LAMINATED MUDSTONES IN THE CLAY-SULFATE TRANSITION INTERVAL AT MT. SHARP – SIMILARITIES TO EVAPORITIC MUDSTONES FROM PAHRUMP HILLS AND POSSIBLE IMPLICATIONS. J. Schieber[1], M. Minitti[2], W. Rapin[3], K. Bohacs[4], G. Caravaca[3], M. Coleman[5], D. Bish[1], L. Thompson[6], M. Reed[7]. [1]Indiana University, Bloomington, IN, jschiebe@indiana.edu, [2]Framework, Silver Spring, MD, [3]IRAP Toulouse, [4]ExxonMobil retired, [5]JPL, Pasadena, CA, [6]Univ. of New Brunswick, [7]University of Oregon.

Introduction: Mudstone-rich lacustrine strata at Gale Crater, Mars, dominate the Mt. Sharp sedimentary succession. The Gale crater strata provide the opportunity to test hypotheses regarding past climate shifts early in the planets history [1, 2], a key motivator for selecting Gale Crater as a landing site for the Curiosity rover.

At the base of the Mt. Sharp succession, at Pahrump Hills, mudstones with sedimentary features and geochemical attributes occur that suggest that these rocks accumulated in an underfilled lake basin. Lake waters were saline to hypersaline, and lake levels, shorelines, and salinities fluctuated greatly at various temporal scales [3, 4, 5].

Laminated mudstones, characterized by alternating softer and harder (cemented) layers and apparent evaporite pseudomorphs [4, 5] associated with the latter, dominate the Pahrump succession. They show multiple textural similarities to evaporitic lacustrine strata on Earth [3]. Although indications of evaporitic conditions have been reported from higher in the section [6], laminated evaporitic mudstones of the type seen at Pahrump Hills were not been observed for the next 400 m of Mt. Sharp stratigraphy since leaving Pahrump Hills.

During the recent ascent from the clay trough towards the Sulfate bearing unit, rocks resembling the Pahrump Hills evaporitic mudstones were again encountered at elevations above -4030 m. Examples of these laminated mudstones are compared to textural equivalents from Pahrump Hills.

Observations: The first example of similarity (Fig. 1) is a MARDI image from Sol3211 (-4027m).

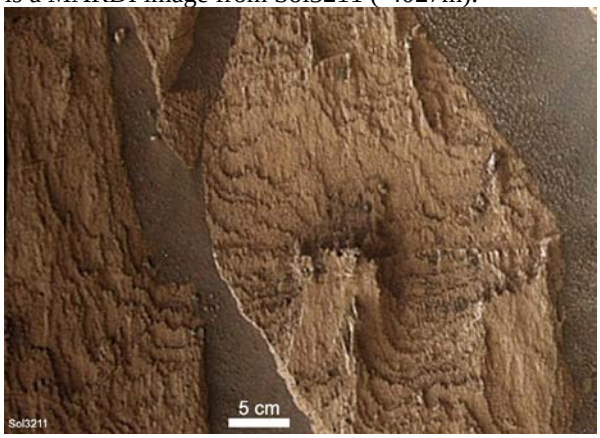

Figure 1: Plan view of eolian abraded mudstone. Alternating harder and softer laminae form a "stair-step" topography, and more resistant objects in the harder layers form erosive pedestals, not unlike what has been observed in mudstones at Pahrump Hills [3].

The second example (Fig. 2) shows a comparison of lamina appearance at Pahrump with lamina appearance at Sol3212 (-4024m).

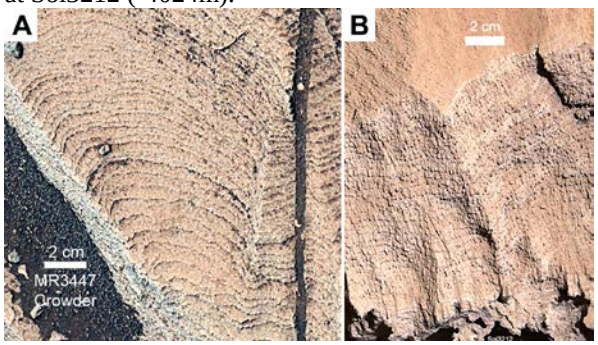

Figure 2: (A) Alternating harder and softer laminae at Pahrump Hills, and (B) comparable laminated mudstones in the clay-sulfate transition.

In both locations (Fig. 2), the harder laminae contain mm-size resistant objects, that at Pahrump were interpreted as evaporite pseudomorphs [3,4].

The third example (Fig. 3) illustrates the softness of the mudstones at Pahrump and in the clay-sulfate transition by way of anhydrite/gypsum veins that form resistant ribs as the softer mudstones are worn away by eolian action.

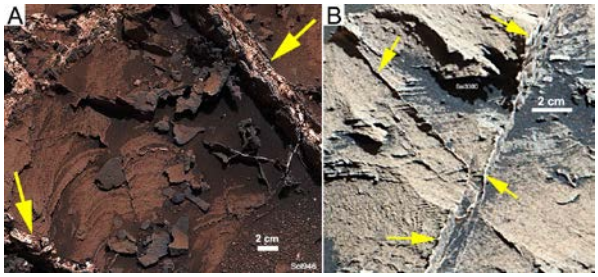

Figure 3: (A) Resistant veins (yellow arrows) at Pahrump (Garden City) surround a depression of soft mudstone. (B) A comparable outcrop in the clay-sulfate transition (Sol3300; -3991m).

