The Evolution of Lower Mt. Sharp: An Orbital Perspective

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Detailed geologic and compositional maps from orbital data are key tools for contextualizing Curiosity's observations of Mt. Sharp (formally Aeolis Mons) and for reconstructing time ordered events of the mound's growth and alteration. Mt. Sharp can be divided into five broad, relatively flat lying (across ~10 km) units delineated by differences in texture, mineralogy, and thermophysical properties. From lowest to highest elevation these units are: (1) a basal unit (the Murray formation) that can be divided into three sub-units, (2) a phyllosilicate-bearing unit, (3) a hematite capped ridge, (4) a unit with unique NIR spectral properties, and (5) a layered unit with spectral signatures of hydrated sulfates. All units are relatively flat lying across ~10 lateral km. Two additional units with much higher thermal inertia are unconformable.

Secondary and redox sensitive phases are distributed non-uniformly through many of the primary Mt. Sharp units, including hydrated silica, iron oxides, sulfates, and phyllosilicates. At least two large hematite deposits at different locations in the stratigraphy are confined to discrete strata conformable with other Mt. Sharp layers. A third large deposit not clearly confined to a layer occurs at a similar elevation as one of the other two deposits. These deposits formed either at a redox interfaces where anoxic Fe^{2+}-rich waters become oxidized or in a region of oxidized leaching (*Fraeman et al*., 2013).

The occurrence of hematite at multiple stratigraphic horizons suggests redox interfaces were widespread either in space or in time. The observation that hematite is associated with discrete, conformable layers suggests two end member scenarios for the timing of hematite formation: (1) hematite (or a precursor ferric phase) was an authegenic phase that formed concurrently with Mt. Sharp or (2) hematite is secondary diagenetic product, but the diagenetic fluids were controlled by stratigraphically determined residual matrix porosity or fracture porosity. Some combination of these end member processes may also have occurred. Future measurements by Curiosity will test these hypotheses and provide insights into the past geologic depositional settings.