Geologic and Thermophysical Unit Mapping of the Proposed Mars Science Laboratory Landing Site and Traverse Path in Gale Crater. R.B. Anderson[1], J.F. Bell III[1], R.E. Milliken[2],
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Introduction: Gale crater is located at 5.3°S, 222.3°W (137.7°E) and has a diameter of ~150 km. In the center of the crater is a layered mound ~5 km high with a diverse mineralogy [1] accessible to a rover. Gale is one of a class of ancient partially exhumed craters on Mars, and the stratigraphy of the Gale mound may represent a "type section" for early Mars, recording evidence of multiple climates and environments [2]. For these and other reasons, Gale has been chosen as a potential landing site for the Mars Science Laboratory (MSL) [3]. Here we present a unit map of the proposed landing site and traverse, with descriptions and preliminary interpretations of key units.

Data Sets and Unit Identification: Our mapping is based primarily on a ~6 m/pix mosaic of Context Camera (CTX) observations from the Mars Reconnaissance Orbiter (MRO) [4] and a 100 m/pix THEMIS thermal inertia map [5] of the region. Although the boundaries on the unit map are sharp, in some cases they mark a more gradual transition in the data, and the map should be interpreted with this in mind. Elevation data is from the High-Resolution Stereo Camera (HRSC) on Mars Express. [6]

Floor Unit Descriptions: Much of the terrain in the ellipse is a uniform cratered plain of varying thermal inertia (~400 - 530 $Jm^{-2}K^{-1}s^{-1/2}$). In some places near the mound, the cratered plains maintain their large-scale texture of subdued craters, but transition smoothly from smooth to a more rocky appearance.

In the center of the ellipse is a fan-shaped deposit fed by a network of dendritic channels that cut the northwestern crater rim. The smooth, lower thermal inertia (~420 $Jm^{-2}K^{-1}s^{-1/2}$) unit closer to the source channel has fewer craters, most of which are small. This unit appears to be eroding back, revealing a higher thermal inertia (~740 $Jm^{-2}K^{-1}s^{-1/2}$) unit in the distal part of the deposit. There are numerous ridges, possibly inverted channels, preserved in the western half of the deposit.

Another common floor unit is "pock-marked" terrain, characterized by a surface that is smooth over large length scales but marked by many small craters. It is common around the edge of the mound, where it forms a sharp boundary between the plains and the lower-lying base of the mound. The pock-marked terrain is often pyroxene-bearing [1], and may be a thin (<10 m) younger layer with a greater resistance to erosion than the plains. Other units that resemble the pock-marked terrain include "erosional remnants", a series of small outcrops that occur in irregular chains inward from the crater rim and in a fan-shaped deposit on the mound, and "washboard" terrain characterized by a series of parallel grooves that may be the erosional expression of ancient bedforms or bedding planes.

Mound Unit Descriptions: The basal unit of the mound is a thick (>200 m) fractured, light-toned rock unit that is lower than the surrounding plains. It is somewhat rough, with occasional mesas and outcrops and the thermal inertia varies (~530-700 $Jm^{-2}K^{-1}s^{-1/2}$).

Above the basal unit is a thin (~30 m) erosionally more resistant light-toned layer whose erosional surface is nearly flat-lying: its elevation changes by only ~130 meters in seven kilometers. If the layer is confirmed to be flat-lying by careful measurement of its dip, its origin may be lacustrine, but this would not rule out a pyroclastic or aeolian origin.

Above that layer is a thick (100s of meters) dark-toned unit that appears rough at the CTX scale. HiRISE and CRISM [1] data show that near the light-toned layer the dark unit is comprised of smectite-bearing wind-sculpted rock, transitioning at higher elevation to rougher, fractured mafic- and sulfate-bearing layers.

Intruding into the rougher unit is a raised, fan-shaped high thermal inertia (~710 Jm^{-2}K^{-1}s$^{-1/2}$) deposit, connected to a sediment-filled channel that extends 4.3 km upslope and disappears under an erosional unconformity. The unit appears to be relatively thin (10s of meters) and extends ~2.3 km laterally and follows the slope of the mound, spanning ~260 m in elevation. The surface of this deposit resembles the pock-marked terrain and the deposit ends in abrupt scarps, suggesting that it is an erosional remnant of a previously more extensive unit.

