not to create a single unifying model, but to demonstrate the pervasiveness of local practices, rooted in specific places, in the generation of a necessarily general imperial entity. It is an effort to characterize the diversity of Roman social and economic life through an exploration of a single resource within such an expansive system of overlapping structures.



Figure 6.1: Bin Tepe as seen from Haciveliler 2 (photograph by author, courtesy of the Central Lydia Archaeological Survey).



Figure 6.2: Bin Tepe as seen from quarry Yeniköy 1 (photograph by author, courtesy of the Central Lydia Archaeological Survey).

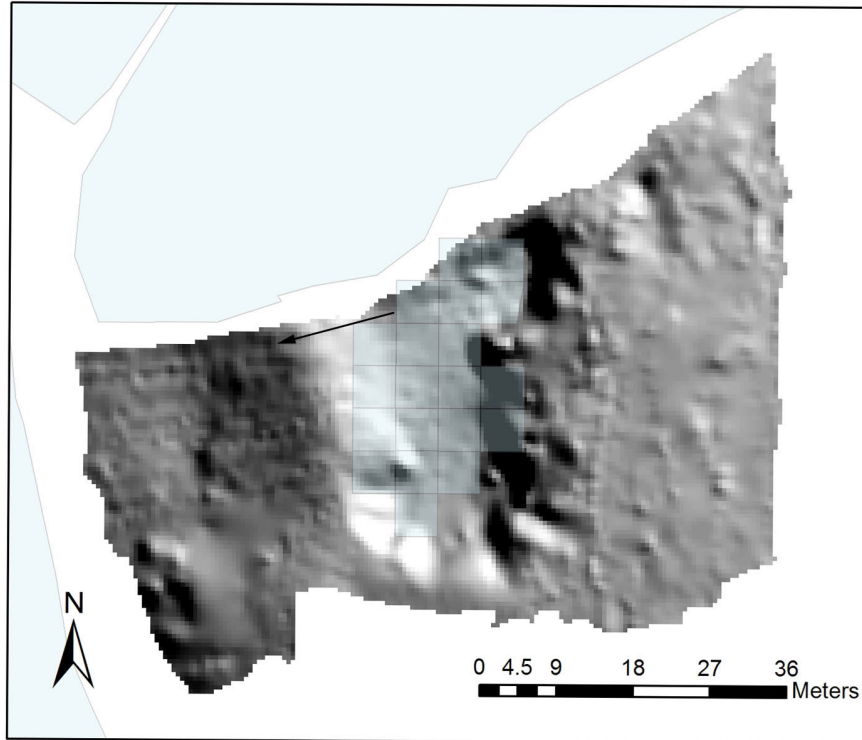


Figure 6.3: Hillshade showing probable path out of quarry Haciveliler 2 (image created by author, courtesy of the Central Lydia Archaeological Survey).

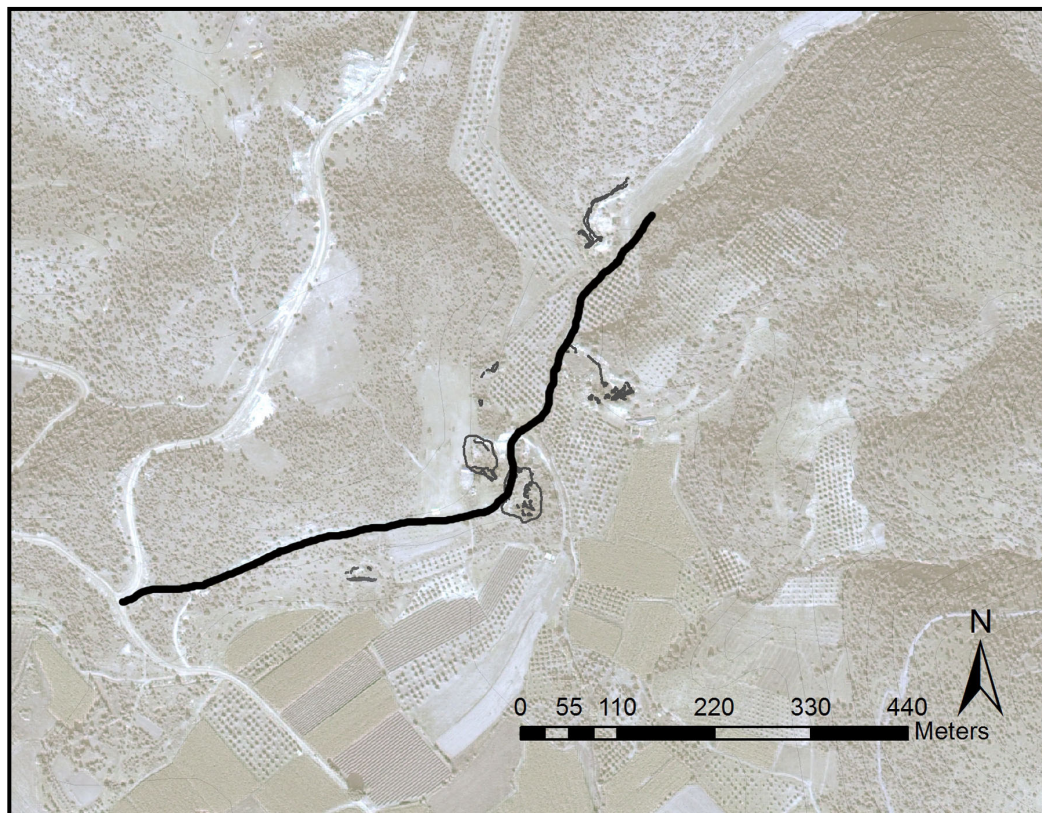


Figure 6.4: Satellite image showing dirt road connecting quarries near Yeniköy to flood plain (image created by author, courtesy of the Central Lydia Archaeological Survey).

Chapter 7

Quarries in a Wider Context

Indeed, while making these reflections, one cannot but feel ashamed of the men of ancient times even. There are still in existence censorial laws which forbid the kernels in the neck of swine to be served at table, dormice too, and other things too trifling to mention: and yet there has been no law passed, forbidding marble to be imported, or the seas to be traversed in search of it (Pliny NH XXXVI.2).

Introduction

At stake in a discussion of how resources fit within a specific landscape, and how that landscape in turn fits within the Roman empire, is an understanding of the relationship between the individuality of a region and the structures of governmentality and economy. It is the coupling of explorations of community formation through detailed analysis of human-landscape interactions and the pervasiveness of external structures on the decision-making practices of the full spectrum of a polity's inhabitants that will lead to new understandings of the role of quarries in Roman social life. Acknowledging, however, that a polity comprises multiple strategies, as the previous chapters have demonstrated, raises the potential to apply a new line of questioning to a broader array of examples, moving the discussion beyond central Lydia and into other, varied portions of the empire. Instead of exploring the pervasiveness of an external political entity on the lives of subjects, as cautioned by Smitih (2003: 155), the starting point must be an

assumption that polities and people inform each other, a presumption recently taken up in Grey's (2011) discussion of peasant communities in the Late Roman countryside. From this perspective, the appropriate questions pertain to the range of decision-making practices in the full composition of a polity, not the degree to which a polity acts upon a people; the people are the polity, and so their actions, big and small, urban and rural, characterize it (Foucault 2006a).

What follows, therefore, is an exploration of multiple decision-making practices with respect to quarrying in the Roman world. Three categories of resource acquisition are probed, each representing different levels of connectivity between community and official state and economic policies. I begin with the most studied form – imperially-owned quarries – providing two examples to demonstrate different approaches to state oversight. The second section deals with quarries directly related to urban construction. These quarries are far more numerous than imperial quarries, but have suffered from the assumption that acquisition practices within them would have been the same. This section demonstrates how they are, in fact, quite different. The third section deals with decision-making practices governing the nearly ubiquitous small-scale quarries associated with the rural countryside – that is, quarries whose use did not translate to an urban market. Paradoxically, the most numerous type of quarry offers the least amount of scholarly documentation and is supported here by discussions of the nature of rural economies in antiquity, with special significance given to epigraphic evidence from Asia Minor. This research further supports the claim that quarrying within the Roman empire was not a uniform industry.

In developing conclusions about multiple decision-making strategies related to stone extraction, major emphasis is placed on the specific attributes of different locations and, most importantly, on the reciprocal feedback this has on community formation. The role of technology and behavior therefore forms a constant thread running throughout this discussion. At issue is the degree to which new quarries and new organizational practices influence community formation, and the degree to which existing communal practices push back and influence the nature of Roman economic practices. I explore the evidence for bodies being disciplined to new environments and labor practices, as well as social constructs disciplining policies pertaining to those bodies and to those landscapes.¹¹⁵

Imperial Quarries

Euboean cipollino

The problem of Roman Greece, as Alcock (1993) called it, dealt with a similarly polarizing dichotomy between academic stances as confronted in this dissertation. Was *Graecia capta* predominantly “untouched by Roman domination” or in a state of decline as a result of changes brought on by Rome (Alcock 1993: 215)? While Alcock demonstrates that much of the logic behind this dichotomy stems from poor scholarship on this period of Mediterranean history, the overtones of cultural reliance on political events attest to the prevailing belief in big change with big consequences. The reality on the ground, however, is that continuity and change rarely occur without each other, resulting in a far more complicated pattern of social constructs within periods of political

¹¹⁵ These issues are taken up in a number of sources, including Bourdieu’s (1977) discussion of habitus and Giddens’s (1984) discussion of structuration theory. More recently, specific attempts have been made to tie archaeological landscapes to the politics of the past by Bender (1993) and A. Smith (2003).

change, whether slow in development or punctuated by abrupt disjuncture. Things change, but not in uniform ways.

The extraction of marble in Roman Greece, for instance, underwent some structural changes with consequences for the landscapes in which these resource sites were situated. In larger quarries, new administrative units were instituted that created harmony between Greek, Egyptian, and Asian quarries that participated in the imperial marble trade (Figure 7.1). But Greek marble had already circulated in a Mediterranean-wide discourse about that particular material's value, resulting in certain areas of continuity as well. The same is true on a more general level, as agricultural production patterns changed dramatically, though landholding systems were not abandoned entirely. Roman Greece is largely characterized as being more urban than the preceding periods, as ownership at rural estates became centralized in the hands of the wealthiest few and resource ownership remained, for the most part, private (Hopper 1968). The marble quarries on Euboea, however, were likely run by the Roman military (Sutherland and Sutherland 2002; Kozelj and Kozelj 1995): Dragon Houses – structures made of stacked stone - provide the otherwise industrial landscape with an air of surveillance.¹¹⁶

Production at these imperially-owned quarries, however, was not new in the Roman period. The island of Euboea, off the northeast coast of mainland Greece, offers numerous examples of quarries whose significance to the development of social life in the Roman period is demonstrably large. The well-known cipollino marble quarries around Karystos, and the more recently explored cipollino quarries near Styra (Vanhove

¹¹⁶ Hirt (2010) notes that these “huts” are not well dated. Chidioglou (2010) dates them to the Hellenistic period. Kozelj and Kozelj (1995) date them to the Roman period. The pattern of surveillance best supports a Roman period date, and their continued existence into the Roman period, even if they date to an earlier period, suggest their likely continued use during that time as well.

