LANDFORMS ANALYSIS OF A FLOOR FRACTURED CRATER IN TERRA SIRENUM, MARS.

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Introduction. Floor-Fractured Craters (FFCs) are characterized by their typical floors, which exhibit fractures, mesas and knobs and they are found on different planetary bodies. They were first observed in the early 1970s on the Moon and were later identified on Mars using Viking and MOLA (Mars Orbiter Laser Altimeter) data. The origin of fracturing is explained by many models that hypothesize different genesis. The periglacial one [1], considers the melting of subsurface ice reservoirs according to overburden material, resulting in increased temperature and pressure. In the model of groundwater migration [2], a confined aquifer and flowing water in the subsurface is needed. The water will lead to seepage and piping in the deposited crater filling. Craters that are located close to volcanic areas on Mars could have a volcanic origin. Impacts lead to a reduction of crustal thickness beneath the crater, and magma could arise though this zone of weakness [3]. In the case of ice-rich subsurface, outflow could form by tectonic pressurization. Fault movements put the subsurface drainage under pressure and lead to outflow events and fracturing within the crater [4].

It is indeed likely that diverse FFCs have different genetic origins. Hence, it is extremely important to discriminate the geological features within FFCs for understanding their diverse evolution, which might or might not imply a relevant role of water.

This work is focused on the analysis of the landforms of a crater located in the area of Terra Sirenum, which has a chaotic floor and periglacial morphologies.

Site Location and Setting. The area is located in the southern hemisphere of Mars (37 ° S, 190 ° E) in the Noachian terrain of Terra Sirenum. This region has large and isolated basins, a relatively young graben (Sirenum Fossae), and one of the largest runoff channels on Mars, Mad'anim Vallis. The crater, placed in the Gorgonium Chaos (a basin extended for about 240 km in diameter [5]) is about 18 km in diameter, has a smooth and degraded rim and a chaotic floor characterized by a polygonal fault network bounding large and irregular blocks (**Fig.1**).

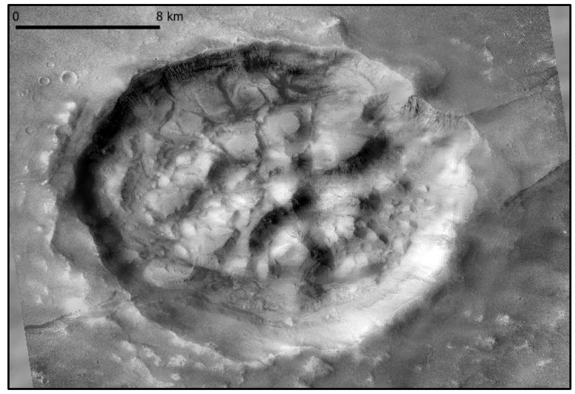

Fig.1: The floor fracturing crater. The block size tends to decrease southwards.

Methods. Through remote sensing we analysed different images at various spatial resolutions from the Mars Reconnaissance Orbiter and of MOLA altimetric data. The photointerpretation led to the identification of different Photogeological Units, i.e. areas that have the same characteristics of tone, texture, structure and response to erosion. They were divided into coverage units and bedrock units. The recognized landforms have been classified according to their presumed morphogenesis, through a comparison, where possible, with terrestrial analogues. Data were managed in GIS environment (QGis).

Results and discussion. The photointerpretative analysis led to compile a geomorphological map at the scale of 1:25,000 of the studied area. The large scale enables to study landforms assemblage with high details. The results highlighted that the crater was modeled and modified by the action of at least three main morphogenetic agents: subsurface ice, gravity and wind, plus the interaction with fractures and faults which played an important role in dissecting the crater floor into several blocks. Each block is characterized by a part of outcropping bedrock and slopes covered with debris and Latitude Dependent Mantle (LDM). This layer has an evident degradation state, demonstrated by the presence of pronival rampart-like forms (**Fig.2**) at the slope toe.

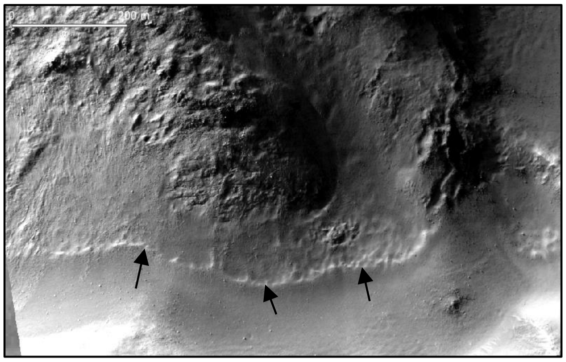

Fig.2 – The pronival rampart-like form outlines the LDM

In some cases, the blocks' slopes show evidence of wide gravitational collapses recalling DSSGDs. The fine material in organized into TARs (Transversal Aeolian Ridge) and ripple, some of which show small polygon structure on the windward side.

Weathered bedrock is associated, along the slope, with deep and sharp incision defined as Gullies. (**Fig.3**)

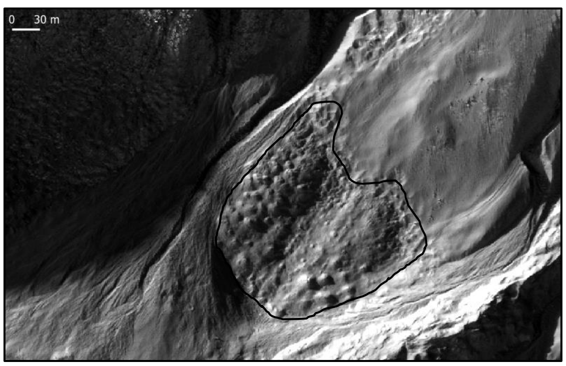

Fig.3 – The circular structures of the weathered bedrock

There are some complex landforms, like the Longitudinal Incision (**Fig.4**) along the slope and a kind of small sink hole in the bottom of gully' channel.

Fig.4 – The longitudinal structures are located on the southpole facing wall of the crater.

Frequent periglacial forms, such as block fields (**Fig.5**), Pingo fields and polygonal terrain points towards a relevant presence of ice in the subsoil.

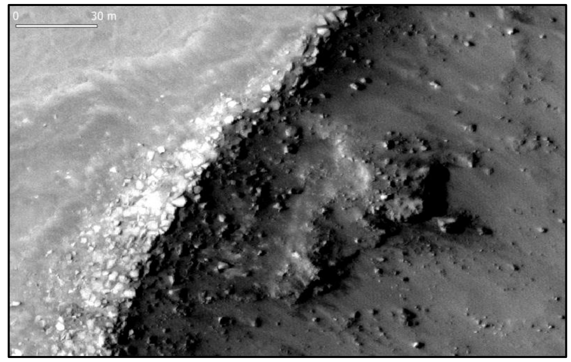

Fig.5 – Block fields are located mainly on the crater rim and the blocks change from metric to plurimetric size.

This ice could indeed explain the formation of the chaotic floor of the area. In fact, referring to the model [1], the fracturing of the crater floor could be linked to the melting of a subsurface layer of ice, potentially due to the pressure of the overlying material. Usually, this model explains the very large chaotic terrains and a critical mass is needed to bring total melting of the underground ice. In our case (a crater of about 18 km in diameter), the filling material could have led only a partial melting of the ice layer. Then the melting of ice stored in the pre-existing fractures, would have caused an underground runoff and the erosion of the fine materials within the fractured floor.

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