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Elongated craters on Mars revisited: Test of the decaying moonlets hypothesis?

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Abstract

Elongated craters on Mars have been addressed in a number of articles. Subsequently, three datasets were established in 1982, 1988 and 2000 respectively, using Viking images [1,2,3]. A new and improved set of data with 258 craters based on these previous datasets, and a database including up-to-date images taken by the High Resolution Stereo Camera (HRSC) onboard ESA's Mars Express were compiled. An analysis of the database shows amongst other information a change in impact direction with respect to crater age and an increase of maximum crater diameter as well as an increase of eccentricity with increasing crater age.

1. Introduction

Thanks to space exploration, impact cratering has been revealed as a fundamental process in shaping the surface of terrestrial planets. One common characteristic of most impact structures is their circular shape. However, a small fraction of elongated craters formed by oblique impacts can be observed. Detailed surveys of those elongated craters have been performed for some of the inner planets. Especially for Mars, target of many planetary missions, three datasets were compiled based on Viking images.

2. Motivation for the study

One factor in the revision of elongated craters on Mars is the availability of high-resolution images in colour and 3D taken by the HRSC imager onboard Mars Express. Since the existing investigations are all based on Viking data, the advanced imaging capacity of Mars Express means a major step forward in the re-appraisal of elongated craters on Mars. Another important aspect is the ongoing discussion on the decaying moonlets hypothesis, which might be an explanation for at least some of these craters, as well as the unsolved origin of the Martian moons, Phobos and Deimos [4]. The improvement of the existing datasets, the development of a database with HRSC images and the analysis of this database are expected to contribute to this discussion and might also serve as a foundation for further studies.

3. Database of elongated craters

The established database includes 258 elongated craters that are divided into three age groups according to their relative state of preservation. Furthermore the database is composed of 15 attributes including amongst others crater eccentricity, crater depth, crater age, terrain age or further comments and the resulting spreadsheet makes Mars Express images directly accessible via hyperlinks.

4. Figures

Figure 1: Crater number related to maximum diameter

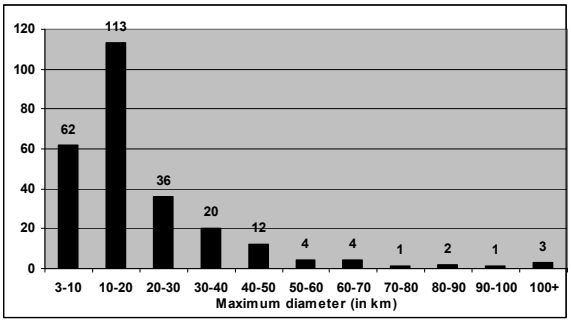
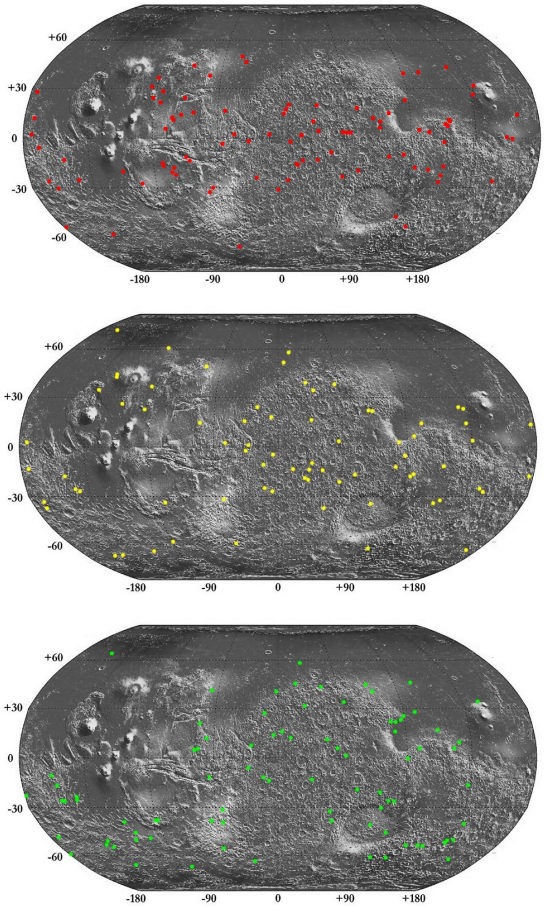


Figure 2: Global crater distribution according to crater age (red = youngest, yellow=middle age, green = oldest)



5. Tables

Table 1: Crater age with respect to crater size and crater eccentricity (group 1 = youngest, group 2 = middle age, group 3 = oldest)

Age group 1	Age group 2	Age group 3
Average max. diam. 16 km	Average max. diam. 27 km	Average max. diam. 50 km
Average min. diam. 11 km	Average min. diam. 16 km	Average min. diam. 32 km
Average eccentricity 1.45	Average eccentricity 1.63	Average eccentricity 1.78

Table 2: Crater age related to impact direction

Age group 1			Age group 2			Age group 3		
Direction (°)	# of craters	%	Direction (°)	# of craters	%	Direction (°)	# of craters	%
0 to 67	42	43.8	4 to 86	58	78.4	0 to 90	26	29.5
68 to 109	15	15.6	97 to 170	16	21.6	91 to 168	57	64.8
110 to 177	39	40.6				Erosion	5	5.7
Total	96	100	Total	74	100	Total	88	100

6. Summary and Conclusions

The focus of this study was the development of a new database of the elongated crater population on Mars with up-to-date satellite imagery from ESA's Mars Express. In order to achieve this objective the existing datasets from 1982, 1988 and 2000 were analysed and an improved dataset was established. The result is a database with 258 elongated craters and 15 database attributes including high-resolution images mostly in colour and in 3D. The discussion of the decaying moonlet hypothesis shows that it is still a controversial topic. When evaluating the results of this study and other investigations, it seems probable that at least some of the elongated craters on Mars resulted from the impact of former satellites [5]. Future exploration of the Red Planet and its moons will deliver more data that might eventually lead to a definite answer to this open question. With respect to future planetary endeavours that might contribute to answering the origin of the Martian moons, the decaying moonlets hypothesis and therefore also the origin of the elongated craters, the Russian Phobos-Grunt mission and the ESA-NASA programme of Mars Exploration are of the utmost importance.

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References

[1] Schultz, P. H. and Lutz-Garihan, A. B.: Grazing Impacts on Mars: A Record of Lost Satellites, Journal of Geophysical Research, Vol. 87, pp. 84-96, 1982.
[2] Barlow, N. G.: Crater Size-Frequency Distributions and a Revised Martian Relative Chronology, Icarus, Vol. 75, pp. 285-305, 1988.
[3] Bottke, W. F., Love, S. G. and Tytell, D.: Interpreting the Elliptical Crater Populations on Mars, Venus and the Moon, Icarus, Vol. 145, pp. 108-121, 2000.
[4] Craddock, R.A., Are Phobos and Deimos the result of a giant impact? Icarus, Vol. 211, Iss. 2, p. 1150, 2011
[5] Rosenblatt, P., and Charnoz, S., Formation of the Martian Moons from a circum-Mars accretion disk, this session, 2011