GLACIAL MORPHOLOGIES IN THE WESTERN CHARITUM MONTES, ARGYRE BASIN RIM.

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Introduction: Strong evidence of glacial flow and erosion has been identified in the Argyre Basin, east of Hellas Basin, the northern fretted terrain and amongst the Tharsis volcanoes [e.g. 1-7]. Understanding more about the history of ice on Mars could reveal important information about Martian geologic and climatic history including variations in insolation, orbital parameters, volatile mass balance, large impacts, volcanic eruptions, catastrophic floods, and solar luminosity.

The Southern Argyre Planitia and adjoining Charitum Montes have been heavily modified by uncertain processes. Using lower resolution Viking Orbiter and MOC images, chief landforms in the Charitum Montes have previously been interpreted as a glacial suite of cirques, horns, moraines, drumlins, eskers, kettles, and outwash plains [e.g. 5-8] and a link has been proposed between Argyre's glacial or melt water inflows and the South Polar cap and Dorsa Argentea region [e.g. 9-11]. The High Resolution Imaging Science Experiment (HiRISE) camera aboard the Mars Reconnaissance Orbiter (MRO) is revealing previously indiscernible details of the Martian surface. In this abstract we provide preliminary interpretations of morphologies and their implications for glaciation on Mars from the HiRISE image AEB_1_150.

Image Details: HiRISE image AEB_1_150 (Fig. 1) is centered at 52.2º S, 300º E and shows part of the Argyre Basin rim in the Western Charitum Montes. The image is 29.5 km wide and 76.4 km long with a resolution of 2.94 m/pixel. It is illuminated from the upper right and has a relief of ~5 km.

Image Observations and preliminary interpretations: Highlands occur in the lower portion of the image bordered by semi-circular cirque-like features with a ~5 km drop in elevation. Many of the cirques have gullies and streamlined hills (Fig. 2). Gullies may be coeval with the eroded surfaces, but in most cases they are superimposed over older eroded terrain with a few exhibiting depositional aprons on top of the valley-floor surface. The streamlined hills extend from the cirques onto the valley floor. They are slightly irregular in shape but are generally streamlined in the downhill direction with a blunter upstream nose and more gradual downstream tail (Fig. 4). The orientation and morphology of these features is consistent with that of glacially sculpted bedrock or subglacial till deposits. Drumlins form similar landform shapes and occur in similar swarms, but they ordinarily occur in low-gradient valley floors and plains and apparently are produced by ice streaming activity or subglacial floods related to ice streams. The cirque associations in Argyre indicate that a bedrock or till sculpture process different than the highly dynamic origins of drumlins is involved. Alternatively, the streamlined hills could be remnants of debris-covered glaciers.

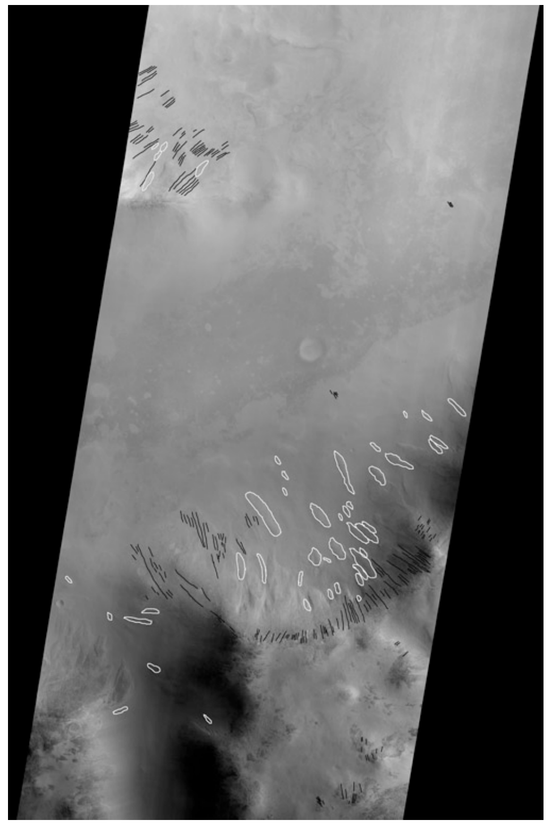

Figure 1: HiRISE image AEB_1_150 of the Western Charitum Montes, Argyre Basin rim. The image is illuminated from the upper right revealing topographic highs in the upper left and lower portions of the image. The valley floor is in the center of the image. Grooves are highlighted with black lines and streamlined hills have been outlined in white.

