EPSC Abstracts
Vol. 5, EPSC2010-777, 2010
European Planetary Science Congress 2010

Geological Mapping of Crommelin Crater, Mars

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1 Introduction

Crommelin impact crater is located on Mars at 349.8° E and 5.1° N and stratigraphically situated within the cratered plateau sequence of Arabia Terra. The crater interior is marked by a central bulge for which layered units were described [1][3] and discussed in the context of a spring-mound formation scenario[3]. Textures of central crater bulge and layered rim materials are seen in connection with thermokarstic erosion and spring deposit formation ([2].

2 Material and Methods

Image data from the High Resolution Stereo Camera (HRSC), the Mars Orbiter Camera (MOC), the Thermal Emission Imaging System (THEMIS), the MRO Context Camera (CTX) and High Resolution Imaging Science Experiment (HiRISE) were selected to geologically and geomorphologically map the impact crater structure at a scale of 1:240,000. Mapping was conducted within ESRI's ArcGIS 9.2 environment. Crater bulge and rim units were differentiated with respect to relative albedo, textural and structural context, as well as on contacts based on HRSC images which provide full coverage of the crater.

3 Units

The main units as depicted in fig. **??** are separated into a central crater bulge unit, rim materials, and units of surrounding terrain. Based on HRSC image 3264_0000 and 3253_0002 a first differentiation of units is conducted. Available image data of higher resolution is used to support the established outlines and to collect additional information on the context. The surrounding area is only mapped in small neighbouring craters where comparable features appeared.

The central bulge is divided into 4 basic units topped by large mesa-formations. Those units show strong differences in texture and relative albedo but the transitions between them often appear gradual and clear steps in morphologies are mostly too small to be seen in medium-resolution (< 20 m) image data. HiRISE provides a good look at complex textures and unit context in partiular on the eastern slope of the crater bulge unit.

The crater rim is mostly covered by layered deposits of alternating light-toned and thinner dark-toned beds. The northern and eastern study areas also show vast yardang-formations of relatively massive light-toned material which are found on top of the layered units. The layered units are separated into 4 units of similar material properties but different appearance. While the northeastern setion seems to be mostly subhorizontally layered, surface morphologies apparently become increasingly rugged towards the southwest.

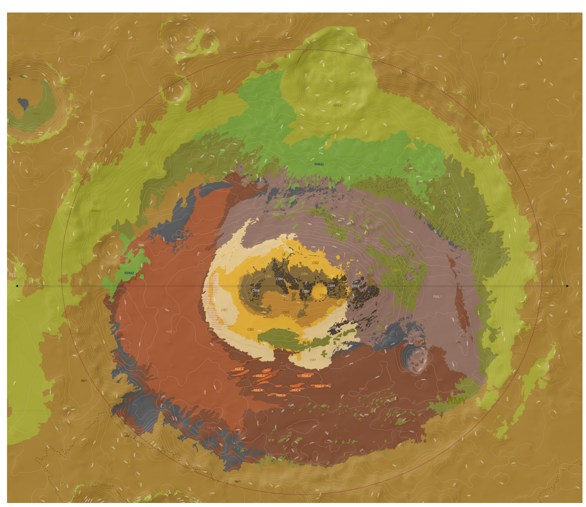

Figure 1: Map of Crommelin Crater. Yellow-brownish colours mark central crater bulge units, reddish-brown mark layered rim materials, and green units show other radial rim material. Surrounding terrain belongs to unit Npl1 (after [4]).

4 Discussion and Conclusions

Although the outlines of the established units are visible on all images, and described albedo and texture as well as variations due to thin dust mantles provide good differentiation attributes, the formation of morphologies remains ambiguous. The scenario outlined below has come up and forms an alternative to existing hypotheses on the formation scenario for the Crommelin impact crater structure. Several image sections of the crater rim show features which are here tentatively interpreted as fold structures and small-scale faulting signatures that are suggesting a scenario involving deformation and metamorphic modification. Especially in the southwest of the crater rim morphologies could be interpreted as a series of large-scaled folds. The scenario evolved around a resurfacing event which might have been triggered by extension after compressional forces effected underlying layered deposits during the impact event. An uplift of the central section of the crater bulge could easily cause compressional stress on surrounding terrain and consequently cause ductile or brittle deformations leading to folding or faulting, respectively.
Such a scenario would explain a number of other features observed on high-resolution images.

To further investigate possible formation scenarios for Crommelin Crater a digital terrain model of higher resolution (HiRISE and/or CTX basis) is needed to receive topographical data on small-scaled features and to allow for a proper identification and characterisation of fold structures. A larger coverage of the area with high-resolution image data should also provide more insight into the complex crater morphologies and the context of units.

References

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