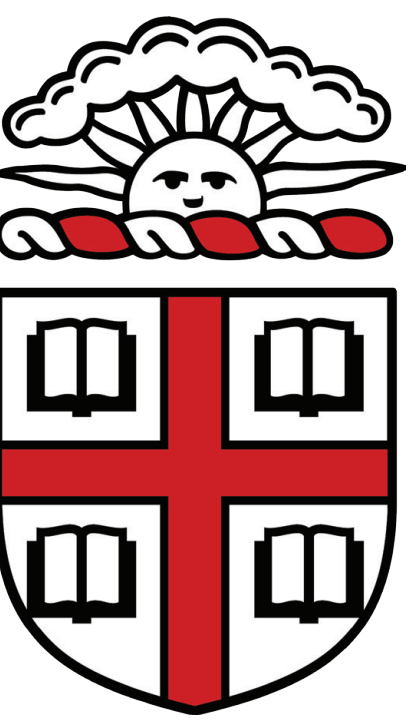


# An ancient lake system on Mars: Implications for past habitability and future exploration

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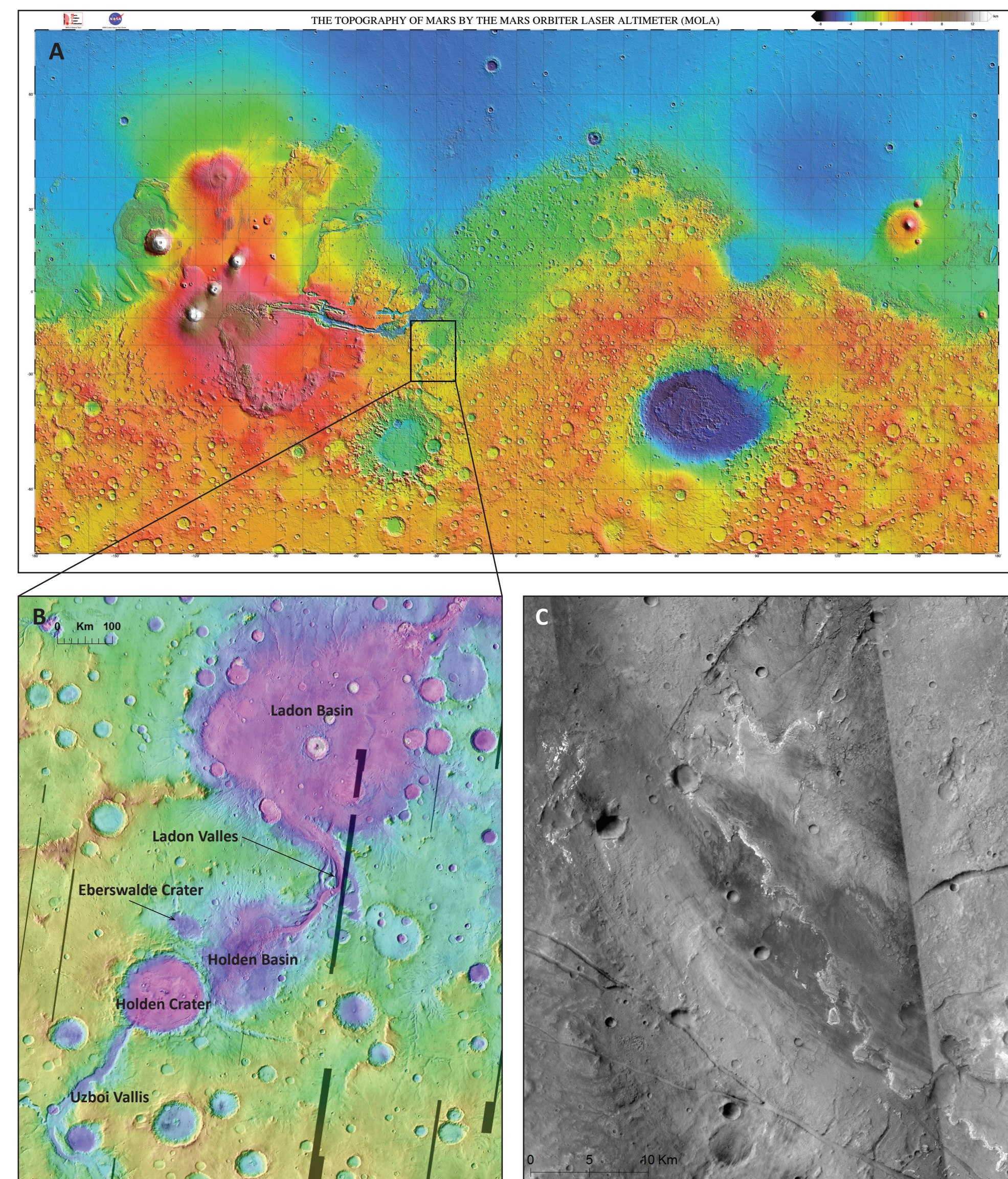