Long grooves or striations (Fig. 3) consistently run downhill regardless of relation to the existing bedrock stratigraphy and unlike a regional wind direction thus indicating downhill flow (Fig. 4). The lineations also cross cut 100 m scale features that may perhaps be 10s of meters in relief, thus making ice-rich flows a more likely cause than fluvial flows.

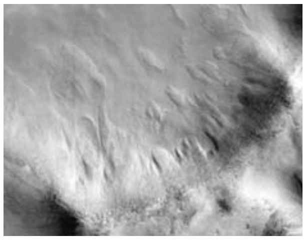

Figure 2: A close-up of a potential cirque (~5 km drop in elevation) with gullies and streamlined hills. Downhill is from the lower right corner to the upper left of the image.

Figure 3: Close-up of grooves. Arrow oriented downhill.

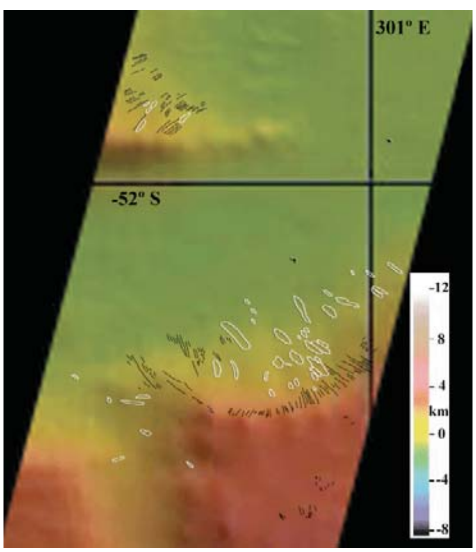

Figure 4: Grooves and streamlined hills from figure 1 overlaying a MOLA elevation map. Both grooves and hills trend down the local topographic slope rather than following a larger-scale regional pattern as would be the case if their formation were due to strong regional winds.

Discussion: Features observed in this image indicate a predominant down-slope erosional process. The erosional agency could be gravity-driven katabatic slope winds, but the collective observations buttress prior evidence for glacial flow and erosion. Craters observed on the glaciated surfaces indicate that the resurfacing most likely occurred in the last ~300 My. The significant bedrock erosion, streamlined hills, and potentially coeval gullies could also indicate wet-based glaciation as previously proposed for the Charitum Montes [6-7]. Esker-like features occur in southern Argyre Planitia [6-7], as expected for subglacial runoff associated with warm-based glacial flow, but similar features have not been identified in western Argyre Planitia near the ones described here. Neither are there any visible terminal and/or lateral moraines in this scene. Erosion of the downhill striations should have formed sufficient amounts of till to result in moraine deposits. The streamlined hills may account for some till, and other features on the main valley floor could be small lateral moraines. Alternatively, moraines could be present outside the field of view or could have been eroded. A widespread ablation zone may have scattered till over a large area thus creating deposits such as those observed in the middle of the valley downstream from the streamlined hills consisting of large boulders (10 m).

Potentially, the valley floor may currently be covered by a deposit of dirty ice with a protective soil lag. Darker material on the valley floor may represent the exposed subglacial floor and the streamlined hills may be the peaks of subglacial deposits exposed by sublimation. This hypothesis is supported by the appearance of ridges, furrows, and steep-fronted lobes similar to those of terrestrial rock glaciers [7, 12].

Future work and imaging by HiRISE will hopefully reveal further details, enable continued analysis and development of these interpretations, and allow landscape-level analysis and testing of plausible glacial and nonglacial mechanisms for landscape development.

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References: [1] Head, J. W. and Marchant D. R. (2003), *Geology*, *31*, 641-644. [2] Head, J. W. et al. (2005) *Nature*, *434*, 346-351. [3] Head, J. W. et al. (2006) *Earth Planet. Sci. Lett.*, *241*, 663-671. [4] Moore, H. J. and Davis P. A. (1987) *LPI*, 78-80. [5] Kargel, J. S. and Strom R. G. (1990) *LPS XXI*, 597-598. [6] Kargel, J. S. and Strom R. G. (1992) *Geology*, *20*, 3-7. [7] Kargel, J. S. (2004) *Mars: A Warmer Wetter Planet* (Praxis-Springer). [8] Baker, V. R. (2000) *LPS XXXI*, Abstract #1863. [9] Head, J. W. III (2000) *LPS XXXI*, Abstract #1119. [10] Parker, T. J. et al. (2000) *LPS XXXI*, Abstract #2033. [11] Kargel, J. S. (1993) *LPS XXIV*, 753-754. [12] Whalley, W. B. and Azizi, F. (2003) *JGR, 108*, 8032.