1996), have been surveyed extensively for the scale of extractive operations and for related infrastructure. Whereas the area around Sardis reflects small-scale life-ways existing alongside grand production of marble in imperial quarries, thus indicating the involvement of stone resource acquisition in the seasonal rhythms of a lacustrine hinterland, the Euboean quarries reflect the degree to which intensive marble extraction practices resulted in new crossovers of industry and social life while perpetuating strong geographical ties with deep historical roots. In other words, the preexisting industrial practices on Euboea were intensified. The cipollino quarries therefore need reevaluation from the perspective outlined in Chapter 5, assessing how these high-level, imperially-owned and operated marble resources intersected with local social and economic practices apart from the Mediterranean trade in marble.

Following an Iron Age reorganization of settlement location on Euboea, the result of territorial disputes between Chalcis and Eretria, the island took on a pseudo-urban form that persisted into the Classical, Hellenistic, and Roman periods.¹¹⁷ Primary social concern during pre-Roman periods on the island appears to be proximity to the seas and access to disparate trading connections, both Greek and Phoenecian, and then principally Greek as colonies spread to the Western Mediterranean creating social and economic networks that revolved around Greek interests (Ridgway 2007). Results published by the Southern Euboea Exploration Project (SEEP) indicate high site-density in the countryside around modern Karystos (Keller and Wallace 1986; 1987). Coastal and inland towns began to take on monumental appearances in the form of city walls and sanctuary construction. The obvious material chosen for construction was the locally available

¹¹⁷ For survey of earlier periods on Euboea, see Sackett *et al.* 1966.

marble with wavy patterns, later to be called cipollino due to visual similarities it shared with onion peels. Marble consumption during this period, due to limited use in exclusively local contexts, has therefore been characterized as relatively modest in comparison to the subsequent Roman period (Chidioglou 2010: 51).

The explosion in marble exploitation on Euboea appears only after Roman annexation in the 2nd century BCE, and truly only during the Roman imperial period, particularly the 1st-3rd centuries CE. This period also corresponds to an intensification of urban settlement on Euboea around the city of Eretria and its rapidly developing chora. SEEP has identified fewer rural aggregate site numbers for this period, and a pronounced shift towards the urban centers during this time (Keller and Wallace 1987), a pattern consistent with events elsewhere in Roman Greece (Alcock 1993). The broad transformation of the countryside into one of large landed estates with greater agricultural output, but fewer total habitation sites, speaks both to the shift in social and economic networks brought about by Roman integration of Achaea into its broader sphere of influence, as well as to a potential Greek propensity to live in urban settlements.¹¹⁸

The marble quarries in southern Euboea, which lie exclusively in the area around Karystos and between Karystos and Styra, were extensively exploited in the imperial period to serve markets throughout the Mediterranean basin. Euboean Cipollino marble has been identified in Asia Minor, throughout Greece, Egypt, Italy and the west, often associated with elite construction practices. Chidioglou (2010) notes that only very rarely is cipollino marble used for sculptural pieces, instead often appearing as building

¹¹⁸ Discrepant experience and taxation (Alcock 1997).

blocks or architectural fragments.¹¹⁹ The wide pattern of distribution for this material, exclusive (and therefore associated with notions of rarity and value) as it is to this particular geographic location, resulted in what Vanhove (1996) calls full-time quarries: that is, quarries for which a dedicated series of laborers were assigned to work – a dedicated industrial site, with the presumption that it derived exclusively from Roman consumption patterns.

Roman-period quarrying in Euboea is therefore associated with a high volume of extraction that far surpasses the small marble quarries studied in central Lydia. Whereas the quarries near Sardis (not including the Gölarmara quarries or the Mağara Deresi quarries) average only 3m in maximum height, the quarries on Euboea routinely stand more than 12m tall at maximum extent. The spoil heaps that cover the landscape also attest to the more substantial pattern of extraction in Euboea.¹²⁰ Careful consideration had to be given to where chips of discarded marble would be placed, access routes into and out of the quarry for transport were located, and where associated infrastructure should go. The cipollino quarries reveal slip roads, transport roads, postholes for cranes, ladders and other wooden support structures, water basins, metal-forging basins for tool preparation and repair, and associated religious shrines, all suggesting heavy time – and labor – investment in the extractive process (Vanhove 1996).

¹¹⁹ Hadrian's villa at Tivoli represents one such instance. Here, a crocodile is carved from cipollino marble.

¹²⁰ Aphrodisias also exhibits large mounds of marble refuse. This pattern, notably for all large-scale Roman period quarries, masks the ancient floor from modern view while also posing serious challenges for ancient masons and foremen. Although regarded as more efficient and less wasteful than modern quarrying, ancient quarries nevertheless had to address the physical burden presented by unused material, which could easily inhibit access to desired marble veins.

This labor investment was overseen by the Roman military, contributing to the notion of Euboean marble as part of a specialized and centralized economic mechanism.¹²¹ Military oversight of cipollino marble production placed these quarries at odds with the prevailing eastern Mediterranean tendency of private ownership of mines and quarries. It also exercised Rome's ability to exert authority over specific resources, which generally occurred in instances of exceptional material value. Military oversight, additionally, meant that Euboea participated in a fundamentally different economic and social network than that which characterized central Lydia. The Marmara Gölü region during the Roman period existed within a small, regionally-focused network of small farmsteads and towns with their own markets and administrative units that intersected with the urban networks of Roman Anatolia, and with Rome itself, through secondary channels. In Euboea, the intensification of marble extraction was more directly connected to the state apparatus.

Traditionally, this pattern of resource intensification has been explained as the product of Roman intervention in a pacified Greece. Earlier Greek methods for organizing labor and resource acquisition were replaced by more economically-intensive Roman programs. The contemporaneous changes in settlement pattern that impacted the countryside of Euboea offers support for this suggestion, indicating that new social strategies were needed to thrive under Roman rule. Missing from this discussion, however, is a sense that authority as performed on the ground (not the abstract concept) and Smith's notion of the subject are part of the same enterprise. The clearest example of

¹²¹ Chidiroglou (2010) suggests that mining and quarrying were the only forms of direct state intervention by Rome. The relationship between mining and the production of coinage further suggests that quarrying would have been the only direct state intervention in an industry not depended upon for the proper running of the central Roman government.

how this is neglected in the scholarship on Euboean marble is seen through the almost exclusive discussion of cipollino marble as part of Mediterranean-wide networks of economic activity. While all the evidence exists to derive a sense of the socially constructed places that these quarries were, the efforts to synthesize the experiential aspects of cipollino extraction and the lived networks of the inhabitants of Euboea are overlooked in favor of identifying nodal points in the network, a tendency that inherently favors the newly-introduced Roman economic networks at the expense of existing Greek relationships with the landscape.

Refocusing on the role of these quarries in a local landscape context provides access to a wider array of networks with more immediate impacts for the communities of Euboea, and it begins with a reevaluation of the road system. The evidence suggests, for instance, that the production of an imperial quarry landscape relies on a complex mixture of infrastructure that facilitated the movement of stone, while bringing together a range of tools and technologies in a single location. Of significance is movement along these roads, which helps to create the social and economic character of this particular landscape. The road system associated with the quarries connected primary thoroughfares, such as the Via Claudiana near Styra with secondary branches that lead to the industrial regions. The entire road network itself appears geared towards embarkation at the sea for long-distance trade, while facilitating overland travel as well. The same roads were used for other purposes, as connectivity between inland sites and coastal towns increased during this time as well. The lack of permanent settlement in the quarry zones suggests that laborers were moving between residence and job site along roads as well.

Similar to Strabo's criteria for what constitutes a city in antiquity, modern scholars have argued over a list of criteria for what constitutes Roman imperialism. Roads – and in particular straight roads with block construction – are always on that list (Laurence 1999; 2001). They are frequently associated with military activity (French 1981; Elton 2005), but are also implicit portions of imperial landscapes of production, such as mines and quarries; the documentation of such features occupies substantial space in publications on quarries in Roman Egypt (Peacock and Maxfield 1997) and, of particular relevance here, in Roman Euboea (Vanhove 1996). Interestingly, they serve as markers of imperial participation in the landscape: Hirt (2010: 10) suggests that road systems develop primarily to ease the problems presented by geographical constraints in a rational system of landscape development related to resource acquisition. There are indications, however, that the relationship between road construction and quarries on Euboea – and therefore that the relationship between quarries and the production of imperial landscapes here as well – stemmed from slow-developing interactions with the region and its geology.

The creation of an imperial Roman landscape in southern Euboea resulted from an interplay between quarrying and subsequent structural development – in other words, the Euboean landscape was not pre-imagined by Roman authorities. Instead, its development grew in a more organic fashion as the rare form of marble here increasingly became part of the trans-Mediterranean market. The best evidence for this is in the construction of the road system, which followed initially modest, then increasingly intense, efforts at extracting the variegated material from the ground. Following a typical pattern of Roman road construction, the Via Claudiana and the three other primary roads through the region

around Styra were built by layering rubble beneath slabs of cut or partially prepared stone. In this instance, the stone most readily available was the local marble, and there are many instances in which surface pavement stones were faulty or otherwise unused architectural blocks that were removed from local quarries first (Vanhove 1996: 17). In short, the imperial road system, intended to deal with the complications of the Euboean landscape, was not part of the quarry region until well after extraction of stone for architectural projects throughout the Mediterranean was underway. In this sense, the development of this imperial landscape arose in response to specific interactions with the terrain and the increasingly prominent role quarrying took in everyday social and economic life on the island.

The significant role of quarries in social life on Euboea is also seen in the overlap in industrial activity and non-industrial behavior. The Styran quarries, which have undergone far more rigorous documentation than the quarries above Karystos (cf. Hirt 2010), reveal materials from related industries. These include timber for the production of hoists and scaffolding, for which postholes remain in the marble surface; basins for water, presumably for consumption (Vanhove suggests by donkeys and other pack animals); and basins for forging and tool repair, which could have been produced locally given that Euboea is also rich in iron ore. Finally, the presence of a shrine suggests long-term residence near the quarry, indicating that religious life and wage labor occupied the same space. This suggests, minimally, that the economics of production in specialized marble quarries impacted social life on the island as well. Unfortunately, specific examples of individual laborers on Euboea are not extant, so developing notions of shared knowledge or individuals moving through the landscape are not provided here.

But external perceptions of the role of cipollino marble on the development of Roman notions of Euboea are, in some places, available. Together they paint a portrait of a region that becomes identified with the material produced there. In some respects, this is similar to Bradley's (1993) notion of how landscapes retain social significance over time. While Bradley's example of Stonehenge is temporally and regionally specific, there are some interesting parallels in how cultural significance develops in relation to continued activity in a given landscape. On Euboea, the act of quarrying from the 2nd centuries BCE to the 2nd/3rd centuries CE dramatically altered the landscape, such that huge mounds of chipped stone – the detritus of stone extraction – dotted the southern Euboean countryside, leading Strabo to comment on it. Whereas renewed significance is attributed to the English countryside at Stonehenge through continued – yet periodic – activity at a ritual site, the continuous act of extracting marble in antiquity solidified social perceptions of Euboea as an industrial Roman imperial landscape that was commensurate with the organic development of specific landscape features. Thus, quarrying in Euboea impacted social life for the island's inhabitants as well as for non-local observers, while feeding into an economic system. Such a system, however, depended on the specifics of this location in the production of a unique imperial landscape.

