HRSC-BASED MAPPING AND INTERNAL ARCHITECTURE OF GALE CRATER (MARS).

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Introduction: Gale crater is located in a near-equatorial area on Mars, right at the crustal dichotomy boundary. It has a diameter of about 160 km and anomalously thick-layered deposits are present at the center (slightly off-centered northwards) of the structure. The thickness of these deposits is variable, up to about 2 km. The age estimates of Gale crater bulge deposits are largely variable among authors between Noachian [1], Hesperian [2], Amazonian [3]. It is currently (December 2006) one of the candidate landing sites for Mars Science Laboratory (MSL) rover.

Gale crater central bulge has also distinct thermophysical properties [4] respect to its surroundings, consistently with its rocky morphology.

HRSC-derived DTM: We produced a high-resolution digital elevation (Fig. 2) model using 3 sets of images acquired by the Mars Express High Resolution Stereo Camera (HRSC) during orbits 1916, 1927, 1938. We are using both imagery and high-resolution digital elevation model for characterizing the bulge deposits.

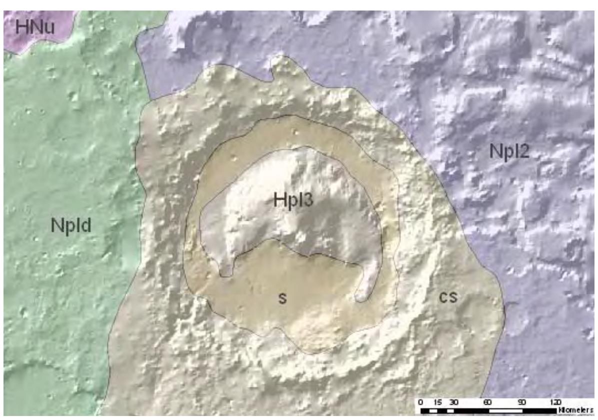

Figure 1: Geological outline of Gale crater area (geology from [2] over MOLA shaded relief).

Geology and bedding attitude: The deposits in the central bulge can be roughly subdivided in two main portions with different architectural style: a slightly tabular half moon-shaped basal unit, (Fig. 3) affected by fluvial erosion and characterized by few craters (possibly exhumed) and an upper mound-shaped unit unconformably overlaying the tabular unit.

Further internal unconformities [1] are possibly present (Fig. 3), mostly in the upper mound-like portion of the crater bulge.

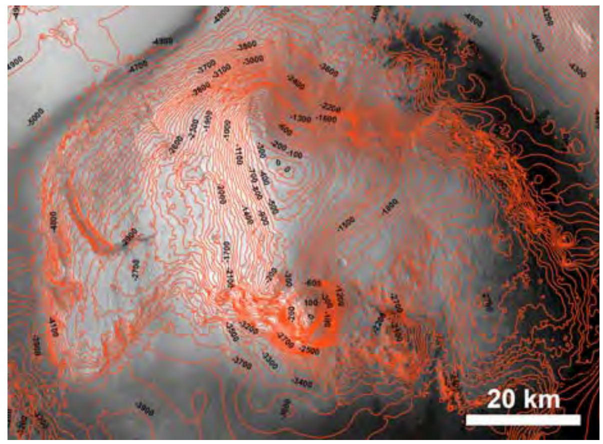

Figure 2: Gale crater bulge: HRSC digital elevation model contour map overlain on a nadir mosaic from orbits 1916, 1927, 1938. The different portions of the bulge have clearly different topographic signatures.

It is likely that a significant hiatus is present between the basal flat sub-unit and the upper mound-like one.

We are mapping the morphology and internal geometry (according to outcrops, e.g. layering exposed on cliffs) of the central bulge of Gale crater. Preliminary attitude measurements are showing layering dipping northwards up to few degrees (Fig. 3).

There are some evidences of mound draping bedding, especially in the NE side, where the layers seem to follow slightly the local topography, unlike the W facing cliff, where the bedding is apparently dipping more than the local topography, and more erosion is present.

Possible interpretation: Various hypotheses have been proposed in order to explain the genesis of Gale crater layered deposits [e.g. 1,3].

