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Crater palimpsests on Mars

E. I. Alves (1, 2), M. T. Barata (1), G. A. Barberes (1) and N. Peixinho (3)
(1) Centre for Geophysics (2) Geophysical Institute and Department of Earth Science (3) Astronomical Observatory and Center for Computational Physics, University of Coimbra, Portugal (livo@dct.uc.pt / Fax: +351-239-793428)

Abstract

We report the finding of palimpsest craters on Mars HiRISE image ESP_016526_2415. These craters show clear relationships with periglacial features: polygonal terrains whose characteristics are controlled by the craters.

1. Introduction

The word palimpsest meant originally "writing material (as a parchment or tablet) used one or more times after earlier writing has been erased" [1]. Planetary Geosciences borrowed the term to describe craters whose flat topography lets them be perceived mainly by reflectance contrasts.

Palimpsest craters have so far been identified on Earth (such as Popigai, in Siberia [2]), the Moon (such as Yerkes, on Mare Crisium [3]), and possibly even Titan [4], and they dominate the images of Ganymede and Callisto. Earth and Moon palimpsest craters are mostly attributed to long duration geodynamics, be it the filling of crater basins by lavas (dominant process on the Moon) or erosion (dominant process on Earth).

Figure 1: Memphis Facula, 344 km diam., left, and Nidaba, right, on Ganymede. (Voyager 2/NASA/JPL.)

On the other hand, palimpsests on Jupiter's icy moons have been attributed to several processes, of which, nowadays, the Passey and Shoemaker hypothesis [5, 6] is favored: an impact process similar to those on the Moon, with emission of continuous dry solid ejecta deposits – albeit on crusts with very different mechanical properties. Two different types of palimpsest craters have been observed on Ganymede: palimpsest *s. s.* and penepalimpsests. The former (figure 1, left) are generally high-albedo and otherwise featureless while the latter (figure 1, right) are generally low-albedo and display concentric inner ring systems [6].

2. Martian Palimpsests

HiRISE image ESP_016526_2415_RED [7] shows an area between latitudes 61.067° and 61.240°, and longitudes 326.082° and 326.345°. It was acquired on April 2nd 2010 with a 0.25 meter per pixel resolution (figure 1). This image displays several features which can be identified as palimpsest craters and we will look closer at the one which is marked with an arrow on figure 2.

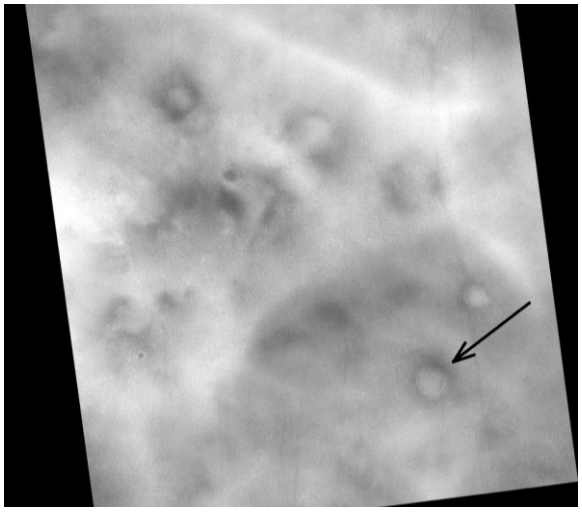

Figure 2: HiRISE image ESP_016526_2415_RED. The crater marked with an arrow is 400 m in diameter. (Image: NASA/JPL/University of Arizona.)

Figures 3 and 4 show the whole crater and a close-up on its northern rim. The crater is set on polygonal terrain which, on the first tens of meters on either side of the rim, is geometrically controlled by it. Polygon areas do not seem significantly different inside and outside the crater.

However, there are clear differences in the granulometry and distribution of boulders on either side of the rim: inside the crater boulders are smaller and of seemingly random distribution whereas on the rim, and up to 100 m outside of it, boulders are larger and preferentially set along polygon cracks.