Quarries in the Eastern Desert, Egypt

Nowhere in the Roman world is the intersection between specialized landscapes, economy, industry, and social life more evident than in the quarries of the Eastern Desert. The peculiar nature of these quarries, situated as they are some 50km from either the Nile

or the Red Sea, in some cases (see Mons Claudianus), have provided the fodder for substantial scholarly research. Of particular interest are the indications that the founding of these quarries was a deliberate process by which appropriate stone was located through geological prospecting.¹²² As such, these quarries have been regarded as clear displays of Roman authority and of Roman organizational prowess, serving as industry sites *par excellence* due to their state of preservation and associated ostraca. Archaeological remains provide insight into the complex Roman bureaucratic system. Roman authority is seen in particular in the associated labor camps in immediate proximity to the labor sites, which also provide an interesting perspective on daily social life.

The quarries of the Eastern Desert were part of the imperial system of ownership and operation. The first indications of extraction at these resource sites dates to the first century CE, at which point Nero, following shortly after the Tiberian expansion of resource possessions by Rome, appears to have approved the opening of new operations.¹²³ The majority of the quarries in the Eastern Desert remained active into the 3rd century CE, after which time they were abandoned due to a reduction in demand for granite (Hirt 2010). Physically, the quarries at Mons Claudianus and Mons Porphyrites are a series of small, u-shaped, extraction zones connected by slip roads and small causeways that lead downhill to the main transport conduits (Peacock and Maxfield 1997; Maxfield and Peacock 2001). This has generally to do with the geological properties of granite outcrops more than any idealized exploitation system. The open layout of these

¹²² Instances of ancient geological prospecting are covered by Healy (1978) for mining, but most instances of prospecting for valued stone are limited to indications of small or failed attempts to follow specific veins.

¹²³ This date applies specifically to the Mons Claudianus quarries, from which site ostraca dating to the earlier phases of occupation offer start and end dates. See Hirt (2010) for a more complete synthesis of the entire Eastern Desert quarry network.

districts reduced the burden posed by the quarry debris, as it was able to slide down the hills upon which the extraction sites sat (Hirt 2010). Lookout posts placed within the quarry zones speak to administrative oversight, as does the close proximity of most associated workmen's camps. The roads from these desert regions to the Nile and the Red Sea are dotted with numerous military outposts as well, implying both strict oversight and the need for protection of valuable material in transit.

Because the state of preservation in the Eastern Desert is so good, additional sources of data are available to add texture to events in these quarries. Ostraca reveal details about the titles held by individuals, including their names, as well as information about the living conditions of people in the work camps; Hirt (2010) notes that many of the ostraca refer to requests for bread.¹²⁴ What is clear from the ostraca is that the same titles used throughout the Roman empire for quarrying and mining are also in use, adding to the notion that these far-flung resource sites fully participated in Roman imperial bureaucracy and wage conditions. Similar camps were established for laborers in Chemtou/Simmithus (in modern Tunisia), though the spatial boundaries between camp, quarry, and town were rather pronounced in the northern, more urbanized zones. Although worker camps are not attested for quarries in Greece or Turkey, the titles, administrative units and wages paid to laborers were largely consistent throughout the Mediterranean basin during the Roman imperial period.¹²⁵

¹²⁴ Hirt, citing Bingen (1996).

¹²⁵ There is some speculation that such a camp existed at Dokimeion, but there is no evidence for this. The modern town of Iscehisar completely obscures any earlier foundations and the quarry district has undergone substantial exploitation during the last 50 years. Mining at Laurion, in Attica, Greece, was conducted by the inhabitants of local towns (Hopper 1968). The imperial quarry at Teos was also worked by local inhabitants on a seasonal basis, not by paid laborers forced to live at the extraction sites (Fant 1988).

It is this uniformity in titles, wages and administrative patterns that have, above all else, been discussed with reference to the Eastern Desert quarries, often at the expense of other, local landscape attributes. The reach of Roman economic and social institutions into the desolate Eastern Desert corroborates many notions of a rational and standardized empire-wide economy. Indeed granite from Mons Claudianus and Mons Porphyrites was used in construction projects as far away as Rome, and partially-finished column drums indicate a pattern of craft production that engaged the tastes of many elites in the Roman world. The feat of procuring stone from such an environment, as Peacock and Maxfield (1997) note, speaks to the might of the Roman body-politic: no hardship was too great to stop the influx of goods into the increasingly wealthy hands of the elite. The organization of the desert landscape into a productive landscape is therefore the result of planned ingenuity – a type of conquest over the natural world.

One important thing is missing from this characterization of Rome's march into the desert. Namely, the experience of desert quarrying was fundamentally different from imperial extractive processes in other parts of the Mediterranean. The need for nearby worker camps and the presence of huge, manned guard-towers along the desert roads speak to the endeavor's peculiarity. Hirt (2010) mentions the desert itself as posing a major complicating geological factor. But surely such an undertaking results in more than merely recognition of Roman engineering supremacy or Rome's ability to transplant large populations of people through its political and economic might. Consumption of rare goods might very well have been the final motivating factor in the decision to create a desert infrastructure, but the effects on the experiences of those living and working in these conditions contributed to new senses of location and place as well.

Recalling that masons in Lydia participated in mixed economies, including agriculture, fishing, and resource acquisition draws a stark comparison to events in Egypt. Whereas Lydian laborers were part of a community dependent on seasonal rhythms and the local needs of farmsteads, villages, and possibly towns, those in the Eastern Desert existed in a more homogenous environment with fewer possibilities for seasonally shifting jobs. Ostraca offer insight into the lives of attendant mining towns, which included bakers and providers of other life necessities (Bingen 1996). But associated agricultural fields, small market towns and opportunities for recreation were not present in this landscape. In brief, the formation of a community in the Eastern Desert came about in dramatically different ways than in either Lydia or Euboea.

An often overlooked aspect of this community is the manner in which different aspects of social life came together in an industrial zone. Given that the discourse around these quarries is couched in terms of coercion, daily practices persisted in the formation of this particular imperial landscape as well, albeit in different ways than elsewhere in the Roman world. Returning to the aforementioned notion of imperial landscapes as comprising specific infrastructural amenities, it is also apparent that both these, and the communal activities that occurred in industrial zones, depended to a high degree on local circumstance. The presence of huts for apparently temporary occupation by quarry-workers, the proximity of towns adjacent to major quarry zones at both Mons Claudianus and Mons Porphyrites, and the breadth of social activities that took place in these places speak to overlapping social and economic practices. Indeed, economic activity in this region could not occur without the conditions for social life as well, and the two nominally different forms of activity reciprocally acted on each other.

Focusing on one of the major quarry areas in the Eastern Desert, Mons Claudianus, reveals the degree to which social and industrial activity overlapped, as well as efforts to regiment space according to function. Features of the town include a large temple to Zeus Helios Sarapis, a fort that housed both military officials and civilians, a bath complex, animal pens for draft animals associated with the transportation of stone, grain storage facilities, and, 500m away in an adjacent wadi, a worker's village and a quarry administration complex (referred to as the Hydreuma). Each of these architectural features falls within the sphere of the 130 quarries located at the site. The decision to use Zeus Helios Sarapis, an amalgamation of Egyptian and Greek influences into an all-purpose deity – including the power of Zeus, the sun, affinities to the underworld through incorporations of Dionysus, healing through adaptation of Asklepios' features, and seemingly many others – is an indication of the group's geographical isolation. In much the same way that the town itself plays numerous roles at once, the patron deity fulfills every need of its inhabitants through his enormous breadth.

Additionally, the earliest administrative building (the Hydreuma) was, after a time, replaced almost entirely by the larger, more centrally positioned fort, suggesting responses to patterns of production. As more and more quarries were opened to the north of the site, the location of the administrative structure was moved in response. Taken together, the evidence indicates meaningful instances wherein a Roman imperial landscape of production is created in conjunction with social and environmental concerns. The surveillance of workers and the transportation of stone through the desert, and the attempts to regulate extraction of stone through the application of administrative units common throughout the empire, speak to participation in high-level political and

economic policies. The community that took shape within and around these practices, however, was the result of a particular confluence of conditions. The deliberate founding of a new settlement in the desert for extraction of granodiorite resulted in crossovers of highly specialized labor practices by full-time masons and artisans in immediate proximity to other aspects of social life, including social gatherings at baths and religious worship in the temple to a god specially crafted to meet a vast array of social concerns. As with the cipollino quarries on Euboea, this imperial landscape is not a pre-planned microcosm of Roman institutions transplanted to a new context, but grew out of fundamentally different social and environmental conditions. In this sense we can develop a notion of Roman social institutions that very directly responded to the actions undertaken in direct association with the landscape.

Imperial ownership and operation of mines and quarries constitutes only a small percentage of engagements with stone in the Roman world, but their intense use and wide distribution resulted in a focus solely on Roman organizational models. Nevertheless, the two examples of Euboea and the Eastern Desert highlight the degree to which economic conditions in imperial Rome overlap with other social concerns in unique and diverse ways, calling into question approaches to the subject of the trade of rare stones that privilege only the economic aspects of production. Within a structured administrative system, the flexibility to adapt to local circumstance was paramount in the successful procurement of stone to serve distant markets. Both in patterns of intensification of existing quarries and in the founding of new quarries, such flexibility was on display. What follows departs from imperially-owned quarries in order to demonstrate how other

types of economic networks – that is, non-imperial networks of production and consumption – also existed.

Urbanism and quarries

In reality, only a very few of the quarries exploited during the Roman period fell under imperial ownership. Those quarries tended to be of particularly valuable material, for reasons of either color, texture, or homogeneity of stone. People in antiquity appreciated geological content in more ways than not.¹²⁶ By far the most stone utilized by volume can be found in the various cities throughout the Mediterranean, where participation in things Roman implicates urban design in both the imperial marble trade and the acquisition of local stone for local use. The geology of the Mediterranean basin being what it is, many cities, such as Ephesos, Aphrodisias, and Sardis, (to name a few from Asia Minor) had access to marble in their immediate hinterland. Others, however, relied more on imported marble to complement construction in local limestone and, in some cases, sandstone, basalt, andesite, and more. This section deals with how decisions about stone use and stone acquisition were made in urban sites and how those decisions impacted social life therein. Of particular interest are cities with local quarries. Spatial constraints necessarily limit this discussion to a few examples.¹²⁷

¹²⁶ See chapter 2 for a discussion of Roman notions of value.

¹²⁷ Some examples include Athens and the Pentelic marble quarries; Dura Europos in Syria; Ancyra and many more.

Quarries and Change Over Time

One such city with access to considerable amounts of marble in its hinterland is Sardis, which has received a fair amount of attention in this dissertation. It has not, up to this point, been discussed with respect to quarrying within the imperial polity. A few pages are therefore dedicated to condensing the data from Roman Sardis into such a discussion here.

Sardis offers an array of perspectives on quarrying that challenge notions of industrial activity within patterns of Roman urban contexts. In part this has to do with Sardis' own shifting relationship with the Roman polity itself, and the subsequent changes this brought about in Sardis' participation in social, economic, and political developments in western Asia Minor and further afield. While Chapter 6 argued for a highly localized pattern of quarrying in the hinterland of this city, marble extraction for urban purposes presents a markedly different pattern, as well. As mentioned throughout this dissertation, the primary quarries used for marble extraction during the Roman period were those opened to the south of Sardis – the Mağara Deresi quarries – in the Tmolus mountains that form an east-west ridge against which the city rests. Although not surveyed by the author, the patterns of extraction present in these quarries reflect full-time, specialized labor by quarrymen and masons. Some debris and partially reduced blocks remain in the valley in which the quarries rest attesting to some crossover of activity within the quarry sphere.