## Background: The Uzboi-Ladon-Morava (ULM) system

The ULM system on Mars was an ancient, integrated network of rivers and lakes. Clays, which are known to preserve organic materials on Earth, have been detected across the region. If microbial life ever existed on Mars, organic markers could be preserved in such clays. This makes the ULM region a potential target for future missions to Mars.

## Purpose: Mapping of clay deposits

While the ULM region is a strong contender for future exploration, the distribution of clay deposits in the region is not well constrained. I provide detailed morphological and mineralogical mapping of possible clay deposits in Ladon Valles, an ancient river within the ULM region, to precisely identify the locations of clay units.



**Figure 1.** In all figures, North is up. (A) Global topographic map of Mars, with boxed area defining the ULM region. (B) The ULM system as indicated in (A). Labeled valleys and craters represent ancient rivers and lakebeds. (C) Portion of Ladon Valles as imaged by the MRO Context Camera. Bright white regions thought to be clay deposits.

## Methods

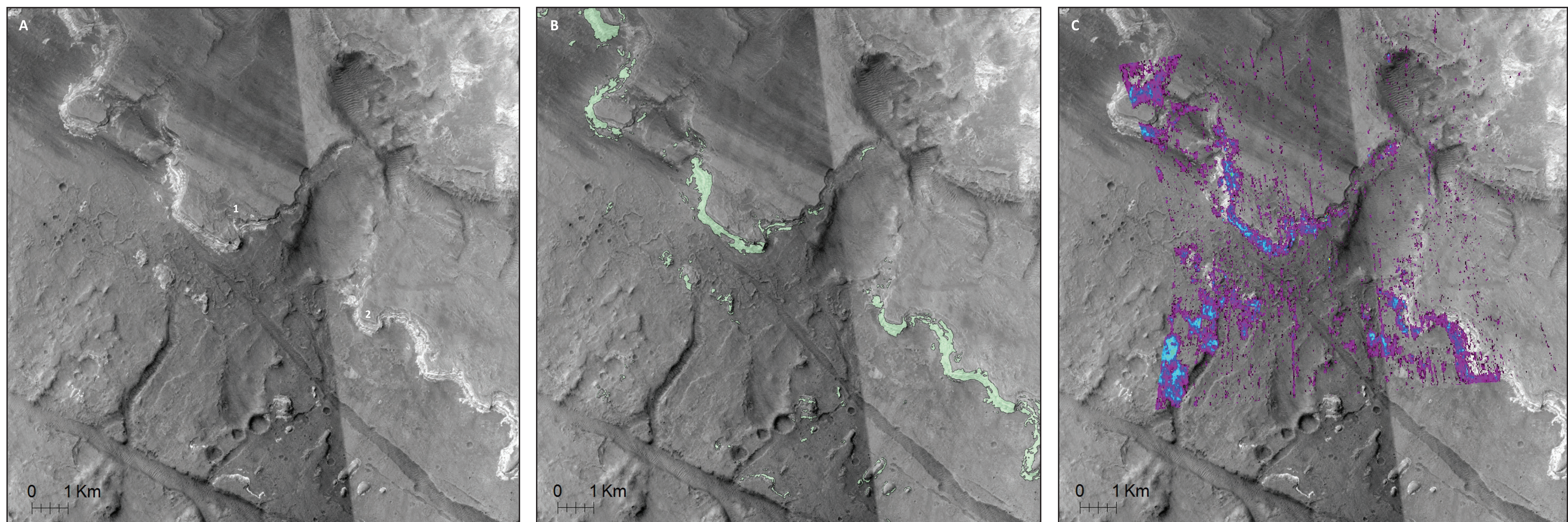
Mapping out the distribution of clays involves constructing two independent maps:

- 1) Morphological map: outlines light-toned deposits (thought to represent clays) using images taken by the Context Camera (CTX) on the Mars Reconnaissance Orbiter (MRO)
- 2) Mineralogical map: identifies possible locations of water-bearing minerals using spectroscopic data from the Compact Reconnaissance Imaging Spectrometer for Mars (CRISM) device on the MRO.