We suggest that the current appearance of bulge deposits inside Gale crater is mostly related to depositional processes rather than erosive [1]. Therefore, apart from some relative erosion, the current bulge morphology, shared by various other craters in specific areas on Mars [5] is basically reflecting the original deposition of the deposits, which would be, in the present hypothesis, locally formed [6]. We suggest that such deposits might be some sorts of large spring mound [e.g. in 7], possibly active in different times with different produced morphologies, possibly also with lacustrine facies. The upper portion of the mound, apparently clinostratified with an inferred northward progradation, could be, in this hypothesis, interpreted as both vertical and lateral accretion of a spring mound.

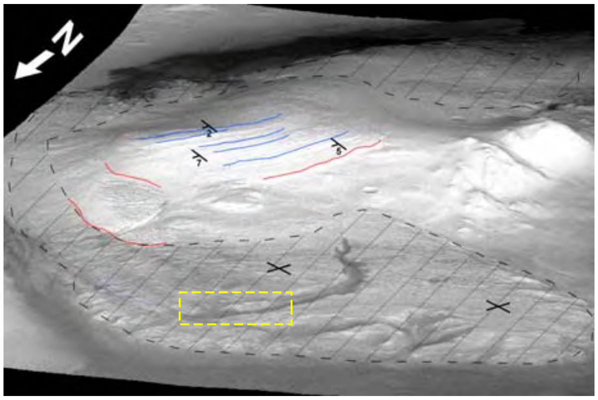

Figure 3: 3-D perspective view of HRSC nadir mosaic over HRSC stereo-derived DTM, showing unconformities (red) and possible clinostratification in the upper portion of the bulge (some layers outlined in blue). Rough location of figure 4 is outlined in dashed yellow. The light black diagonally dashed unit indicates the basal sub-horizontal layered sequence, likely separated by a sensible hiatus from the upper mound. Some of our preliminary attitude measurements are indicated.

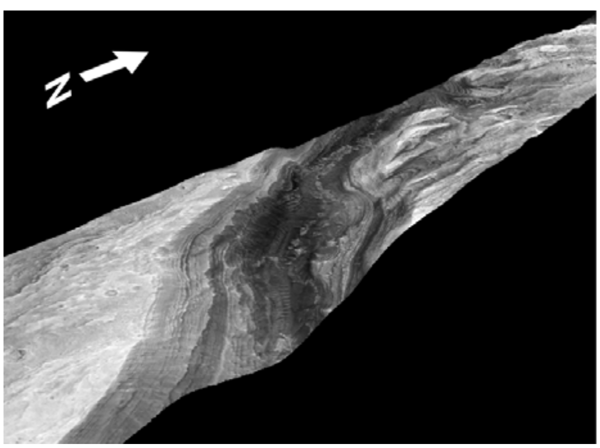

Figure 4: MOC NA image e1602204 draped on HRSC stereo-derived digital elevation model (cell size: 100 m). The image covers the flat basal portion of the bulge, which appears finely layered at MOC scale.

Conclusions: Gale crater has few of the most spectacular outcrops of layered sedimentary rocks on Mars. These sequences show a complex internal architecture, with noticeable interruptions in the sedimentation. We suggest that an intermittent supply of material locally delivered from the subsurface in the form of precipitated spring deposits could be responsible for the formation of the different portions of the bulge deposits, with different styles reflecting facies variations through time (e.g. lacustrine, mound, etc.). We are planning to use refined higher-resolution digital elevation models derived from HRSC data to better characterize the three-dimensional structure of the bulge. We are also trying to date the different sedimentary episodes in Gale crater with crater counting techniques.

References: [1] Edgett K. S. and Malin M. C. (2001) *LPS XXXII*, #1005 [2] Greeley R. and Guest J. E. (1987) USGS map I-1802-B. [3] Cabrol N. et al. (2001) *Icarus*, 39, 235-245. [4] Pelkey S. M. et al. (2004) *Icarus*, 167, 244-270. [5] Rossi A. P. et al., this conference. [6] Ori G. G. and Baliva A. (1999) *LPS XXX*, #1758. [7] Pentecost A. (2005) *Travertine*, Springer, p. 445.