

Ice-related features within Danielson crater, Mars?

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Abstract

Various ice-related features recognize on the floor of Danielson crater suggest that this area located in the southeastern region of Arabia Terra experienced in the recent past one or more periods of glacial activity. Geomorphological observation highlight some landforms that on the Earth are associated with fluvio-glacial and periglacial environment.

1. Introduction

Arabia Terra is a relatively low elevation, high albedo, densely cratered province within the Martian southern highlands that lies close to the crustal dichotomy. Arabia Terra represents the largest portion of ancient cratered crust in the Martian northern hemisphere, displaying a crater densities indicating a dominantly Noachian age [1]. In the southwestern region of Arabia Terra, the Danielson Crater (7°W , 8°N) is located about 775 km south of Becquerel Crater.

The Danielson Crater has a diameter of 67 km, an intracrater plane elevation of about -1862 m, and displays steep symmetrical walls. From the crater floor to the walls of the crater hundreds of meters of exposed strata showing stacked couplets of strikingly uniform erosional expression can be observed. These layered beddings appear to display evidence of post-depositional erosion and removal of sedimentary material. The depositional origin of this material, however, is still poorly understood [2]. Dark-toned debris material forming dunes can be observed on the floor, representing relatively recent sediment deposition in the craters. In the northeastern part of the floor, next to the crater wall, an area showing different morphology from the surrounding can be seen. Here, the morphology seems to display characteristics typical of ice-related landscapes, with a series of periglacial or glacial-looking landforms that resemble those that can be found in the fluvio-glacial and periglacial environment on the Earth.

A detailed analysis of high-resolution images (CTX, HiRISE) was used to analyze these apparently

ice-related landforms within the Danielson crater. In addition, an HiRISE DTM of this portion of the Danielson crater was built and used to identify the possible processes involved in their formation and shaping.

2. Ice-related features

The study area is characterized by an irregular topography displaying several mainly flat topped hills, separated by U-shaped valleys (Fig.1). The main valleys trend according to the regional slope direction and in some cases show secondary smaller hanging valleys. In some cases the valley slopes show steps with smoothed nearly horizontal surfaces with rounded shaped depressions. Cirque-like landforms can be observed on the upper side of some of the biggest hills.

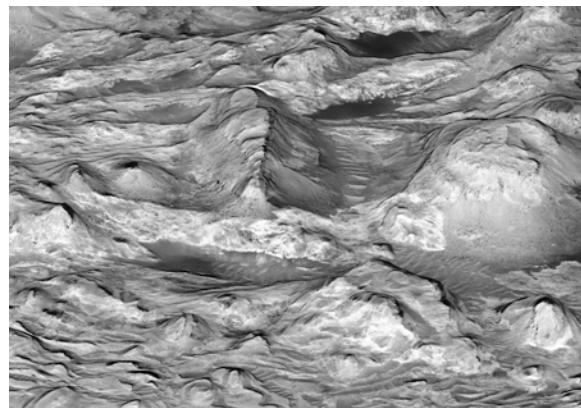


Figure 1: HiRISE DTM showing U-shaped valleys.

Many shallow closed depressions of various sizes, mainly rounded in plan view, can be observed both on the lower slope surface of the hills and in the region adjacent the study area, toward the center of the crater. These depressions, characterized by steep sides, flat floor geometry, and in some case by an outflow channel, resemble similar features found on the Earth. In particular they display morphological similarities with the karst doline formed as huge

solutions pans or bevels by sheet wash water flow during ice melt, in the evaporite terrain in the terrestrial cold region.

A fan shaped deposit, interpreted as an outwash fan, can be clearly observed at the end of the valleys system (Fig.2) toward the centre of the crater in the direction of the regional slope. The deposit appears as a multi-lobate fan, characterized by an arcuate front, vertical sides, sub-horizontal top surfaces and braided channels in part buried by dark sediments with dune morphology.



Figure 2: Outwash fan located at the end of the valleys system (image HiRISE PSP_002733_1880 north toward up).

3. Summary

The landforms observed in the area next the base of the inner northeastern wall of the crater suggest a geologically recent action of ice-related processes.

In particular, both the fan deposit and the karst landforms provide compelling evidences of the existence of liquid water.

In the whole study area no evidences of impact crater of any size can be found.

The presence of both glacial-looking and fluvio-glacial landforms might indicate that possible melting of ice or ground ice happened probably more than one time, highlighting possible climatic changes that occurred probably in the Amazonian age. The interpretation of morphological features to infer changes in climatic conditions has been made

observing the landscape in the geological context, trying in this way to avoid the problems due to the morphological convergence (or equifinality) reported in a previous study on periglacial landscapes on Mars [3].

References

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