While an expanded program of marble sampling and testing within Sardis will help confirm the local origin of the Roman material – and perhaps some of the Lydian material as well – notes from earlier tests indicate a local origin for most of this stone

(Hanfmann and Ramage 1978). This material was likely used in the construction of the Bath-Gymnasium complex and associated Marble Court, the reconstructed theater, and the numerous examples of marble statuary present in the Roman period city. Estimated volumes of extraction are not available at this time, though the quarries series of at least four distinct, large-scale quarried zones indicate something comparable to the volume of stone extracted in the series of more than nine quarries in the vicinity of Aphrodisias. The extant pattern of extraction represented here is similar to those seen elsewhere in the Roman world: curving, parallel lines created by a heavy iron pick striking the surface of the rock in a systematic pattern of channeling and trenching to remove the stone from its source. Visually, the stone also similar to the marble seen in the Marmara Lake Basin. Both sources yield a marble that is primarily white-gray, with bands of gray and sometimes rust. The characterization of the Mağara Deresi marble as “coarse-grained” (Ratté 2011: 18) matches that of the Marmara Lake Basin as well. Nevertheless, the material from each marble zone has plotted in substantially different ways through stable isotope analysis (see Chapter 5), and the considerably greater size of the outcrop south of Sardis created, in general, a more homogenous layer. The timing and processes of metamorphism surely have something to do with these differences as well.

Transport of stone from the quarries to the city was made possible by the combination of two features: the river cutting through the valley, and remains of a quarry road are visible (Ratté 2011: 18), though precisely what this is remains somewhat unclear. The effort required to haul marble from the quarry locations to the top of the ravine would have been immense. The very act of quarrying itself, however, served to widen the streambed in several obvious areas.

This is interesting for several reasons. First, the Sardian quarries at Mağara Deresi reflect a much more condensed pattern of activity than several of its western Asia Minor counterparts, including Aphrodisias and Ephesos. Both of those sites have abundant marble sources, but these sources tend to be distributed more broadly throughout the territory governed by that city. Nevertheless, the quantity of marble used in Sardis places this city in positive comparison to its neighbors. Considering how the distribution of marble sources, and the variability in stone color and texture that this reflects, influenced the interpretation of the Aphrodisian quarries as subject to elite patterns of consumption (Russell 2009a), the implication for Sardian patterns of consumption are indicative of something different.

The material remains of cut and sculpted marble within the city suggest that much of its production was related to elite and, at times, imperial consumption. As mentioned in Chapter 4, imperial benefaction in Sardis increased some time during the 2nd century CE. The skill of the craftsmen working on marble in Sardis was likewise of excellent quality, continuing trends established in this region during the Iron Age, while introducing new tools and techniques that speak to Sardis' increasing participation in the broader Mediterranean world. What is interesting, however, is how similar patterns of patronage and consumption in different cities of western Asia Minor can result in patterns of quarrying that reflect back on issues of value and taste. Whereas Aphrodisias witnessed substantial variation in consumption on a project-by-project basis (Russell 2009a), Sardis reveals a pattern whereby a specific, local quarry (4km south of the city) was targeted repeatedly for production of a single type of high-quality stone. This is certainly related to the geology of the region, since marble was fairly uniform in type,

and since the quarries in the Tmolus mountains were sufficiently abundant to meet demand. Nevertheless, acquisition of other types of stone, which happened frequently, though less than the use of local stone, would have required interaction with other regions of Asia Minor and beyond.

Indeed, the scale of production at Mağara Deresi might indicate a wider field of stone distribution beyond the city, suggesting the possibility of Sardis acting not just as a consumer city. Several local cities, such as nearby Philadelphia, are likely destinations for stone, as are several larger estates in the city's hinterland. Although the previous chapters outlined a specifically local character for marble projects in the Marmara Lake Basin, several of the field finds tested in 2011 yielded a stable isotope signature that is more consistent with Mağara Deresi than with the more local sources in the form of column drums. It is thus possible that specific types of architectural adornment were more appropriate for different stone sources in the region, and the very few instances of architectural adornment in the Marmara Lake Basin sought stone of a subjectively "better" quality. A systematic study of distribution patterns for Sardis and other major sites in western Asia Minor, such as Pergamon, Priene, and even smaller sites such as those near Uşak and Philadelphia could prove quite informative in explaining how material moved throughout this region as a whole, and what role local circumstances played in such patterns.

Organization of labor

Specialized labor has long been a feature associated with the rise of urban centers, going back to the writings of Childe (1950). The ability to control and mobilize labor has

been a central tenet of discourses in political economy (Helms 1993). Such assumptions have been applied to the Roman economy as well, and with good cause: guilds for professions as disparate as masons, bakers, fullers, and prostitutes are well attested in the primary sources (Burford 1972; Allison 2004; Liu 2009), conforming to the presence of artisanal workshops for materials such as ceramics and sculpture (Poblome 2004; Russell 2009a; Smith 2011). For the entirety of Rome, however, it is perhaps best to limit notions of specialized labor to wage labor for hire. This notion leaves room for the artisan members of guilds as well as for the part-time laborers who constitute a significant portion of the labor employed for stone acquisition, as demonstrated below.

While professional full-time stonecutters are convincingly attested in imperial mines and quarries, the evidence for their presence in other types of quarries depends on archaeological accounts of the inner workings of resource sites. Petra offers a complicated array of evidence, pointing to both full-time and part-time stoneworkers at a city that was, quite literally, cut out of the bedrock. Of particular interest in the context of this dissertation is the nature of construction at Petra. The ‘rose-red city, half as old as time’ was not a constructed city in the same sense that Rome was a city of brick turned marble in the Augustan era. Instead, the majority of construction (though certainly not all of it) started as rock-cut facades in the bedrock of the site itself (McKenzie 2005; see also Schmid 2007; 2009). Construction of monumental architecture at Petra, in the manner of finished architectural masonry rather than rock-cut buildings, occurred only after the city became a client kingdom in the mid 1st century BCE (Netzer 2003). After this time, major extraction sites appear along the city’s wadi system and in more open areas as well.

The evidence for full-time labor at Petra relates both to the scale of operations and to the apparent overlapping of stone extraction and stone dressing in the same physical spaces. A group of what Rababeh (2005) calls ‘primary quarries’ are the largest sources of stone used by the city. The three main areas of quarrying cover a large area in the outskirts of the city center. The Wadi es Siyyah quarries begin at the edge of the core of urban construction, running along the entire length of the wadi until it opens out into a deep chasm. These quarries exhibit three distinct techniques of extraction: stepped, curved and conchoidal (Rababeh 2005: 50). These may relate to different quarrying groups, as identified by a series of quarry marks and inscriptions running along the wadi system. Rababeh (2005: 51) estimates that 31,500m³ of usable sandstone was extracted from this area, with some of it going directly to the construction of Qasr el-Bint.¹²⁸ The Turkmaniyah and Umm Sayhoon quarries are similar in scale and share the same overall patterns of extraction.

The extant tool marks at these ‘primary quarries’ reveal that extraction occurred following the Hellenistic period, that these quarries provided blocks of stone for architectural construction, and that sometimes elaborate infrastructure was necessary for the extraction process. The pick marks left on the (curving) vertical surfaces of the quarry walls occur in well-defined horizontal rows of great consistency in vertical height (approximately 95cm) in a curved sweeping pattern (Figure 7.2 and 7.3). This pattern is wide spread throughout ancient quarrying practices and has been attributed to the introduction of a new, heavier pick following the 4th-3rd centuries BCE (Waelkens *et al.* 1989; see also Chapter 2). The related infrastructure, indicated by squared holes cut into

¹²⁸ See also Pflüger 1995 for a discussion of sourcing sandstone at Petra.

the quarry surface, presumably provided slots for ladders and scaffolding to enable work to begin at the top of the bedrock layer. It also indicated a gradual movement backwards. Occasional instances of cut blocks of sandstone at the base of a quarry (e.g. at the Umm Sayhoun quarry) reveal that the process of dressing stone for architectural use also occurred, at least some of the time, within the quarry limit. The scale of extraction at these quarries, coupled with the evidence for quarry groups, suggests full-time production of architectural blocks for multiple monuments, the majority of which are dated to the period during Petra's status as a client kingdom or after Rome had annexed the entire region (Fiema 2003).

The construction of numerous rock-cut facades occurred during the same general time-frame, involving similar patterns of stonecutting. Cut-marks, such as those that appear throughout the urban center (Figure 7.5), demonstrate parallels in technological intervention with the bedrock in both rock-cut architecture to the cut-marks left by the extraction of stone blocks. Major differences are seen, however, in the application of dressing techniques to entire surfaces, both horizontal and vertical. The direction of tool-marks for dressing run in regular, straight or diagonal lines, which is consistent with the use of point chisels, tooth chisels and rasps. While the application of this pattern to whole surfaces is unique, the tools themselves are not, as demonstrated by the dressed stone for constructed buildings as well. The ubiquity of cut facades and cut interiors throughout Petra, however, and the gradual changes to façade style throughout the centuries, argue for a steady pattern of stonecutting within the city limits, requiring full-time skilled and unskilled laborers for both roughing out the design and dressing the stone surfaces.

The sort of intensive labor required for full-time laborers at Petra is implied by the collection of quarrymarks on cut surfaces. The very fact of guilds suggest that certain quarries, such as the Pentelic quarries in Attica, and the quarries at Dokimeion in Turkey, required similarly steady levels of extraction over great spans of time. The trend appears in other less well-known regions such as Catalonia, where several marble quarries near Tarraco appear large enough to have been continuously worked over long spans of time. Gutierrez Garcia-Moreno (2009: 271), for example, identifies two potentially different types of organizational practices in the Spanish quarries: short-term and long-term. Short-term quarries in the region were opened for specific projects, such as the La Rierussa quarry opened for a Roman bridge at Pont del Diable (Gutierrez Garcia-Moreno 2009: 272). Nevertheless, the Spanish evidence in particular is indicative of the difficulty inherent in attributing specific types of labor practices to both mines and quarries. Long-term use may just as easily indicate periodic returns to specific sites for stone, rather than a steady rate of removal. This is particularly true when the stone used for a specific project is not marble.

Periodic quarrying for urban centers

There is growing evidence that project-specific quarrying, on scales able to support both continuous extraction and short-term extraction, was quite common during the Roman period. In addition to countering the evidence marshaled by Ward-Perkins (1973), Fant (1988) and Dodge (1991) for market production of standardized blocks for export, this recent re-conceptualization of Roman quarrying industries develops the potential for more local flavor in the creation of modified landscapes, both architectural

and industrial. Little investment has been put into understanding the nature of these quarries from organizational or landscape perspectives.

