Mineralogical Analysis of drilled Mudstone At Yellowknife Bay, Gale Crater, Mars

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The Sheepbed mudstone, the lowermost observed member of the Yellowknife Bay formation at Gale Crater, is interpreted to be a lacustrine deposit at the distal end of an alluvial fan [1]. Two samples of this unit, John Klein and Cumberland, were drilled and subsequently analyzed by the CheMin XRD/XRF instrument.

The <150 μm fraction of drill fines analyzed by CheMin is typical of the mudstone matrix, with some incorporation of white veined material seen in the walls of the drill hole. The mudstone contains detrital basaltic minerals, calcium sulfate, iron oxide and sulfide, amorphous material and a trioctahedral smectite clay [2]. The basaltic minerals are broadly similar to those sampled in a nearby eolian deposit called Rocknest [3,4], with notably less Fe-forsterite and more magnetite. A detailed analysis of the 001 and 02ℓ diffraction band suggests that the phyllosilicate is a trioctahedral Fe-saponite rather than a dioctahedral phyllosilicate like montmorillonite or nontronite. Relative to eolian material as seen at Rocknest, the presence of ~20% smectite and excess magnetite with the near absence of Fe-forsterite suggests that saponitization (a reaction akin to serpentinization) occurred. On the basis of its mineralogy, the Sheepbed unit is hypothesized to have been a shallow lake deposit with circumneutral pH and low ionic strength, with evidence of mineral reactions that occurred *in situ* and could have supported chemosynthetic life.

[1] Grotzinger, J.P. *et al* (2013) *Science*, 10.1126/science.1242777. [2] Vaniman, D.T. *et al* (2013) *Science*, 10.1126/science.1243480. [3] Bish, D.L. *et al* (2013) *Science,* 10.1126/science.1238932. [4] Blake, D.F. *et al* (2013) *Science*, 10.1126/science.1239505.