NEW OBSERVATIONS OF GLACIAL FEATURES ON THE LOWER NW FLANK OF HECATES THOLUS VOLCANO (MARS) BASED ON CTX AND HiRISE IMAGES. M.A. de Pablo[1,2] and J.D. Centeno[3], [1]Departamento de Geología. Universidad de Alcalá. 28871 Madrid, Spain. (miguelangel.depablo@uah.es). [2]International Research School of Planetary Sciences. Università d'Annunzio. 65124 Pescara, Italy. [3]Departamento de Geodinámica. Universidad Complutense de Madrid. 28040 Madrid. Spain.

Introduction: The most important volcanoes of Mars shows possible glacial features on their NW flanks [1][2][3][4]. Hecates Tholus, 31.6ºN, 150ºE (Fig. 1), at the Elysium volcanic rise, shows glacial features that have been recently mapped [5][6][7]. The age of this volcano ranges between 3,800 and 100.000 yr [5][8][9]. The glacial activity in its NW flank in mainly related to a double elliptical depression with an origin not yet clarified [5][9][10].

The recently available CTX and HiRISE images of this volcano made possible to afford detailed studies of the local geomorphology on the NW flank of this volcano, targeted to confirm the glacial origin of different materials and features and the glacial processes involved. We show here a preliminary analysis of the only available HiRISE image at present day of this site (PSP_001527_2125), and two CTX images (B04_011324_2128; B06_011957_2127).

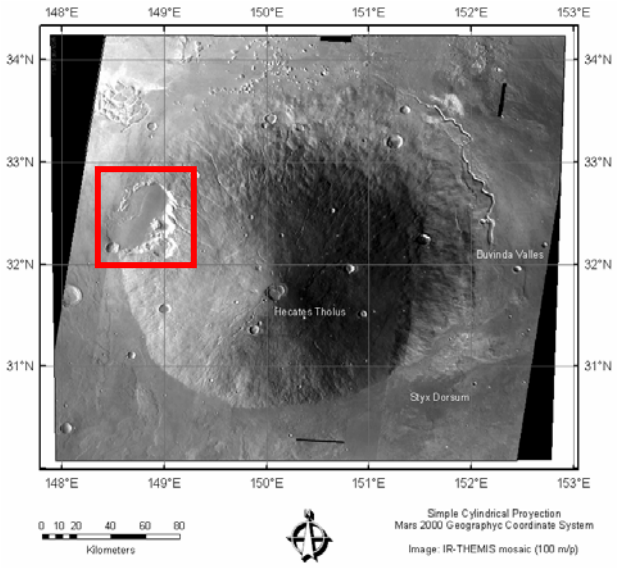

Fig. 1: Location map of the study area (red box) in the NW flank of Hecates Tholus volcano

Glacial features: The available HiRISE and CTX images reveals the existence of different glacial features (Fig. 2), some of them previously described [5][7][9][10], but never under this detail, and other neves described. We interpreted the existence of:

Cirques: Although the putative glaciers existing in this area (most of them) seems to start in the flank of the volcano, at higher altitude outside the depression, and filling different valleys, inside the depression there are recognizable spoon-shaped depression on the feeding area of the possible glaciers.

Glacial valleys: the edge of the depression is characterized by narrow and deep valleys, with smooth materials filling them. Possible moraine deposits and crevasses are recognizable on the floor.

Crevasses: they are recognizable in the botton of the depression and valleys. There are transversal-extensional crevasses (related to a change in flow speed along the valley) and chevron-crevasses (related to speed transversal diferences. They are more frequent in the SW sector of the depression. The conservation of crevasses rises the question of present ice preservation bellow surficial dust and sediments.

Bergschrunds: most of this type of crevasses (tipically located at cirques on the Earth) are located at the end of the glacial valleys, marking a possible step in the topography underneath the glacier. Small ones are located inside some of the cirques.

Morraines: elongated ridges, located both inside the valleys, but also in the flor of the depression. They could have curved and lobated traces, very complex in some cases. They mark the shape of the possible glaciers and their flow-direction.

Erratical blocks: Mainly inside some valleys, dispersed blocks are visible, sometimes related to Aeolian deposits, with a irregular distribution, what we interpret to be such as blocks transporte on the glacier, such as the terrestrial erratical blocks.

Kames: the NW half part of the depression is characterized by a rugged to knobby terrain formed by thousands of small hills. Some of them could be blocks, but we interpret most of them as kames.

Arêtes: valleys arriving to the main depression leave elongated hills, very narrow, forming arêtes.

Roches moutonées: smooth outcrops located in the NW inner edge of the depression shows a gently slope toward the SE (opposite to the general slope of the floor of the depression, and opposite to the supposed ice flow), meanwhile the NW side is sharp, irregular and steeped.