Drawing again from my own field research, numerous quarries around Petra speak to precisely this punctuated investment and organization of labor investment and labor organization during the Roman period. The best examples at Petra are extra-urban in location, falling predominantly north of the city center in an area now named Shammasa.¹²⁹ Here, at least three obvious quarries exist, exhibiting the characteristically 1st century BCE-3rd century CE style of curved diagonal lines associated with, in one case, a quarry mark identifying a labor group (Figure 7.4). Although the tool marks left on the vertical quarry surfaces are the same as those at the ‘primary quarries’ nearer the city center, the general pattern of extraction differs. In the cluster of smaller-scale sandstone extraction sites in the Shammasa neighborhood the most prevalent technique for removing stone is trenching. As discussed in Chapter 2, trenching leaves a tell-tale series of channels or ruts around defined blocks of stone, representing efforts at what Rababeh (2005) calls leveling. This technique corresponds to two of Bessac’s more precise categories: *carrière par arasement général*, and *carrière en paliers ou en gradins* (Bessac 2007: 253).¹³⁰ It is a type of quarrying that occurs without prior exploration of the depth of viable bedrock, which has been connected to short-term projects or special-purpose projects due to the primacy of immediately available stone, over prospecting for

¹²⁹ These quarries were first discussed and preliminarily documented by Lindner (2002). Subsequent work by the Brown University Petra Archaeological Project has provided further landscape and settlement context for these quarries as well as further documentation of their tool marks and extraction techniques.

¹³⁰ Bessac’s complete list of 8 different quarry types: “a) extraction verticale par petits chantiers juxtaposés; b) carrière par arasement général; c) carrière en paliers ou en gradins; d) carrière en conque; e) carrière linéaire; f) carrière liée au dégagement des structures rupestres; g) carrière en galerie; h) carrière liée au dégagement des structures rupestres souterraines” (Bessac 2007: 253).

sources that will provide long-term resource availability (Gutierrez Garcia-Moreno 2009). (Although, arguably, when your entire environment is sandstone, such concerns are perhaps less relevant.) The primary method of stone removal in the countryside around Petra is therefore one that utilized blocks of stone for construction on a project-by-project basis.

This project-by-project approach to resource acquisition led to Russell's development of the consumer-driven model for understanding the marble trade in the Roman period (Russell 2009a). It is, therefore, a practice that is well attested throughout the Mediterranean region, including at the city of Aphrodisias and in the Spanish examples mentioned above. While the practice of quarrying tied to specific projects has been used as a sweeping generalization for the difference between the Greeks and the Romans (Fant 2008), specific commissions for stone objects are also famously attested for the Roman period as well. A case in point is the granite from the quarries at Mons Claudianus, whence the columns originated for Hadrian's final construction of the Pantheon. Numerous other examples exist of patrons purchasing specific types of stone for the properties that were associated with them, such as color, texture, and warmth (Molholt 2008). While this all speaks to awareness of stone types, and a sense of what was appropriate for specific construction projects in antiquity, it does not place the practices at these quarries within a local social context. Thus, while the practice is widespread, the site-specific meaning of quarrying can be dramatically different throughout the Roman Mediterranean.

Petra, again, provides a case in point, since the social fabric within which quarrying occurred was markedly different than elsewhere in the empire. In brief, the

survey results from the Brown University Petra Archaeological Project (BUPAP) reveal that the densest periods of occupation in the Shammasa neighborhood were during Nabataean (Hellenistic) and Roman periods. This settlement pattern corresponds to periods for which there is also the greatest amount of evidence for stone-working activity both within the city and in the countryside. In addition to collecting surface finds, the survey also documented a range of features in the extra-urban landscape. These include agricultural features such as terrace walls, shepherd's huts, soil and water management systems in the form of barrage dams and cisterns, graves and rock-cut tombs, shrines (baetyls), and water channels cut into outcrops. Social activity in these extra-urban spaces was varied in scope, including industrial activity, games, religious practice, and indications of daily life from settlements and transhumance.

What separates these features of the Petra landscape – and the activities related to stone-working that they represent – from other quarry landscapes is not the intersection of industry and other aspects of social life *per se*; these are, after all, demonstrated in other contexts developed in this thesis. What Petra reveals is an interlocking system of social and industrial practices utilizing the same tools and techniques for a variety of purposes. The clearest examples of this from the Shammasa neighborhood are seen in the juxtaposition of trenched quarries for blocks of stone, water channels near deep cisterns, and walls cut to direct the flow of water during seasonal flooding of the wadis. Extraction of this stone to create the directional walls invariably occurs within the immediate vicinity of a water channel. These cut surfaces also reveal the same curved herringbone pattern of tool marks seen on other, more definitive, quarry walls.

Pit graves and chamber tombs cut into the bedrock near Shammasa demonstrate the same series of tool marks as in the quarries and the creation of rock-cut façade architecture within the Petra city limits (Fig. 7.6). The placement of these features in direct association with agricultural fields, religious sites, and life necessities such as large water cisterns, reveals a multivalent character to this particular landscape. It appears, therefore, that the iron chisel was put to effective use in the creation of more than architectural features at Petra.

Within the city center itself, however, the quarried surfaces fulfill different social functions, often revolving around notions of monumental or public display. The façades cut into the bedrock of the site itself are obvious examples, but in Petra, the quarries themselves serve to support similar social roles. The Wadi es Siyyah, potentially one entryway into the city, is a giant cut surface, with quarries running almost its entire length. Quarrying at such a scale has a monumental presence to it, as these wall faces are upwards of 20m tall with a passageway as narrow as 5m, literally encompassing the traveler as they pass into the city. The spectacle of the city therefore became its pattern of construction, not just with regard to the production of monumental façades, but with regard to the very manner of production itself. The quarries, from a social perspective, served to reinforce the grandeur of a city that literally had to be cut out of the landscape, creating not just structures for monumental display, but participating in nearly all phases of social life within the city.

The quarry walls of the Wadi es Siyyah also, significantly, led to the rock-cut houses of those who lived in Petra prior to its monumentalization – literally a series of hollowed-out rock shelters lining the opening before the wadi course runs to the West and

North. In this way, stone-working at the site visually juxtaposes old and new, monumental and mundane, in a process of place-making within the city. The fabric of the city and the processes by which the communities at Petra interacted with the environment played a major role in the formation of the city as a place, both in local terms and within an expanding socio-political world. At Petra, in a very real sense, daily practices, industry and political economy overlap in a process of place-generation.

Summary

Participation in the Roman economy as it was manifested in the provinces was a varied process that depended on local practices. As demonstrated here, many of the decision-making practices were motivated in part by efforts at display and monumentalization within the framework of expanding social and economic networks. At the quarries associated with urban sites, control over resource acquisition followed a distinctly different pattern than exhibited in imperially-owned and operated quarries. Production was, at times, on a similar scale, requiring full-time laborers, but the nature of production and distribution differed, as seen at Sardis. Extraction for individual projects was more the norm in such urban contexts, suggesting that there was always a dependence on local stone, even during periods of relatively high levels of trade in stone. Of more significance is the demonstration that local quarrying, even when it occurred with elite consumption as the primary motive, encompassed many social factors that gave rise to notions of place. In Petra, where material manifestation of a city relied heavily on cutting stone to create monumental edifices as well as the accoutrements of daily life, a complex interplay existed between different kinds of social significance attributed to

stonecutting. The outcome was a unique composite of locally-derived features and practices within a highly connected eastern Mediterranean sphere.

Formalizing the Informal

Small-scale economies and informal economies

Smith (1989), in her characterization of research on informal economies, places substantial emphasis on recognizing their role within the whole. That is, she demonstrates the way that officially sanctioned economic functions and those that occur without state approval are, ultimately, interrelated in both social and economic terms – informal economic activities are often vital to the survival of whole sectors of society adversely affected by policies that limit accessibility to the benefits of formal economic conditions. One such example is the food service trucks that operate without licenses in poor urban neighborhoods. These trucks, Smith (1989) notes, often deliver affordable meals to poor communities while siphoning refuse and unused goods from businesses that work within the formal sector. They sustain one struggling group such that they can, in turn, feed back into the formal system through purchases and labor, and often, as is the case with gangs, provide important social services when the state fails to do so.

To be sure, the comparison of modern informal sectors and ancient economies is imperfect. Food trucks in Detroit and rural quarries in central Lydia are not directly comparable, nor are the Roman and American economic systems writ large. The comparison serves, rather, as a lesson about how we conceive of economies and societies as units. The tendency is to treat official sectors as discrete entities under which other

sectors work, sometimes in opposition to them. Modern anthropological studies of informal economies reminds us that the unit of measurement is, in fact, substantially larger than state interventions, and should encompass the range of approaches to sustenance and viability. From this perspective, imperially or officially administered practices are only one portion of the total economic and social activity within any polity.

While Chapters 3, 4, and 5 demonstrated the manner by which a region oriented around small markets participated in different patterns of extraction and labor organization, two issues are important to bear in mind. First, central Lydia still did participate through various channels in the prevailing Roman political system of the time. Even if work within these quarries was unofficial, in the sense that local patrons or local needs provided the motivation to extract stone rather than elite consumption practices or state needs for marble, they still constitute an important portion of the total Roman economy, regionally oriented as it is. Second, and equally important, is the realization that these secondary and tertiary markets within the Roman polity are more numerous than previously believed, and the abundance of evidence for local decision-making, in the form of thousands of small-scale quarries in the countryside, has been grossly neglected hitherto. The first two sections of this chapter made the case that official practices were also social in nature. What follows aims to demonstrate that unofficial quarrying for local purposes predominated during the Roman period in terms of spatial coverage, even if it did not dominate the total volume of stone extracted during the imperial period.

Small-scale economies in Roman Asia Minor

The basic social and economic structures around which small-scale industries in Roman Anatolia operated have become clearer in recent years. The picture developed for central Lydia in the region around Marmara Gölü of a locally-focused social system in the vicinity of small villages and towns during the Roman period is well-established for much of western Asia Minor (Schuler 1996; Riel 2003). In this system, urban centers controlled territories defined by the state, each of which contained a number of small towns and villages. These smaller sites interacted with the larger urban center through politics and through the urban markets. They held their own markets that were fed into by even smaller, farther-removed rural settlements that could, likewise, hold their own periodic markets (Shaw 1981; De Ligt 1993; see Levick and Kehoe 2007 for a different perspective). The territory of Kibyra in Lycia and the associated estates therein are examples (Fig. 7.7). There, three estates run by different families were nonetheless owned by Roman authorities who rented out property (Corsten 2005; see Trombley 2004 for other examples of estate structure).

Villages could also be privately owned, however, with the primary notable difference in social status being the person to whom honorific dedications were made: the urban administrator or the village owner. In central Lydia, the previously mentioned town of Arhillenoi was privately owned by Asinius Rufus, from whom local residents requested assistance in dealing with Sardis, the largest Roman center in the region (De Ligt 1993; Malay 1994; Riel 2003).¹³¹ Inscriptions from Caria suggest similar patterns of

¹³¹ Riel (2003) refers to this entire structure of local ownership, and the presence of rural shrines and sanctuaries in the countryside, as a profoundly conservative aspect of Anatolian social life that persisted from the Bronze Age onwards. She cites lists of Hittite sanctuary attendants as evidence for preexisting parallels to the pattern yielded by Roman imperial period inscriptions. These communities, she argues, are

village ownership as well (Riel 2003: 79). The situation in Roman Asia Minor was therefore a layered series of interconnected pieces, each practicing different kinds of authority over social and economic actions, enabling both trans-Mediterranean markets, regional markets, and highly localized market activity to function simultaneously.