The fourth example (Fig. 4) shows that cm-scale concretions occur in both locales in addition to mm-scale resistant particles (presumed evaporite pseudomorphs)

in resistant/cemented laminae. This attests to partial redistribution of evaporite salts later in diagenesis.

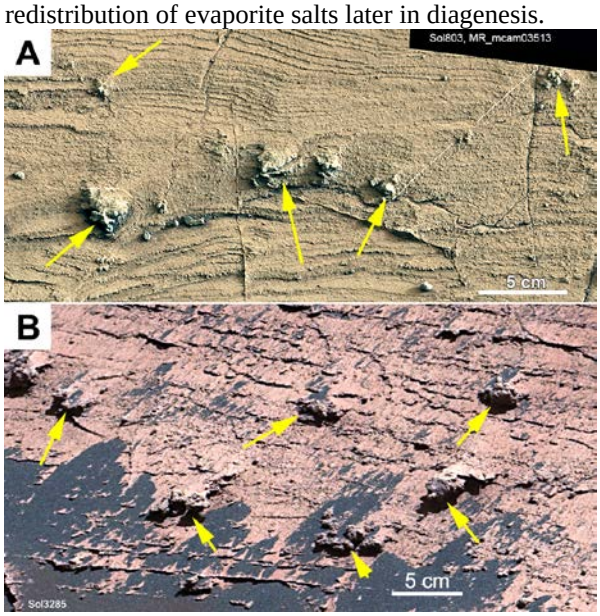

Figure 4: cm-scale concretions (yellow arrows) in laminated evaporitic mudstones at Pahrump (A) and at the Sol 3285 (-3992m) location (B).

The fifth example (Fig. 5) is a comparison of MAHLI images of presumed evaporite pseudomorphs at Pahrump with potential equivalents in the clay-sulfate transition.

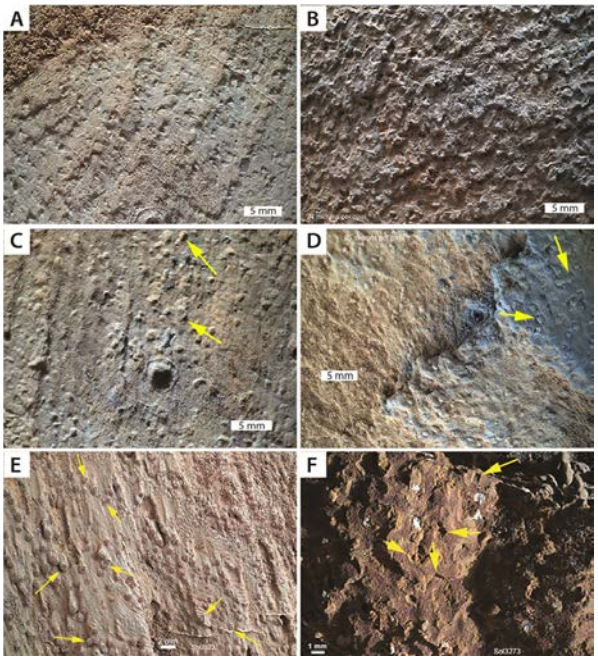

Figure 5: (A, B, C, D) show expression of x-tal pseudomorphs at various locations in the Pahrump section. (A, B) are dominated by angular shapes, (C, D) are dominated by rounded shapes, but also show a subset of angular shapes (yellow arrows). (E, F) are from the clay-sulfate transition and are in many respects similar to (C, D). They are dominated by rounded shapes but contain a subset of angular shapes.

Common Elements: The laminated mudstones of the clay-sulfate transition show lamina style and associated diagenetic features comparable to those observed earlier in the mission at Pahrump Hills. Millimeter-scale resistant shapes, rounded as well as angular, are by analogy considered pseudomorphs after precursor evaporite minerals. The dominance of rounded shapes is interpreted as an indication of physical reworking and partial dissolution of earlier formed evaporite grains [7, 8]. The continued presence of angular shapes suggests that the mm-scale resistant features in the clay-sulfate transition originated as evaporite minerals.

Conclusion: The laminated mudstones observed in the clay-sulfate transition occur stratigraphically below what currently is considered (or hoped for) an interval of bedded sulfates in the Mt. Sharp sedimentary succession [2, 10]. The similarity of these rocks to evaporitic mudstone facies that was first observed at Pahrump Hills [3, 4, 5] suggests the possibility that the Gale Crater lacustrine system has in essence operated within the same parameters throughout the time interval that has been explored by the rover as it ascended Mt. Sharp. Fig. 6 shows a schematic arrangement of the various facies encountered by the rover as contemporaneous lateral equivalents, with the bedded sulfates as a distal end member that is still to be explored.

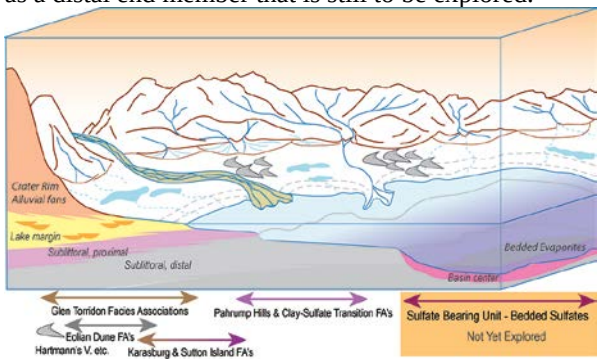

Figure 6: Schematic model of lacustrine facies in Gale crater.

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