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From geologic mapping and cross-sections to 3D reconstruction: the example of the folded deposits of Crommelin Crater (Mars)

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Crommelin Crater is a ∼90km impact crater located in Arabia Terra region of Mars, located at 349.8° E and 5.1° N. This particular region displays a pervasive water and fluid activity fingerprint, made of several sulphate-bearing minerals, recorded both in Arabia and the nearby meridian planum and light albedo fine-layered deposits. These, informally named ELD (equatorial layered deposits) can be found both within craters and in the surrounding plateaus, and can range from 10 m to more than 1 km of thickness. Indeed, several km-thick bulges made by ELDs can be seen within several craters of Arabia, among which the Crommelin Crater.
Its bulge is slightly elliptical in shape (50*30 km) covering almost more than half the size of the entire crater, with the surroundings of the bulge encompassed by gently folded ELDs. In order to investigate the possible origin of the bulge and of the folding we firstly performed a geological and structural mapping on a mosaic of CTX orthoimages at 6m/pixel (Context Camera onboard MRO) and related stereo-derived DTMs with grid sizeof18m and obtained with Ames Stereo Pipeline.
From the geostructural map, scaled 1:160.000, is evident that the bulge occupies a lower stratigraphic level than the surrounding ELDs, that appear heavily eroded and dismantled in correspondence at the bulge flanks. The structural analysis highlighted the presence of gently folded strata whose axial planes appear concentric with respect to the bulge. Km-size symmetric folds sets are visible on the western sector, whereas asymmetric folds with radial outwards vergence are visible on the northwestern sector, appearing more pronounced in the proximity of the bulge.In the southern sector, a sequence of elliptical basins with inward dipping strata and major axis concentric to the bulge suggest a dome-basin interference pattern of folding.In order to investigate the folded geometries and the overall setting, we approached the problem in 3D with the MOVE software. We built 13 interpreted cross-sections of the folded strata of the ELD unit in the westernmost crater sector, roughly perpendicular to the fold axis, and interpolated the most prominent and continuous deformed strata banks. By constraining the geometries with tens of punctual measurements of dip direction obtained with the 3-point method, we reconstructed 3D ribbons of the folded strata spanning in an area of about 20x10 km.
The geostructural observations and the 3D reconstruction point towards the idea of a bulge uplift after the deposition of the surrounding layered deposits, that have caused fold sets typical of a diapiric phenomenon.

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