One instance of local authority, related in part to the use of stone (among other land-use practices), is the construction and maintenance of rural shrines, which were a prominent part of the landscapes of Roman Lydia and Phrygia (Riel 2003). Rural shrines and sanctuaries pose a problem archaeologically in that they are difficult to locate through means other than the evidence from inscriptions. But this evidence is strong and provides a picture of land tenure systems that are only tangentially concerned with Roman legal customs. Instead, *curatores* – one of the positions with a permanent presence at these shrines – were responsible for the upkeep of the physical building and the surrounding territory. These include the votive structure itself and, commonly, a frontal portico. Although the materials used in construction are not attested, some examples of rural shrines and sanctuaries in the region are extant and attest to the incorporation of, primarily, local stones. In fact, the predominant material used in rural contexts, including construction and sculptural pieces, is of local material.

Where did the material from small-scale quarries go?

For such small-scale use of stone within this backdrop of layered economic practices, four primary contexts emerge from the archaeological record: building material for public projects; building for private projects; the production of sarcophagi and other

“conscious of the fact that they belonged to a unit larger than their nuclear families” referring to it as a “corporate identity” that roots communities in places through strong collaborative efforts.

funerary stones; and the commemorative use of stone in inscriptions.¹³² All are attested widely throughout Asia Minor and the Eastern Mediterranean, and all encompass the use of a variety of stone types, depending as they do on local sources. Addressing this problem is, however, complicated by the a paucity of such finds in the archaeological record with secure sourcing and a tendency to overlook small-scale quarries and small-scale quarrying as aspects of human society that are too obvious or inconsequential to higher-level economic trends.¹³³ Nevertheless, a series of examples will suffice to demonstrate just how prevalent these features are in the Roman landscape and how they should be regarded as more than mere “background noise”. The quarries in central Lydia are not an anomaly, but served as a primary focus for community-building in the entire countryside of Roman Asia Minor and beyond (Hirt 2010).

Some 26 rural shrines associated with known rustic deities have been identified in Lydia and Phrygia, each commemorated with a stone dedicatory inscription (Riel 2003: 78). Comprehensive archaeological work at these shrines, however, is lacking, as are systematic explorations of the full range of Roman sites in central Lydia, most of which are known through evidence from inscriptions and targeted site based, extensive explorations (Roosevelt 2003). Nevertheless, those whose publication includes archaeological finds and documentation reveal the prominent use of what is likely local stone. The temple to Zeus at Aizanoi, the temple to Meter near Philadelphia, and an unknown deity above Gokdere, serve as some of the larger examples of what are otherwise typically small, rustic shrines common to this region, though many more

¹³² Thonemann (2011).

¹³³ This is made more difficult, as well, by the recent Turkish Ministry of Culture and Tourism mandate that excavation projects focus on touristic aspects of sites, with particular emphasis on theaters.

existed and have been mentioned in other contexts (Malay 1994; Haspels 1971; Mitchell 1993a; 1993b; Roosevelt 2003). Of note are the local stones and the presence of inscribed blocks, usually in marble. This suggests both that local, yet to be identified sources of limestone, schist, and marble were used in the construction of these projects, while the marble dedicatory inscription is, from the 2nd – 4th centuries CE, the product of marble blocks pre-cut for such purposes, circulating through regional and urban markets.

Similar shrines, albeit of grander repute, exist in neighboring Caria as well. Labraunda and Sinuri, near Mylasa, Caria, were well-adorned shrines, built initially during the Hellenistic period, that underwent renovations during the subsequent Roman process of annexing Asia Minor (Williamson 2012). Shrines of similar construction and regional significance from Hellenistic and Roman Anatolia were, more often than not, the source of community participation and community gathering, rather than competition; indeed numerous urban sites were founded in direct correlation to existing rural shrines and sanctuaries, as focal points in the landscape developed into dense settlement concentrations (Dignas 2002).

Most significantly, the pattern of part-time involvement in the maintenance and upkeep of regional shrines and sanctuaries in western Anatolia mirrors the pattern of seasonal stone extraction enumerated for central Lydian marble quarries with an emphasis on the support of local communities. This pattern therefore impacted both private land ownership, as likely to be seen in central Lydian farmsteads, and sites of religious practice. This trend in producing marble objects for local projects extends to other finished products as well, including sarcophagi. In Anatolia, marble, limestone, schist, andesite and, farther East, basalt were commonly quarried for local use and for

local distribution of sarcophagi. One example from a modestly studied context comes from the site now called Fasıllar, near Beyşehir Gölü in Konya province (Fig. 7.7). With sarcophagi dating stylistically to the Late Roman period, this site, with its mixture of iconographic, inscriptional, and monumental features from the Bronze Age, Classical and Roman imperial periods,¹³⁴ demonstrates a temporal depth to the use of its andesite outcrops that is tantalizing in its simplicity. Different features from different periods sit side-by-side in a relatively uncluttered location above a small modern village.

The primary reason that the temporal depth of Fasıllar site is so readily recognizable is the site's long-term function as a regional gathering-place. Although some scholars have suggested there might be Hittite or Bronze Age (marking a political differentiation) roads or structures here, the only surface remains for a structure of any kind are of an Iron Age fort with several rooms. The Fasıllar monument, a 7.4m-tall andesite or trachyte statue of a Hittite god standing above two lions, has similarities to the features at nearby Eflatunpınar, the site of a monumentalized sacred pool. These similarities, coupled with spatial proximity, suggest periodic visitation at Fasıllar for sacred practices as well.¹³⁵ Fasıllar's role as a gathering-place in the Classical, Hellenistic, and Roman periods is more certain, based on the Greek inscription on the rock face beneath the Lucianus monument, a rock-cut niche cut into the natural rock-face and into which was placed a larger-than-life sculpture of Lucianus (now missing)

¹³⁴ The features include the Fasıllar monument (dating to the LBA), the Lucianus monument (with a horse and man standing in a carved niche dating to the Roman period), an inscription (in Greek dating to the Hellenistic or Classical period and mentioning a stadium at the site), and the sarcophagus quarry (with a Late Roman date). There are walls on the promontory of the quarry area dating to, perhaps, the Iron Age, suggesting the presence of fortified site here as well. Hall (1959); Mellaart (1962); Waelkens (1990a).

¹³⁵ As Alexander (1968) has pointed out, this Fasıllar monument and the Eflatunpınar monument are too stylistically dissimilar to support an argument that they originated from the same monument.

standing next to his horse (still present). This inscription suggests the occurrence of games at the site, which prompted Mellaart (1962) to argue that the stadium-like shape of the valley could have supported games at a Classical town. Although Hall (1959) convincingly argues against the location of a Classical-Roman town here, the communal role of this site/quarry remains a primary attribute.

Tradition and Production

The stone-cutting tradition at the site continued into the Late Roman period, to which time the sarcophagus quarry appears to date. The materials almost certainly fed a local audience, though likely not one that occupied the site. Mitchell (1993a; 1993b) notes that similar sarcophagi of limestone and the local andesite material were prominently used in settlements closer to Beyşehir Gölü, some 20km to the west of Fasıllar. The geological properties of the site offer good sources of stone, being located at the northern foothills of the Taurus mountain range at the intersection of the Konya plain and the lake basin. Those sarcophagi that have been left *in situ* in a partially finished state, next to empty basins where finished versions formerly stood, have a locally favored floral pattern surrounding the generic faces of their eventual patrons. From this it is clear that much of the reduction and dressing processes for the completion of sarcophagi were undertaken on the site of extraction, a pattern that is mirrored in some of the major marble quarries of western Asia Minor as well (see Waelkens 1985 on Dokimeion). This particular version of an imperial landscape was therefore heavily dependent on past practices and associations with stone-working, serving a primarily local audience while simultaneously promoting strong imperial images, such as in the form of monumental

rock-carvings (Lucianus) and associations to the site's monumental past (the Fasillar monument).

Leaving Anatolia behind briefly reveals that the phenomenon of local use of stone resources is not particular to one region in the Roman Mediterranean. Similar patterns of producing objects for variable audiences were seen in Caesarea Maritima, as mentioned above (Fisher 1998), and several archaeological survey projects in Greece have identified small quarries in the countryside (Fischer 1998; Cavanagh *et al.* 2005). One such example, from the Laconia Rural Sites Survey in the Peloponnese of Greece identified small-scale limestone quarries in the same general region from which the high-valued *lapis lacedaemonicus* is found. Although considerably more research needs to occur within the quarries to identify more precise chronological ranges for periods of greatest activity, their presence within the same geographical landscape as imperial quarries is indicative of a confluence of different administrative types in the acquisition of resources. Greece, in particular, was subject to laws governing private ownership of mines and quarries (Hopper 1968).

The extraction of marble and other stones from small-scale quarries in Roman antiquity is significant for our understanding of the entirety of the Roman economy for three primary reasons. First, these activities ran concurrent with the much larger-scale efforts at extracting stone for both export markets and for attempts at civic display by urban elites, as demonstrated in the first two sections of this chapter. Quite simply, this means that more was happening with stone than studies of imperial quarries typically consider. Second, the acquisition of stone from these quarries resulted in the formation of communities and social practices that were intimately tied to location-specific conditions;

this is true from geological, social, and economic perspectives. Third, these smaller modes of economic and social production were connected to larger-scale processes through a layered approach to economic connectivity in Roman Asia Minor. As others have suggested, Rome succeeded in Anatolia due to the development of interconnectivity between different levels of markets.

Conclusions

This chapter began with a dichotomy between rational economic decision-making and the significance of landscape in the production of social norms. This dichotomy is the presupposed difference between state-level economics and the “background noise” (Hirt 2010) created by small-scale economic activities usually related to the rural countryside in the Roman world. What this chapter has demonstrated regarding markets and productivity of different scales is that all phases of Roman economic institutions were in some ways peculiar, derived (as opposed to contrived), and part of the same overarching social system. Regarding the constitution of the whole Roman economy, the seemingly informal or irrelevant aspects of material and resource acquisition have been shown to be connected to high-level economies through a range of social and economic opportunities, such as small and periodic markets. At the same time, the evidence for large-scale economic practices that stand-in for official, or ‘Roman’, policy have been shown to depend on engagement with specific landscape conditions such that they, too are derived. What unites these different scales of practice are that they form a whole and are the result of landscape-based governmentality. The construction of Roman imperial landscapes of

production is rather more inclusive, a lot less pre-imagined, and more heterogeneous than previously supposed.

Although a substantial amount of work must be undertaken to more thoroughly integrate small-scale operations into the same framework used to characterize empire-wide operations, the data are emerging for an understanding of the significance of landscape and community in the development of the Roman imperial polity. The perpetuation of ‘conservative’ practices in the landscape well into – and even beyond – the Roman imperial period are suggestive of just how important the human-landscape interaction is in the development of social life. The continued significance of certain sites within the Roman landscape, and the propensity to attribute meaning to places for which local materials are acquired through collaborative activity, is a strong argument in favor of a ground-up approach to the ordering of the Roman polity in rural Anatolia. The fact that imperial- and elite-owned quarries throughout the Mediterranean were equally implicated in the development of social life – and the fact that social practices at these sites, such as in the Eastern Desert, were highly dependent on location and specific technological practices – suggests both that more variety must be included in our descriptions of Rome, and that more room must be made for low-level developments in the shaping of polities in our general observations of ancient patterns of life.