Above the fan-shaped remnant is a ~150 m thick band of finely layered rocks with light- and dark-toned layers, punctuated by light-toned outcrops, transitioning into a thick dark layered rock that is eroded into large yardangs. Both of these units are sulfate-bearing. [1] The dark yardang unit is quite thick (>1 km) has a moderate thermal inertia (~450 Jm^{-2}K^{-1}s$^{-1/2}$), and covers much of the western mound.

A light-toned yardang unit with no obvious layering is draped unconformably on top of the dark yardangs. Assuming that the slope of the underlying dark yardang unit remains constant, the light unit is ~200 m thick at its center. This unit has a thermal inertia of ~370 Jm^{-2}K^{-1}s$^{-1/2}$.

Conclusions: The potential MSL landing site and traverse in Gale crater encompass a diverse set of terrain types, likely reflecting varying depositional environments. The origin of the layered mound deposits is not yet clear, though the presence of sulfates and phyllosilicates indicates that water has played a role in their formation. Further interpretation using MOC, HiRISE and CRISM data is ongoing.

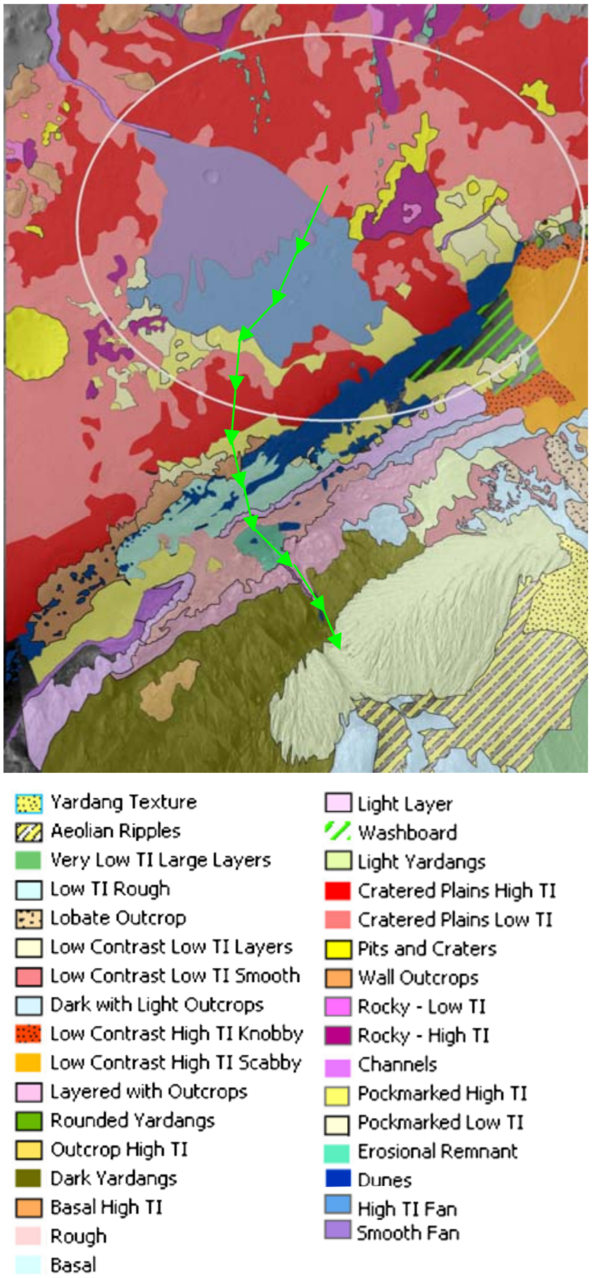

Figure 1: A unit map of the Gale crater landing site (white ellipse) and notional traverse (green arrows). The traverse shown is ~21 km long and climbs ~1 km from the crater floor onto the mound.

References: [1] Milliken, R.E. *et al.* (2009), *this conf.* [2] Edgett, K.S. *et al.*, 3rd MSL Landing Site Workshop. [3] http://marsoweb.nas.nasa.gov/ [4] Malin, M.C. *et al.*, (2007) *JGR, 112*. [5] Fergason, R.L. *et al.* (2006) *JGR, 111*. [6] Neukum, G. & Jaumann, R. (2004) *Mars Express: the scientific payload.*