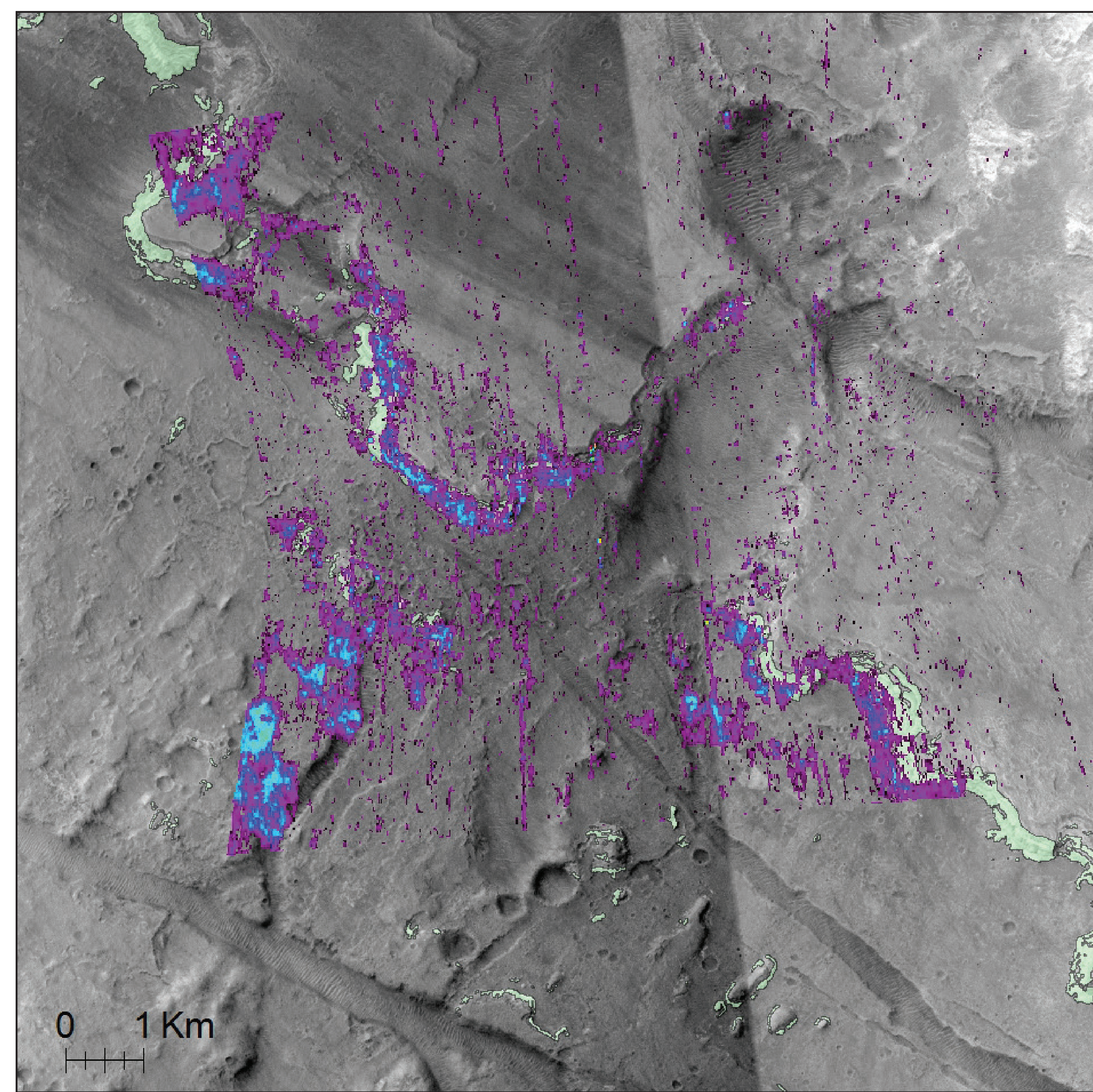
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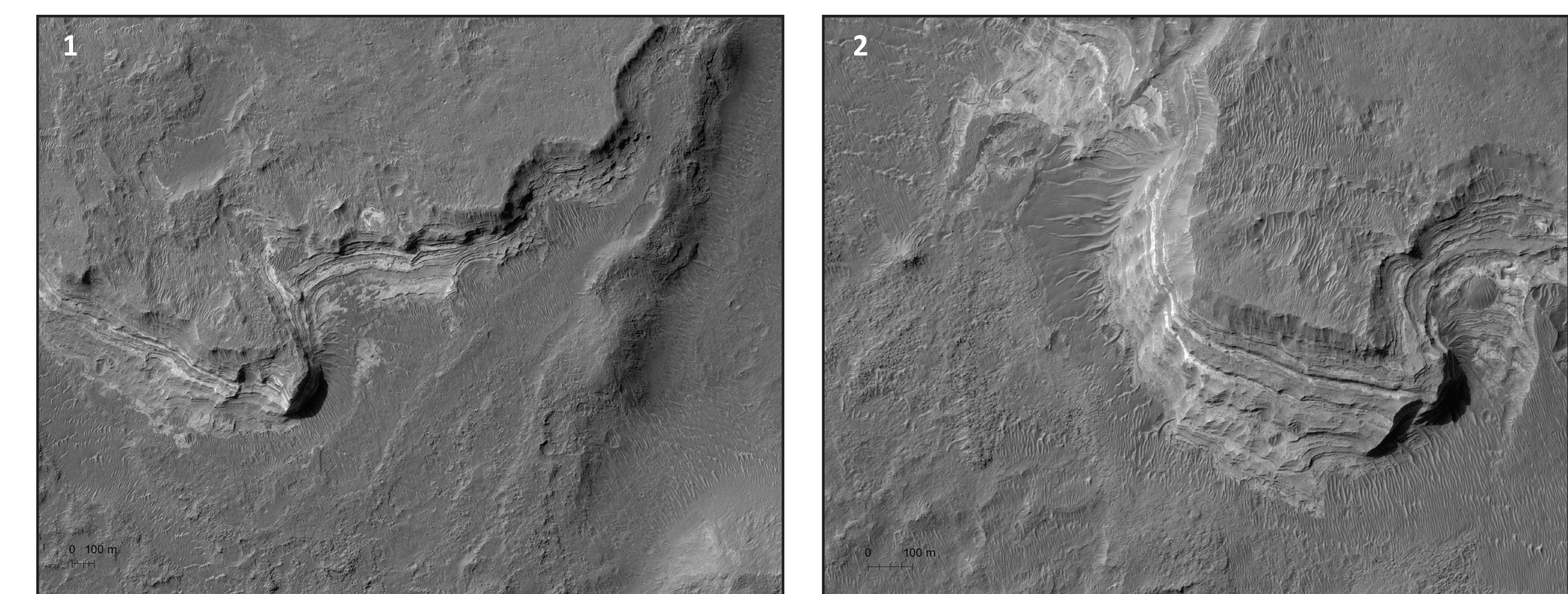
## Morphological and Mineralogical Maps



