MORPHOLOGICAL ANALYSES OF RELIEF-INVERTED CHANNELLED DISTRIBUTARY SYSTEMS IN THE AEOLIS/ZEPHYRIA PLANA REGION: INSIGHTS FROM DEMs DATA SET.
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Introduction: A variety of fluvial landforms preserved in inverted relief have been recognized at a number of sites on Mars [1]. A series of the peculiar fluvial morphology in the Aeolis/Zephyria Plana (AZP) region of Mars has been previously interpreted as inverted fluvial features, which are dated to have formed during the late Hesperian to early Amazonia epochs [2]. This population are concentrated in the two western-most lobes of the Medusae Fossae Formation (MFF). The MFF exhibits nearly ubiquitous 10- to 100-meter scale linear or lemniscate hills interpreted as yardangs which result from aeolian erosion [3-4]. A detailed analysis is currently going on, but it is already possible to identify several fluvial. We report here about a distributary system and surrounding areas.

Data: The NASA Ames Stereo Pipeline (ASP) tools was used for processing Mars Reconnaissance Orbiter (MRO) Context Camera (CTX) Images. It was designed to process stereo imagery captured by spacecraft and produce cartographic products including digital elevation models (DEMs), ortho-projected imagery, and 3D models. Morphometric analyses of the channels were carried out with a series of topographic profiles derived from the DEMs data set.

Morphological analyses: The inverted features are developed around the circumference of the topographic depression along the scarps between the two MFF lobes, within an elevation range of −2580 m to −1970 m (Figg. 1; 2). Moreover, the fan-shaped feature displayed in the fig.1 is located in an area of structural relief bordered by deep basins and is difficult to define the relative drainage basin. By contrast, the inverted reliefs developed along the flanks of the two lobes in the studied area (Fig. 2) show a clear network and their paleo-drainage is easy to reconstruct. The inverted reliefs are located on the flat area with a slope of about 7° (Fig. 3). A series of transversal profiles along one channel of the fan-shaped show Ω-shaped or box-shaped cross-section profiles, and ʌ-shaped sections are restricted only in few and short tracts where channel meander (Fig. 1).

The steep valleys flanks of the channel show an abrupt change in slope angle to a flat valley floor. The slope of the channels varies between 13°- 20°. The mouth of fan-shaped is bordered by a broad and abrupt scarp with slopes up to 50° (Fig. 3).

The fan-shaped inverted channel network is characterized towards SW by two main wide and straight valleys that progressively start to meandering in the central part of the fan. The distal sector of the fan is dominated by narrow distributary secondary channels that diverge from the main valleys.

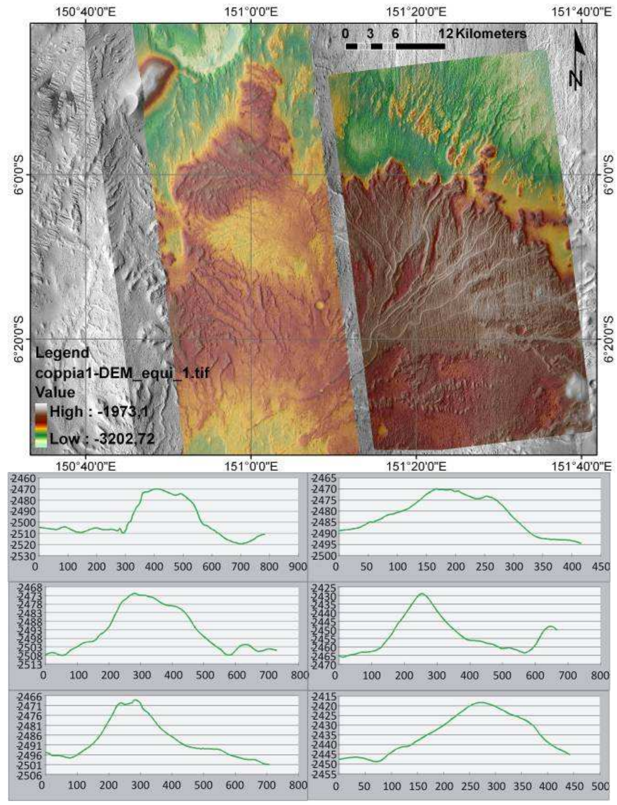

Figure 1. Upper: DEM illustrating fan-shaped inverted relief in AZP; lower: cross-section profiles of a main channel.

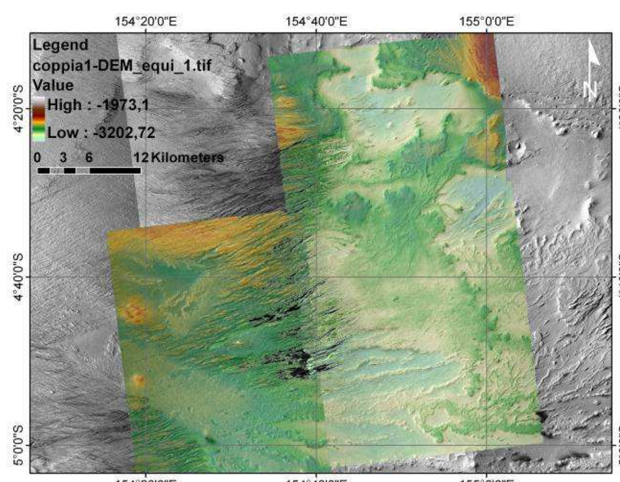

Figure 2. DEM image with inverted reliefs along the scarps of the two lobes.