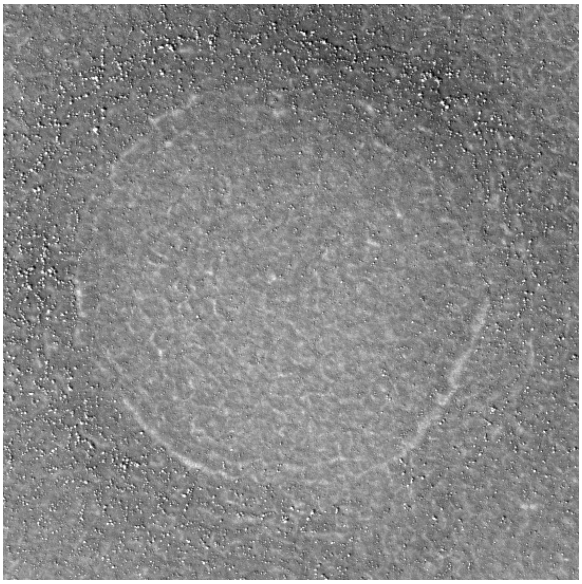

Figure 3: Close-up of the crater marked with an arrow on figure 2.

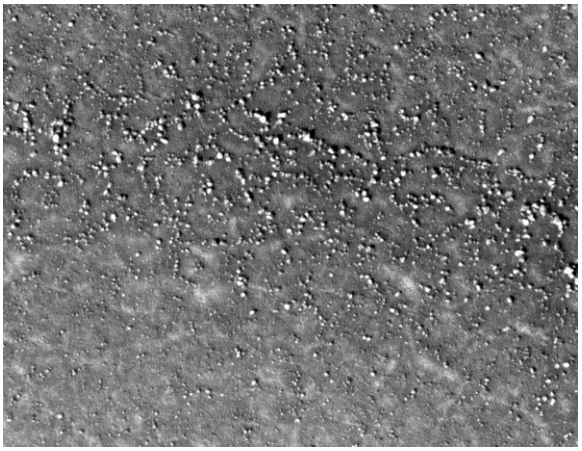

Figure 4: Close-up on the northern rim on figure 3.

3. Future work

The finding of these palimpsest craters on Mars has prompted us to develop work along three lines:

a) To produce a catalog of these features.

b) To accurately define the geometrical parameters that characterize Martian palimpsests, namely, polygonal terrain geometry and boulder granulometry.

c) To clarify the genesis of these features and its relationships with polygonal terrains.

References

[1] Merriam-Webster Online Dictionary, http://www.merriam-webster.com/ (retrieved on April 1st 2011).

[2] Alexander Deutsch, A., Masaitis, V. L., Langenhorst, F. and Richard A. F. Grieve, R. A. F.: Popigai, Siberia – well preserved giant impact structure, national treasury, and world's geological heritage, Episodes, Vol. 23, 1, pp. 3-11.

[3] Butler, P., Jr. and Morrison, D. A.: Geology of the Luna 24 landing site, 8th Lunar Science Conference, Houston, Tex., March 14-18, 1977.

[4] Nelson, R. M., Brown, R. H., Hapke, B. W., Smythe, W. D., Kamp, L., Boryta, M., Baines, K. H., Giancarlo, B., Bibring, J., Buratti, B. J., Capaccioni, F., Cerroni, P., Clark, R. N., Coradini, A., Cruikshank, D. P., Drossart, P., Formisanno, V., Jaumann, R., Langevin, Y., Matson, D. L., McCord, T. B., v. Mennella, V., Nicholson, P. D., Sicardy, B. and Sotin, C.: VIMS Evidence for Palimpsests on Titan as a Constraint on Widespread Precipitation, American Geophysical Union Fall Meeting, 13-15 December 2004, San Francisco, USA, abstract #P41B-08, 2004.

[5] Passey, Q.R. and Shoemaker, E.M.: Craters and basins on Ganymede and Callisto: morphological indicators of crustal evolution. In: Morrison, D. (Ed.), Satellites of Jupiter. Univ. of Arizona Press, Tucson, AZ, pp. 379–434, 1982.

[6] Jones, K. B., Head III, J., W., Pappalardo, R. T. and Moore, J. M.: Morphology and origin of palimpsests on Ganymede based on Galileo observations, Icarus, Vol. 164, pp. 197–212, 2003.

[7] HiRISE Team, NASA/JPL/University of Arizona, http://hirise.lpl.arizona.edu/PDS/RDR/ESP/ORB_016500_016599/ESP_016526_2415/ (retrieved on March 15, 2011).