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Geomorphological analysis of Tinto-B Vallis on Mars

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Abstract

This work analyses a 81 km long 1.85 km wide fluvial valley on Mars (at 2°55' South and 111°53' East) that has not been analysed yet, located near to the so-called Tinto Vallis [1], called Tinto-B hereafter. The studied area is near to the Palos Carter and Tinto Vallis. The crater statistical analysis based age of the analysed valley (2.9 Ga) correlates with the early wet period of the red planet. The analysed area shows marks of a big flood, deposition at the termination of the valley and the other geomorphological features with a presence of flowing water.

1. Introduction

The Martian fluvial valleys [2]; [3] show many similarities with the terrestrial fluvial system especially with the dry or semi-dry valley, wadis [4; [5] – although current conditions are not favorable for bulk phase liquid water, only in microscopic scale [6].; [7] or as small ephemeral flows in gullies [8], however old fluvial systems are well preserved.

The analyzed area is near to the Martian equator to Palos crater and Tinto Vallis (Figure 1). To keep it simple, the analyzed Vallis called Tinto 'B' in the following. The length of the valley is ~ 81 km, the average width is ~1.85 km, depth ~250 m. The highest point of the analyzed area is +402 m, the deepest is -752 meters. The flow direction of the valley is from south to north.

2. Results

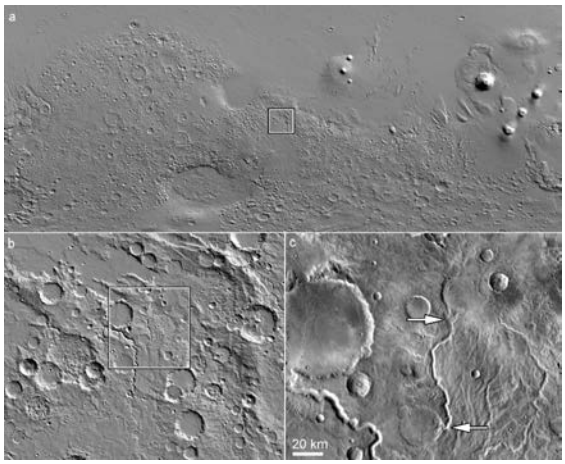

Figure 1: Overview of the analyzed valley near to Palos crater and Tinto Vallis.

Altogether 12 cross-sectional profiles were analyzed of Tinto 'B' (Figure 2). The valley can be divided into three sections, which demonstrate different longitudinal and cross-sectional wall slope values, probable representing different kind of geomorphological features. including rock debris skirts and terrace like features.

The upper section's longitudinal slope value is 1.32°, the average cross-sectional slope value is between 25°–30° . The mid-section's longitudinal slope value is 0.69° and the cross-sectional slope value ranges between 20°–25°. The low section's longitudinal slope angle is 0.44° and the cross-sectional slope of the valley walls change between 10°–15° (Figure 2).

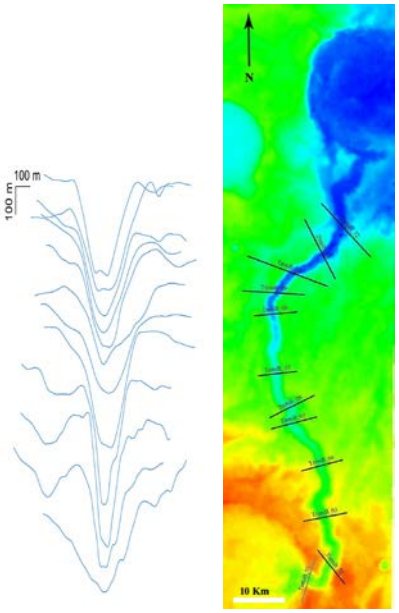

Figure 2: Cross-sectional profiles of Tinto 'B' with 2-times vertical exaggeration. Left image shows the 12 profiles (first: 1; last 12) and the right image shows the place of these cross sections along valley.

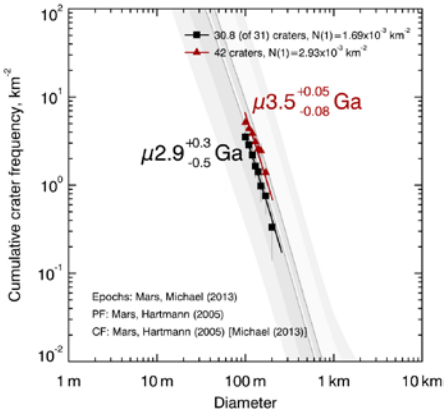

Figure 3: SFD curves of the analyzed craters with the estimated ages. Red curve shows the surrounding area of the valley, the black curve shows the analyzed area of the terminal crater of the valley.

3. Discussion

At the upper section of the valley the walls have more 'V' shape with rock debris on the bottom of the valley. The mid-section shows a transition between the upper and lower parts. The shape of the walls changes from 'V' to 'U' form. Based on valley shape analysis on Mars, profile shapes might be steeper and deeper at the upper than lower sections [9] [10] [11], where the wider and shallower parts are more characteristic to sedimentary infill. The main sediment on the upper and the middle section of the valley might be sand, what are good visible on the CTX image. The bedrock isn't visible in the upper section but at some places on the middle section, where the valley is the narrowest it is visible. At the lower section of the valley the bedrock is clearly visible. The measured craters in the big terminal crater at north accommodates another sediment type, what is different from the sand and the bedrock

4. Summary and Conclusions

The Tinto-B Vallis shows features of fluvial transport and possible sedimentary infill in the terminal crater basin, where a lake might have formed previously, however few firm signatures left behind from these lake. This poorly analyzed fluvial system is an important site for future research on astrobiology [12] [16] [14] [15], [16], and it also provides a good candidate target for detailed mapping of surface geomorphology (Hargitai et al. 2017. Map Projections in Planetary Cartography. Springer, pp 177-202.) to reconstruct early processes on Mars.

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