**Figure 2.** (A) CTX imagery of a sample area of Northern Ladon Valles. Light-toned deposits, moving diagonally from the upper left to the bottom right are believed to contain clays. (B) Green units defining the light-toned deposits from (A), mapped manually in ArcGIS. (C) Same region shown in (A) and (B) overlain with CRISM data. Purple and blue regions correspond to locations of minerals with strong absorption features at 1.9 $\mu$ m and 2.3 $\mu$ m; indicative of water-bearing minerals.



**Figure 3.** Combined morphological and mineralogical maps from 2B and 2C. Though maps don't align perfectly, a significant amount of overlap occurs. This example suggests that there is some agreement between the clay distribution maps of the two separate data sources. Corroborating evidence for clays from both methods produces detailed, precise maps of clay locations.



**Figure 4.** HiRISE details of light-toned deposits in 2A, corresponding to labels 1 and 2. Note layered terrace-like forms which may represent changes in water level through time.

## Preliminary results and implications for future exploration

- Sometimes (as in the above example), morphological and mineralogical maps of clays match. Correlation between these independently-constructed maps provides strong evidence for the presence of clays in areas of overlap. However, morphological and mineralogical maps do not always agree.
- CRISM coverage of the ULM region is far from complete; as more CRISM data becomes available, we will develop a better understanding of the correlation (or lack thereof) between morphological and mineralogical maps on a larger scale.
- Detailed mapping of the clay deposits in the ULM region provides a framework for understanding the geological context in which they formed. Since the clays formed in a liquid water environment, this research is of high relevance to the ongoing search for past habitable environments on Mars.
- Sending a rover to one of the clay-bearing locations indicated by the maps would provide key insights into the nature of past aqueous activity in the ULM region. Furthermore, if ancient microbial life ever existed on Mars, organic markers could be preserved in clays and sampled for analysis by a rover.



Artist's depiction of a Martian rover.

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