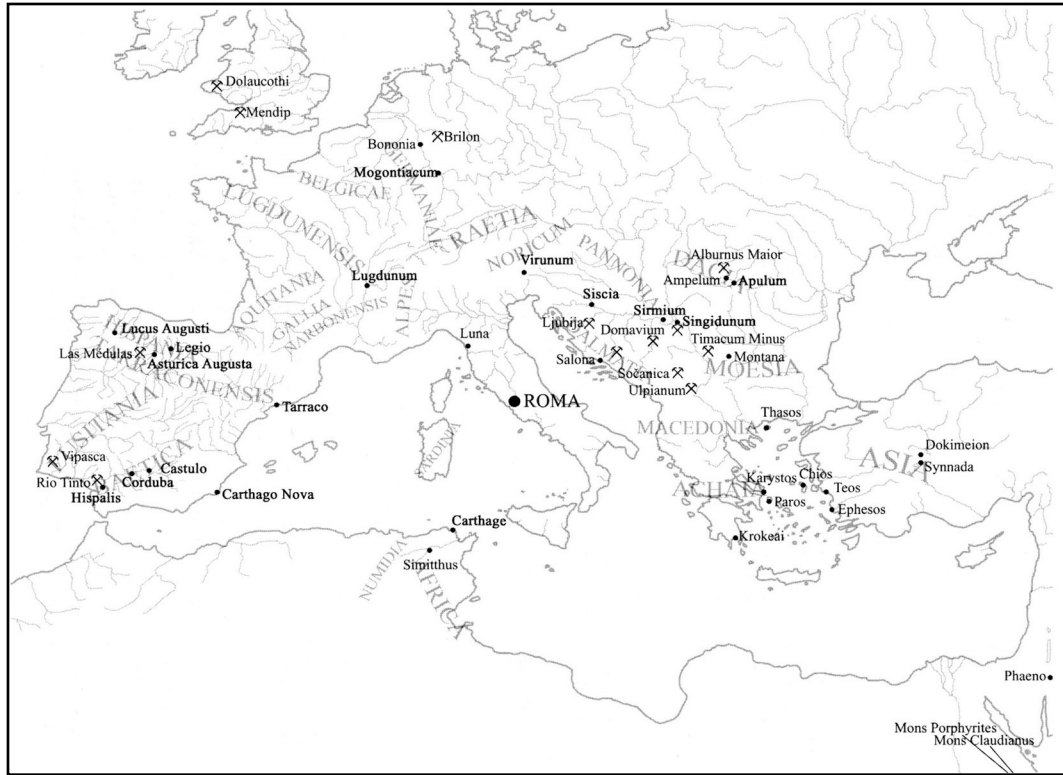


Figure 7.1: The Roman imperial quarries, with Karystos, Mons Claudianus and Mons Porphyrites indicated (from Hirt 2010: 11). Dots are quarries, while mines are labeled with crossed pick-axes.



Figure 7.2: Quarry along the Wadi es-Siyyah, Petra (photograph by author).

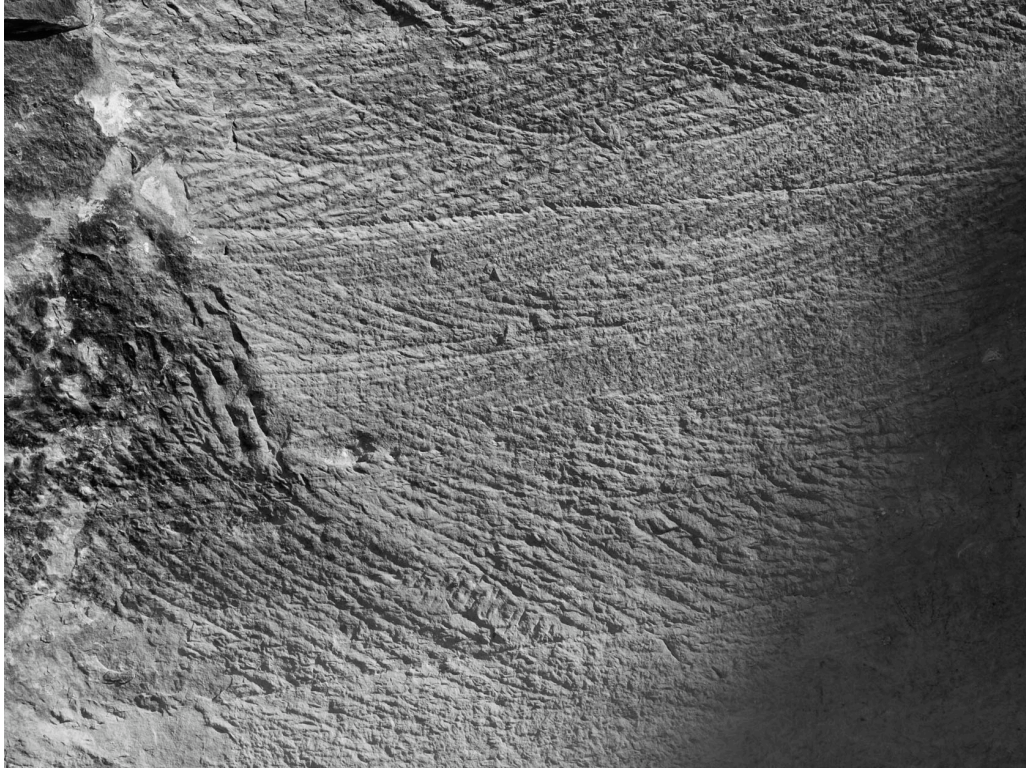


Figure 7.3: Close up of tool marks at Petra – Wadi es-Siyyah (photograph by author).



Figure 7.4: Close up of tool marks at Petra – Siq Alumpti (photograph by author).



Figure 7.5: Tool marks and quarry marks on rock-cut façade within urban center at Petra (photograph by author).



Figure 7.6: View of Petra city center with rock cut sandstone façades (photograph by author).

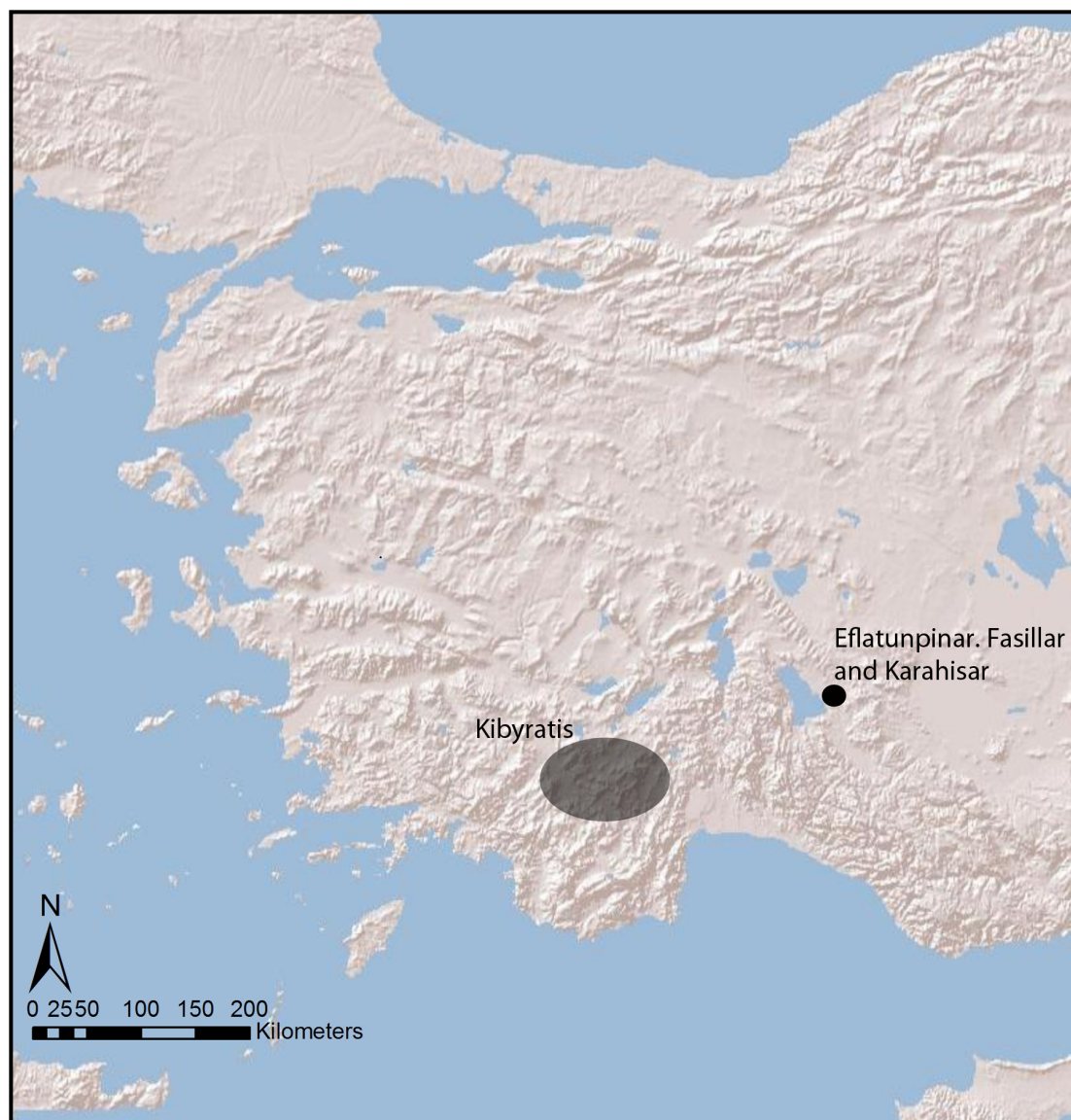


Figure 7.7: Map of western and central Turkey showing the location of Fasillar, Eflatunpınar, Karahisar, and Kibyra (ArcGIS basemap; created by author).

Chapter 8

Conclusions

The Positives of Negative Spaces

The Roman polity, as presented in this dissertation, is caught in many respects between the proverbial ‘rock and a hard place.’ The imperial administration, through deliberate attempts to control and structure industrial practices that occurred in material landscapes, asserted its position in the construction of authority within the spatial polity. Emperors had ideas about land use and resource management, many of which were enacted through massive attempts to control such practices through regulated labor systems and hierarchies. The result of such practices is the empire-wide economic trade and market system that scholars have emphasized and studied for generations. Blocks of marble, both pre-forms and finished objects, traveled great distances.

At the other end of the spectrum, however, is a range of practices related to stone acquisition that did not experience the same level of deliberate imperial planning and oversight. These quarries, though they tend to be small and though their products tend to circulate in considerably smaller regional networks, are numerous and testify to the politically varied nature of polity formation. Put simply, expressions of authority and manifestations of empire cannot be coherently propagated across something as vast as the Roman empire, which covered the entire Mediterranean basin, much of northern Europe,

the reaches of the Nile river and well into the Middle East and beyond. Instead of coherence, we are left with a picture of empire that fluctuated over time and in space in accordance with the landscapes and communities that participated in its formation and constitution. Rome's efforts were necessary to create the imperial notion that bound this gigantic space together through networks and connections, but by no means was the enterprise entirely successful.