Flutes: near the edge of the depression, some reliefs (possible outcrops and roches moutonées) have clear flutes following the local slope.

Eskers: coming from the depression, but outside it, in the volcanic plains surrounding Hecates Tholus, some

sinuous crests are visible. They are completely different than those related to wrinkle ridges.

Moreover, we observed other features what we interpreted to be related to periglacial processes, and water-related processes, such as:

Slopes creeping deposits: lobated and corded deposits located at the lower part of south-facing slopes.

Gullies: black deposits at south-facing slopes in different valleys.

Finally, all the area is characterized by the presence of drop-like reliefs. We do not have an indisputable interpretation of those feature, because they could be wind-related feature, whose orientation is in agreement with local wind direction [11], but also possible drumlins formed by glacial sedimentation under the ice. It is necessary to perform detailed geological and geomorphological studies of those features in order to discern between both hypothesis.

Analogues on Deception island, Antarctica: Althought not ice has been observed in any of the studied images, such it is expected in a glacial area on the Earth, Martian glaciers seems to be covered by a dust deposit, outside the polar caps [9]. It could mask the ice, but also some glaciar features. It also occurs in Deception island, and active volcano in South Shetland island, Antarctica (62.9°S 60.6ºW), where some glaciers are completely covered by thin to deep layer of volcanic ash [12], one of them named such as black glacier. So, although not ice has been observed, the hypothesis of a glacial origin of all the features here described seems to be the most feasible.

Conclusions: All these features observed at the lower NW flank of Hecates Tholus, if they are certainly glacial features, reveal a complex geological, geomorphological, and climatical history of this area of Mars, independently of the own origin of the depression where they are located. Now, we are carrying new and detailed studies focused on geomorphological cartography (in order to know the real distribution of all those features), climatic analysis (in order to stablish the possible conection between glaciers and climate), and surface temperature (in order to stablish the possible existence and depth of relict ice in the depression) what could helpto understand the glacial history of this region of Mars.

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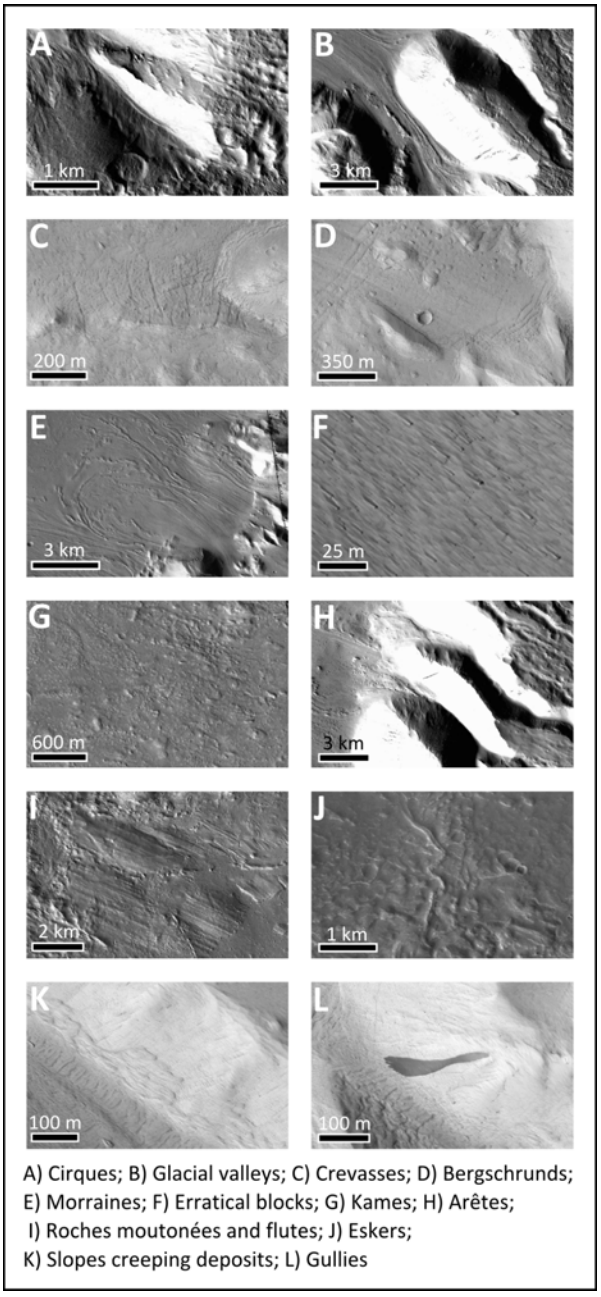

Fig. 2 : Examples of glacial and periglacial feature at the lower NW flak of Hecates Tholus volcano. (Images: C,D,K,L: HiRISE; A,B,E,F,G,H,I, J: CTX).