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Morphologic Map of Glacial and Periglacial Features in the Northwestern Argyre Basin, Mars

Jan Raack, Harald Hiesinger, and Dennis Reiss

Institut für Planetologie, Westfälische Wilhelms-Universität, Wilhelm-Klemm-Str. 10, 48149 Münster, Germany (jan.raack@uni-muenster.de)

Previous studies of morphologic features in the Argyre Basin suggested that they could have been formed by glacial processes [1,2,3]. Possible evidence for a past glaciation of the Argyre basin include landforms interpreted as e.g., eskers, drumlins, moraines and kettles [1]. Glacial features like lineated grooves, streamlined hills, U-shaped valleys and semicircular embayments (possible cirques) are consistent with extensive glacial modifications in the Argyre Basin [3]. For our study we chose a mountainous terrain in the northwestern part of Argyre basin (44°S – 48.5°S and 323.5°E – 329°E) to reinvestigate the glacial inventory and the history and evolution of glacial landforms and processes in this region with new, higher resolution image data. We produced a detailed morphologic map with 13 morphologic units based on High Resolution Stereo Camera (HRSC), Context Camera (CTX) and High Resolution Imaging Science Experiment (HiRISE) imagery.

Large areas of the study region are covered with dissected and intact mantle material units. The smooth and flat mantle interpreted to be a dust/ice mantle [4] occurs in protected depressions or on southern, pole-facing slopes, which receive less insolation.

Glacial/periglacial features (glaciers and viscous flow features) and fluvial features (gullies) are directly related to the dust/ice layer. Gullies are the most common fluvial features in the mapped area. They occur in areas where the mantle appears to be thick. The most obvious characteristics of the gullies are that they only erode into the dust/ice mantle and not the underlying bedrock, indicating a formation by melting of the water-ice-rich mantle [5]. The preferred orientation of the gullies is on poleward-facing slopes, where the dust/ice mantle is thickest. Often the gullies occur in conjunction with viscous flow features. Stratigraphically the gullies are one of the youngest landforms in the study region. Viscous flow features mostly occur between gullies and on dissected mantle material [6]. Often gully debris fans are superposed on this material. Other locations covered with viscous flow features include dust/ice mantle filled craters, where sediments in inclined craters have been deformed. A well-preserved glacier-like flow feature is located in the northernmost part of the mapping region. It shows well developed flow features (striae), which indicate an east to west flow direction with an average gradient of $\sim$1,9°. The glacier is located in a protected area, almost completely surrounded by high mountains. Other possible glacial landforms such as pingo-like forms and polygonal terrains also occur on the dissected mantle material. Recent studies with HiRISE-data indicate a sequence from glaciation to ablation and perhaps subsequent periglacial processes [3].

We have investigated the relative stratigraphy of the morphologic units in our study region: (1) Glacial morphologies (viscous and glacier-like flow features) are superposed on mantle materials; (2) Morphologies formed by fluvial and periglacial processes (gullies, polygonal terrains, pingo-like forms), superpose or originate from glacial morphologies or mantle materials (dust/ice mantle); (3) Aeolian morphologies (various kinds of dunes, ripples) have a wide range of ages and overlie or were superposed by some periglacial morphologies.

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