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# Mechanical Aqueous Alteration Dominates Textures of Gale Crater Rocks: Mars Hand Lens Imager (MAHLI) Results

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The Mars Hand Lens Imager (MAHLI) acquired sub-mm/pixel scale color images of over 70 individual rocks and outcrops during Curiosity's first year on Mars, permitting the study of textures down to the distinction between silt and very fine sand. We group imaged rock textures into classes based on their grain size, sorting, matrix characteristics, and abundance of pores. Because the recent campaign at Pahrump Hills acquired many more MAHLI images than elsewhere along the rover traverse [6], textural analysis there is more detailed and thus types observed there are sub-divided.

Mudstones: These rocks contain framework grains smaller than the highest resolution MAHLI images (16 $\mu$m/pixel), and thus are interpreted to consist of grains that are silt-sized or smaller. Some rocks contain nodules, sulfate veins, and Mg-enriched erosionally-resistant ridges. The Pahrump Hills region contains mudstones of at least four different sub-textures: recessive massive, recessive parallel-laminated, resistant laminated-to-massive, and resistant cross-stratified. Recessive mudstones are slope-forming; parallel-laminated recessive mudstones display mm-scale parallel (and in some cases rhythmic) lamination that extends laterally for many meters, and are interbedded with recessive massive mudstones. Coarse cm- to mm-scale laminae appear within resistant mudstones though some portions are more massive; laminae tend to be traceable for cm to meters.

Well-sorted sandstones: Rocks in this class are made of gray, fine-to-medium sand and exhibit little to no porosity. Two examples of this class show fine lineations with sub-mm spacing. Aillik, a target in the Shaler outcrop, shows abundant cross-lamination. The Pahrump Hills region contains a sub-texture of well-sorted, very fine to fine-grained cross-stratified sandstone at the dune and ripple-scale.
Poorly-sorted sandstones. This class is subdivided into two sub-classes: rounded, coarse-to-very coarse sand grains of variable colors and lusters, set in gray, fine sand; and dark gray, well-cemented, and fine grained, with rare pebble-sized clasts. The latter also exhibits pores or vugs that may have resulted from removal of these larger coasts.

Pebbly sandstones: This texture is characterized by a poorly-cemented, poorly sorted matrix of coarse sand to granules with a variety of colors and lusters. Whereas two endmembers in this class (Bardin Bluffs and Altar Mountain) have a similar fine-grained matrix, they exhibit different populations and proportions of granules to cm-sized pebbles. Bardin Bluffs displays a fining upwards texture and grain-to-grain contact; the stratigraphically lower Altar Mountain does not.

Massive and Vuggy rocks: These two classes are gray and fine-grained. Many of these rocks occur in a sedimentary context, suggesting that differences in grain characteristics and relationships stem from variations in cementation and/or weathering history.

In general, most rock textures indicate fluvial or possibly lacustrine sediments; MAHLI has not unambiguously identified eolian or igneous rock textures, although some pebble-sized clasts may have an igneous provenance and some might derive from impact melt.