KARST-LIKE LANDFORMS IN THREE ILDs LOCATED IN WESTERN TITHONIUM CHASMA (MARS). D. Baioni[1] and M. Sgavetti[1], [1]Dipartimento di Fisica e Scienze della Terra, Università degli studi di Parma, Parco Area delle Scienze 157/a 43100 Parma, Italy.

Introduction: The Tithonium Chasma (TC) is comprised in the Valles Marineris troughs, a rift system that belongs to the Tharsis radial pattern of fractures. The trough is located near to the Martian equator, stretching about 850 km along an E-W direction. The western part of the TC forms a linear trough and may be interpreted as graben structure, in which a recent tectonic activity occurred only on the northern wall, while the other parts of the trough show a morphology that seems to be primarily related to erosional processes and secondarily to tectonics [1].

In the western part of TC three ILDs (Fig.1) displaying a dome shaped morphology, that rise from the chasma floor have been previously idenfied [2]. The mineralogical characteristic of the dome have been previously determined by analysis of the OMEGA data. The domes appear to consist by magnesium sulphate materials, showing on the slopes clear signatures of kieserite and of polyhydrates sulphates [2].

Through the analysis of the MRO HiRISE images we studied in great detail the dome surfaces. In particular we focused our analysis on the features that we interpreted as karst-like landforms, investigating the possible processes involved in their formation and shaping.

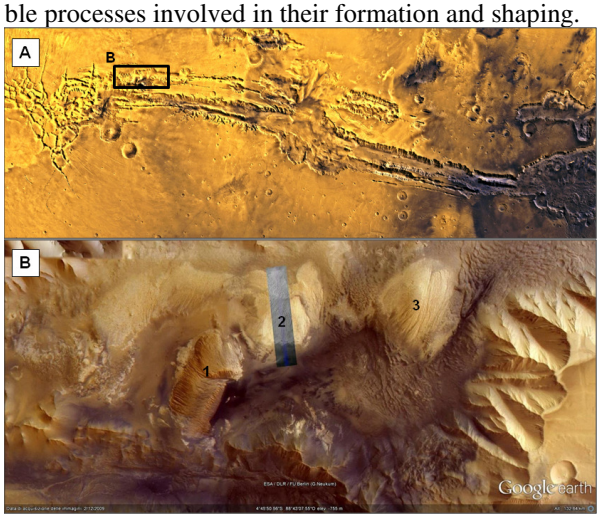

Figure 1: (a) Valles Marineris system with the location of western Tithonium Chasma (black box); (b) western Tithonium Chasma with the locations (black numbers) of the ILDs. (Images taken from google mars web site).

Karst-like landforms: Along the flanks of the domes, karst-like features formed by sheet wash and channeled water flow can be observed. Similar features have been detected also in others ILDs within the Valles Marineris [3]. In particular, on domes flanks many closed rimless depressions surrounded entirely by unbroken plains can be observed. Individual shallow depressions displaying different sizes and shapes can be found in all three domes (Fig. 2). The depressions on the domes flanks are either bowl-shaped or rounded-elongate shaped, have diameters up of 50 m, display both simmetrycal and asymmetrical walls, and concave-up or flat floor geometry. On the upper part of the domes, where the angle of the slope is higher, the depressions have an elongated shape with a wide top and a narrow bottom. These landforms strongly resemble similar features found on Earth displaying deep morphological similarities with dolines that develop in all kind of evaporite and mountains karst terrains.

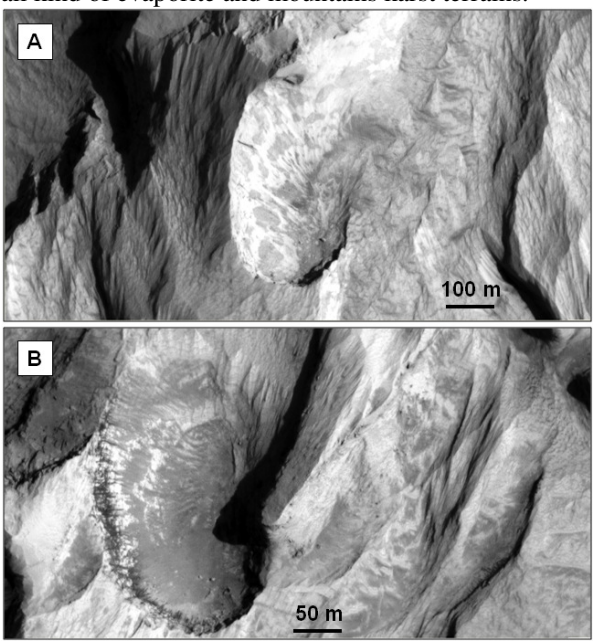

Figure 2: (a) bowl-shaped depression located on the slope of the eastern dome; (b) Elongate depression located on the slope of the eastern dome. (Images HiRISE PSP_005848_1755).

Discussion: The depressions that can be observed in the domes surfaces lack evidence of wind action and erosional features associated with the evolution of impact craters. In fact, the analysis carried out suggests that they were not built or shaped by wind erosion, or impact craters heavily eroded or reworked by geomorphic processes. Thus these morphologic features, might be interpreted as karst landforms of polygenetic origin .

The depressions observed, for which we are not able to determine dissolution and/or collapse mechanism, do not display any evidence that they functioned as typical

solution dolines (where greater mass of the rock is removed from their centers than from around their sides by dissolution of infiltration water). In fact, many of them looks more likely as formed as huge solution pans or bevels by sheet wash water flow during ice melt.

The water necessary to shape and build these forms probably has been provided by the melting of ice or snow, that can be formed during periods of ice-snow-rich deposition from the atmosphere that may occur as the result of changes in the obliquity of Mars [4]. The melting of ice probably should have occurred gradually rather than rapidly, and had to persist long enough to shape the landforms observed.

The depressions appear well preserved and do not seem reworked or modified, even by wind erosion. The freshness of these landforms and the absence of landforms with wind-related modifications might suggest a young erosional age.

Summary: The analysis carried out in this study suggests that:

(i) The observed landforms might be consistent with responses to climatological change and the presence of enough liquid water to form the observed landforms.

(ii) The characteristics of evaporite karst and its rapid formation on Earth, allow us to think that liquid water existed on the domes and persisted long enough for observed features to form but that there probably was only one episode during which water was available. The karstification was probably short-lived. After this period of karstification, there was no more water available and hence no additional karstification of the domes.

(iii) The landforms observed display young erosional age, probably of early Amazonian age.

References: [1] Peulvast J.P. et al. (2001) Geomorphology, 37, 329-352. [2] Popa, C.I. et al. (2007) *LPS XXXVIII,* Abstract #1848. [3] Baioni D. et al. (2009) Acta Carsologica, 38/1, 9-18. [4] Laskar J. (2004) Icarus, 170, 343-364.