This dissertation began with tension, and it ends with tension. Imperial monuments within the city of Rome and throughout the empire spoke to an imperial vision of what 'empire' meant – the power, authority, relationships, and stature that such a polity facilitated and controlled. But even these messages, conveyed propagandistically through various rhetorical methods, found themselves indelibly rooted in places and dependent on the proximal relationships that exist between built structures and landscape features, and *with* which a polity is formed. Because all polities, including empires, are spatial enterprises, they must, however, go beyond the ideal. And it is the ways in which quarries situated in rural landscapes, and in particular those in which the empire has not created scars to facilitate imperial expression both in that landscape, along the stone's route of travel, and in its final place of construction, that have been brought to light in this dissertation. Regional, small-scale industries and networks feed into the production of polities that are, as Adam T. Smith (2011) notes, "always in the state of creation".

Summaries and Conclusions

After establishing the basis for understanding the role of landscapes in the Roman polity, the dissertation moved to the case study of eleven marble quarries in the Marmara Lake Basin. As part of the hinterland of Sardis, the capital of the Lydian kingdom, an Achaemenid satrapy, and a seat of Roman beneficence in the second century CE, the lake basin offered an opportunity to explore the manifestation of multiple polities in a regional context. Although emphasizing Rome, this study speaks broadly to research in other time periods as well, since the quarries were utilized in multiple time periods and reflect different acquisition strategies. The marble quarries in central Lydia therefore framed an exploration of how landscapes and places fit within a discourse on polity formation.

To begin with, the finding that the small-scale marble quarries reflect different organizational practices when compared to other Roman evidence confirms that imperial prerogatives were manifested and experienced differently, and that not all quarries were treated the same. These conclusions were supported by the marble-quarry survey and sampling program implemented during the 2011 field season under the auspices of the Central Lydia Archaeological Survey (CLAS). Observations made in the field about the tool marks that appear in these quarries reflect general similarities in imperial quarries, though the application of these tools differed and the nature of extraction was rooted in individual projects rather than mass production for export. These data can also be contrasted with the Lydian-period evidence, which indicates a more coordinated effort to extract blocks in the Sardian countryside. In addition to the general observation that practices differed between periods, these data suggest that the relationship between polity

and countryside had dramatically changed by the Roman period as well. The region that Lydians associated with ancestral heritage was more tangentially related to the urban center by the time of the Roman empire, full of curiosities yet participating in newly formed local networks of production and trade.

The results from materials science analysis have been, perhaps, even more profound in constructing a narrative about the Marmara Lake Basin. The marble quarries near Yeniköy have yielded oxygen and carbon isotope values that are consistent with results published for two blocks of marble from Sardis that were reused during the Roman period, as well as several samples taken from the marble chamber in the tumulus of Alyattes (Kocamutaf Tepe). These results are significant because they complement existing data from the region that did not identify a suitable local source. These new data therefore add to chemical characterization of the region's marble sources, while indicating that Lydian extraction of marble related to the monumentalization of Bin Tepe was probably linked to the lake basin. Rather than augmenting kingly prestige through construction with external building material, monumental construction in a meaning-laden landscape pulled from that same landscape, reinforcing its role in Lydian society. The Roman-period data suggest a shift in production practices to the Tmolus mountains south of Sardis. In effect, the Roman urban construction program in the city, using standardized labor practices, served to reduce the role of the craftsman as an identity of skill and prestige in the region, something with which Lydian masons were routinely associated earlier in time (Nylander 1970; Ratté 2011).

The application of XRF to marble, a practice that is not normally conducted due to the great interest in sourcing artifacts, proved of great utility when applied to questions

about the region rather than specific finds. Marble of different colors were clearly differentiated by this technique, as were the distinct regions of whitish-gray marble. The potential contributions that pXRF can have on marble study are still unclear, since its application is limited to this study. The emphasis on understanding the role of quarries in a regional context, however, and the inclusion of small-scale quarries that are routinely overlooked in marble studies, might provide the framework for incorporating XRF as a cheaper, non-destructive method for examining quarries.

Placing these data into the context of targeted field survey conducted during the 2011 season and intensive field survey conducted between 2005 and 2010 helped develop a picture of the Marmara Lake Basin during the Roman period. In particular, Chapter 6 developed a clear sense of how this region fit within the broader pattern of Roman governmentality, being affected by some aspects of it while retaining a character that is particular to this specific landscape. Rather than viewing social change in the Roman period of central Lydia, as indicated by the results from regional survey, as dependent on economics or elite prerogatives, the social changes seen in marble extraction and the density and organization of settlements reflect the Marmara Lake Basin's intersections with the Roman polity as a spatial, flexible, project. While projects of public benefaction were going on in the city of Sardis during the imperial period, with concerted efforts to extract marble from the quarries at Mağara Deresi south of the city, the social networks that developed in the Marmara Lake Basin became routinized around a more localized interaction sphere. Production strategies for ceramics and marble became centralized, the movement of material in this area seems to be focused on small, rural networks of markets and pathways. Interactions with Sardis and other places with greater access to

imported goods remained in place, of course, and the region participated in imperial legal structures; but the location of settlements during this time period favored access to natural resources, such as the lake itself, marble, springs, and cultivable land. The region's participation in trade networks in local towns, rather than large markets at Sardis itself, is supported by inscriptional evidence. In this sense, the social fabric running through the Marmara Lake Basin fostered ties to the landscape, such that intersection with Roman governmentality worked in conjunction with it, rather than imposing new practices on it. The ultimate conclusion that this means that Rome, the polity, was diversely comprised, speaks not to the success of its governmental policies in specific places, but to the role that local landscapes play in promoting regional, provincial, and imperial society.

Such claims are supported in the examples that draw from different types of quarries and the communities that form around them in disparate parts of the eastern Mediterranean. In these examples – drawn from Greece, Egypt, Turkey, and Jordan – the forms of Roman governmental techniques run clearly up against landscapes in which similar structures and interventions in the physical topography of a place produce sometimes drastically different social networks and communities. Euboea and the Eastern Desert present two examples of imperial quarry-landscapes around which entirely different communities developed. While this has traditionally been argued as support for Rome asserting its authority over a range of environmental contexts for trade and demand at great distances and with great difficulty, the social implications of such practices enhance our understanding of how this polity was constituted through place-based interactions. The rhetoric of imperial stone acquisition emphasizes that very act:

acquisition. Yet the communities involved in acquisition to support such imperial rhetoric in the constitution of its authority are uniquely formed. In many ways, such rhetoric of imperial authority depends on the very diversity that Rome sought to overcome.

The social significance of quarrying is further made clear through the study of urban and rural quarries, whose operation scholars largely consider similar to those owned by the empire. When focus is placed on the landscapes and the resulting social contexts that arise surrounding urban quarries, they, too, emerge as players in the formation of a total, inchoate, polity. The stark differences between the social context of quarries in Petra and in Aphrodisias, attest to this. The landscape at Petra, and the place-based practices that arose within this context, resulted in quarrying that had major implications for the city, not just in terms of economics or labor practices, but in terms of its visual presentation and the experience of it as a place by others. This context simultaneously served to incorporate the city into the Hellenistic and then Roman worlds, but it did so in a way that made Petra uniquely crafted.

Such dramatic displays of the social aspects of quarries can inform a reconsideration of quarries at cities such as Aphrodisias, where the motivations of patrons have largely guided the quantity and type of marble extracted from a 30km radius of the urban core. Although these motivations are integral to how marble extraction is understood, the same principles regarding the experience of quarries, through both extraction itself and the movement of material to the city, as well as a general portrayal of how the hinterland related to the town, should inform the social matrix of Aphrodisias. While the obviousness of this at sites such as Petra is telling, the less obvious examples can be rethought to incorporate memory, experience, and place as well.

Contributions to a broader audience

These issues, presented here in the context of a specific empire, have ramifications for more general discussions about, as Smith (2003) has called it, “the political landscape”. This particular study, however, shifted the emphasis away from more tried and true questions in the study of complex societies. Woolf’s (1998) study of the ‘Romanization’ of Gaul, for instance, raises a frequent question in Roman studies: How do cultures spread and change over time? Subsequent work on discrepant experience, following the work of Said (1993), approaches empires from the perspective of success, with different viewpoints differentiating how some populations become part of imperial polities. While these perspectives are invaluable in understanding the relationships between people and politics, the approach outlined here complements this through a close examination of how those viewpoints and perspectives are grounded in attachments to real places. The juxtaposition of politics and populations occurs, as Smith (2003; 2011) argues, in space, and the composition of the resulting polity, though always fluid, depends on how those associations play out in landscapes and places. These issues have a broad, multi-disciplinary appeal, treating as they do basic relationships between structures, practices, and populations. While the specific contribution is in the application of social theory, theories of technology and society, and landscape archaeology to the a discussion of the Roman polity, the conclusions drawn from this study can inform studies in other geographical and temporal settings.

Yet the specifics of the project hold significance as well, and in this way the dissertation is able to reach specialist audiences, as well as general audiences. The Roman period of the Marmara Lake Basin has been explored through the application of survey methodology and, now, marble studies, providing critical information on a period previously understudied in the region's history. Issues such as the relationship of settlements to the region's monumental landscape, and the relationships between town and country have been explored for the Roman period in a specifically western Anatolian context. Moreover, the natural resources available in this landscape, and a diachronic study of how communities interacted with them, has been highlighted as critical to the lake-basin's historical trends.

The materials science component of this study, and in particular the merging of materials science with regional survey archaeology, has also contributed to new and different forms of interrogating marble and marble quarries dating to the Roman period. A myopic emphasis on sourcing objects to specific quarries is replaced here with an emphasis on understanding and characterizing the region in which those quarries are located, and how those quarries participated in the formation of social practices within a given region, however it is defined. Although no single methodology employed in this dissertation is entirely new to the study of ancient stones, the application of such methods as XRF to marble quarries reveals some possible future benefits, such as the aforementioned possibility of studying marble in completely non-destructive ways.

In general, it is hoped that this dissertation is accessible to numerous audiences. Through careful study of basic issues such as resource acquisition and social networks under empire targeted the Roman period, the Mediterranean region more generally, and

even archaeological studies globally, have been thematically treated. Methodologically, this study brings together disparate forms of archaeological interrogation into a single study. Previous scholarship on marble has emphasized either the political and economic connotations of control over resources or the highly specific application of materials science to source objects to quarries. Rarely have social issues and scientific contributions been merged successfully in Classical Archaeology, and I hope to have accomplished this here.

Final Thoughts

By examining how the actions of people in Roman Asia Minor and beyond contributed to the production of small-scale social networks that served to link daily practices with large governmental structures, this dissertation has outlined one way forward in linking rural inhabitants advantageously using the resources at hand and the emperor attempting to define an imperial polity across great expanses of land. The method employed here has been to demonstrate how states and communities alike must work with and through landscapes and places in order to create social networks. States apply techniques of governmentality through periodic interventions in the landscape, yet those landscapes push back through the existing social networks and through the material attributes of place. Efforts to define imperial landscapes work in conjunction with varied topography and varied geology. Similarly, imperial governance, though structured to be relevant throughout the entirety of a polity's boundaries, are unevenly applied. In the case of quarrying, imperial marble quarries and small-scale, rural, marble quarries do not

operate in the same fashion, as this dissertation has shown. Rather than perpetuating the notion of formal and informal participation in the empire, however, this dissertation has argued that the formal and informal are both derived from grounded practices in real places. Since the polity is continuously constructed by such spatial practices, then the polity must account equally for those portions that reveal strong state intervention as those portions that do not. The task is not only to discover what structures govern social behavior, but also what practices produce the spaces in which polities arise. Otherwise, the importance of place can all too easily be lost.

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