The morphology of the inverted relief showed in fig. 4 strongly differs from the fan and is well correlated with impact crater that rapidly melts ice in the subsurface. The presence of liquid in the ejected material allows it to flow along the surface, giving the channel morphological characteristic, fluidized appearance. Morphological analyses allowed to define several rounded ridges located at the mouth of the fan-shaped inverted features. These ridges appear to modify the neighboring low relief topography including the superposed inverted channels. However, the paleo-flow of the main channels is not deviated by the positive features; these morphological evidences suggest that the growth of the ridges is subsequent to the formation of the inverted channels (Fig 5).

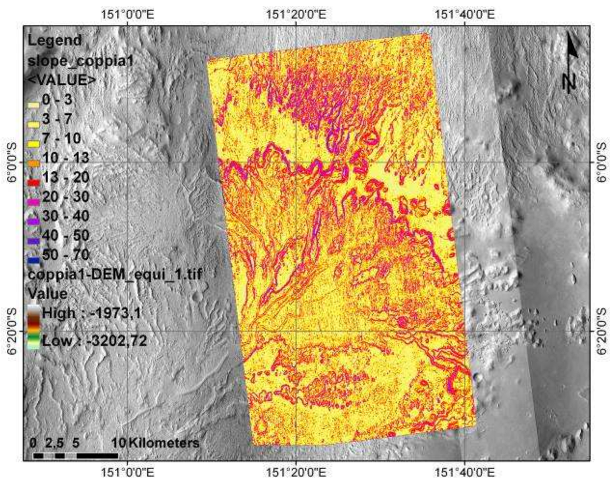

Figure 3. Slope map of the fan-shaped inverted features shown in Figure 1.

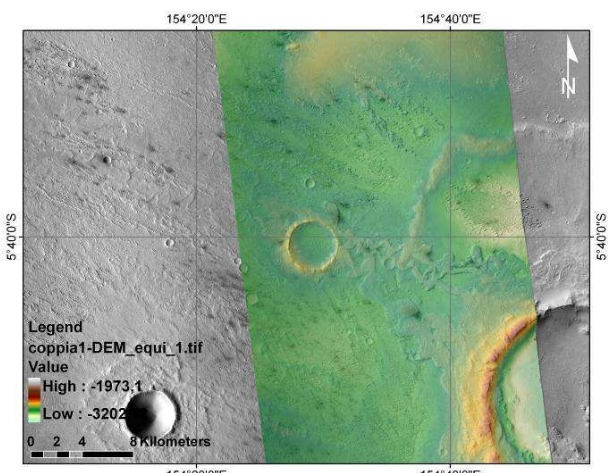

Figure 4. Channelized positive relief along the flank of impact crater.

Concluding remarks: The peculiar morphology of the positive-relief landforms in the AZP region provide useful information for reconstructing the history and evolution or for establishing the conditions of paleo-environment on the planet.

A preliminary result of the morphological and morphometrical analyses show that the main valleys are Ω-shaped or box-shaped in cross-section profiles.

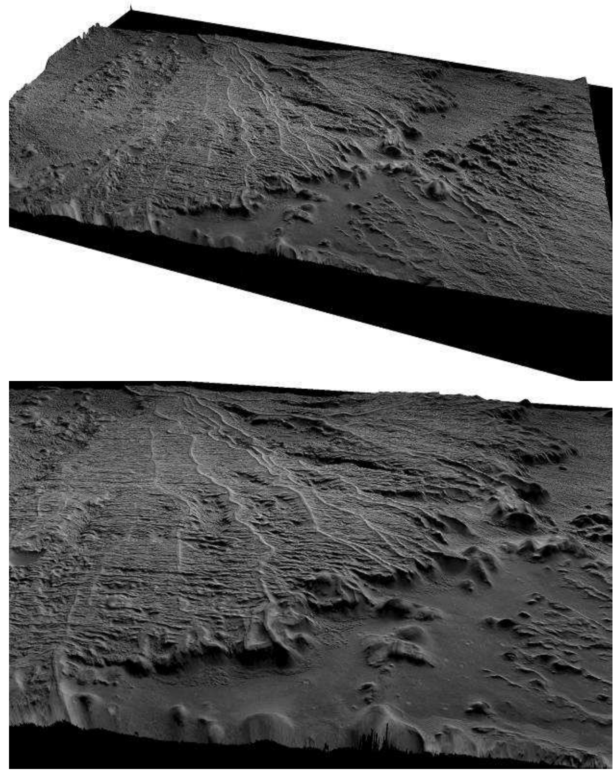

Figure 5. 3-D model showing channelled distributary system and rounded ridges located at its mouth.

Moreover, there are no clear evidence of a catchment area and the drainage basin is limited with respect to the dimension of the channel network; consequently, the flow of shallow groundwater in the channels is an essential prerequisite for such processes to occur. The variation of the inverted relief in cross-section profile along the meanders in the AZP region is compatible with the distribution of coarse grained materials in fluvial networks. Moreover, the relief-inverted channelled distributary system shows several analogies with terrestrial systems including estuarine fan deltas or terminal fans [5] .

References: [1] Pain C.F. et al. (2007) *Icarus*, 190(2), 478-491, doi:10.1016/j.icarus.2007.03.017. [2] Burr D.M. et al. (2009) *Icarus* 200, 52-76, doi:10.1016/j.icarus.2008.10.014. [3] Scott D.H. et al. (1982) *JGR* 87(B2), 1179–1190. [4] Mandt K.E. et al. (2008) *JGR* 113, E12011, doi:10.1029/2008JE003076. [5] Friend, P.F. (1978). *Canadian Society of Petroleum Geologists memoir* 5, 531-542.