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Structural Mapping of the Inner Layered Deposits of the Crommelin Crater (Mars)

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1. Introduction

Like many other impact craters within the Arabia Terra Region, on Mars, the Crommelin crater, located at 349.8° E and 5.1° N, displays a large central bulge and a well-preserved stratification (light albedo layered deposits) with some unusual landforms and structures that can be interpreted as fold sets, typical compressional structures often associated to diapiric rise on Earth [1]. It is possible to hypothesize that diapiric rise could have been responsible for central bulging on Crommelin crater and likely on other bulged craters on Arabia Terra.

This work, as part of the PLANMAP project, aim to realize a structural and geological map of the Crommelin crater area, estimating the extent of the deformation in the inner layered sequence of the crater, and finally to construct a 3D model of the basin showing the deformed deposits and the overall shape of the diapiric body underneath.

2. Data and methods

A high-resolution image dataset as well as DTMs were required to perform structural analysis, verifying strata dips and dip directions within the Crommelin crater floor and evaluate the presence of sequences of folds in the stratified deposits around the central bulge. In order to have an overall detailed view as well as good coverage of the study areas overlapping CTX images (6 m/px) were selected as pairs to produce stereo DTMs and orthorectified image mosaic. In addition, where available, HiRISE stereo images (0.25 m/px) were used. The DTMs were produced with Ames Stereo Pipeline and validated with the alignment on HRSC DTM (from DLR 100 m/px) and calibrating the heights according to MOLA topography (460 m/px) [2].

Analysis and mapping were conducted within ESRI's ArcGIS 10.3 environment, using T. Kneissl's Layer Tools extension [3].

3. Folded deposits

Several areas around Crommelin Craters bulge display clear stratification identified as ELD (Equatorial Layered Deposits) [4], suitable for analysis of strata dips and dip directions on DTMs. Within these deposits, folded stratigraphy were identified all around the central bulge.On the western and north-western sectors of the bulge a first sequence of folds was identified, with an approximate wavelength of ~1-2 km, displaying roughly concentric axial planes with an overall N-S orientation. The folds are symmetrical in the western area and become more asymmetric continuing to the north. The folds vergence is radial pointing outwards. The main sequence of folds seems probably perturbed by another less evident folding phase.

In the southern sector of the crater a second sequence of folds is highlighted by a series of elongated basin-like structures displaying a clear inwarddipping strat-

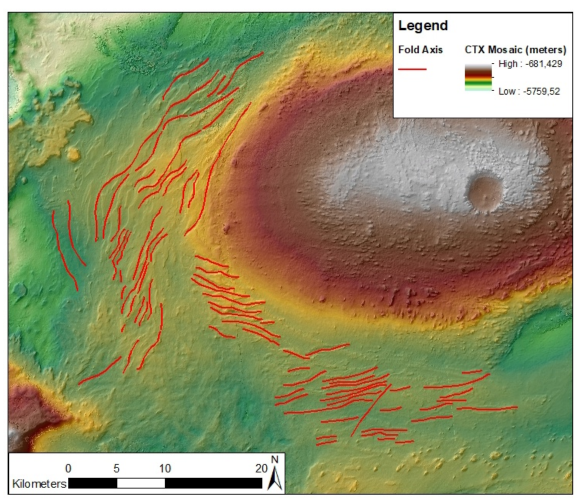

Figure 1: Overall view of the morphology of the central and south-west sector of the Crommelin crater. Red lines indicate inferred fold axes within the layered deposits around the strongly elliptical central bulge. CTX Mosaic (20 m/px).

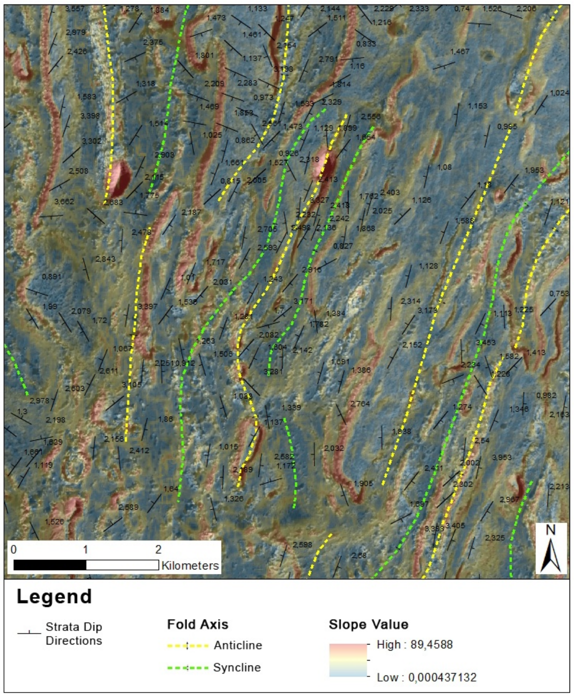

Figure 2: A detail of the western sector of the crater. The dotted lines indicate the axes of a fold sets (anticlines in yellow and synclines in green) inferred by the morphological contest and dip angles dip directions of the strata, measured on the CTX DTM and plottend in black with the dip angle highlighted. Orthorectified image mosaic with a slope layer overlaid in transparency.

ification with the dip angle progressively increasing towards the center of the basin. The approximate wavelength is kilometric and the axial planes are once again roughly concentric to the bulge but with an overall E-W orientation. Presumably, a second and more gentle folding phase overlaps the main one, with an axial orientation similar to that of the western area.The two main families of folds (the western set with N-S axes and the southern set with E-W axes) seem to insist respectively on two different units of the layered deposits, stratigraphically located one above the other and characterized by different morphological features.

4. Implications and future work

Several evidences suggest that crater's bulge may be hint for diapiric phenomenon. The uplift of the central section of the crater could easily have caused compressional stress on the surrounding rocks, leading to deformations that gave origin to fold sets. The trigger for the phenomenon could have been the impact cratering itself, having removed a rock mass vol-

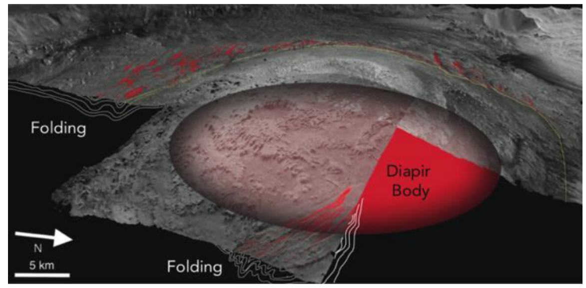

Figure 3: Perspective view and conceptual sketch of the diapiric body emplacement that likely caused bulging and folding. The diapir stays under the sedimentary layering coverage [5].

ume that generated a differential lithostatic load favoring low density buried salt bodies to uprise [5].

The folds setup suggests that the deformation could have occurred in more than one phases, influencing in a different way the various units that make up the inner layered deposits of the Crommelin crater.

The study will continue with a more in depth analysis of the deformation within the layered deposits as well as with a geological characterization of the deposits themselves, in order to create a structural and geological map of the Crommelin crater area and to produce a 3D model that will show the deformed deposits and the overall shape of the diapiric body underneath.

Acknowledgments

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