CONTROL ID: 1814660

TITLE: Evidence for Smectite Clays from MSL SAM Analyses of Mudstone at Yellowknife Bay, Gale Crater, Mars

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ABSTRACT BODY: Drilled samples of mudstone from the Sheepbed unit at Yellowknife Bay were analyzed by MSL instruments including the Sample Analysis at Mars (SAM) and Chemistry and Mineralogy (CheMin) instruments in MSL's Analytical Laboratory. CheMin analyses revealed the first in situ X-ray diffraction based evidence of clay minerals on Mars, which are likely trioctahedral smectites (e.g., saponite) and comprise ~20% of the mudstone sample (e.g., Bristow et al., this meeting). SAM analyses, which heated the mudstone samples to 1000oC and monitored volatiles evolved to perform in situ evolved gas analysis mass spectrometry (EGA-MS), resulted in a H2O trace exhibiting a wide evolution at temperatures <500oC, and an evolution peak at higher temperatures near ~750oC. The low temperature H2O evolution has many potential contributors, including adsorbed H2O, smectite interlayer H2O, and structural H2O/OH from bassanite and akaganeite (identified by CheMin) and H2O/OH from amorphous phases in the sample. The high temperature H2O is consistent with the evolution of H2O from the dehydroxylation of the smectite clay mineral. Comparison to EGA-MS data collected under SAM-like conditions on a variety of clay mineral reference materials indicate that a trioctahedral smectite, such as saponite, is most consistent with the high temperature H2O evolution observed. There may also be SAM EGA-MS evidence for a small high temperature H2O evolution from scoop samples from the Yellowknife Bay Rocknest sand shadow bedform. As in the mudstone samples, this evolution may indicate the detection of smectite clays, and the idea that minor clays may be present in Rocknest materials that could be expected to be at least partially derived from local sources is reasonable. But, because smectite clays were not definitively observed in CheMin analyses of Rocknest materials, they must be present at much lower abundances than the ~20% observed in the mudstone samples. This potential detection underscores the complementary nature of the MSL CheMin and SAM instruments for investigations of martian sample mineralogy.
Information on the nature of Yellowknife Bay clay minerals may also be available from the detection of H2 evolved during SAM EGA-MS at high temperature. A likely source of at least some of this H2 is H2O evolved from the smectite clays at high temperature, and it is possible these evolutions can be used in a similar fashion to high temperature H2O releases to provide constraints on the clay minerals in a sample. In addition, the D/H of this high temperature H2, as well as the H2O, can be derived from SAM MS and Tunable Laser Spectrometer (TLS) data, respectively. These D/H values may help to inform the provenance of high and low temperature

water evolved from martian samples (Mahaffy et al., this meeting).

KEYWORDS: 1060 GEOCHEMISTRY Planetary geochemistry, 5470 PLANETARY SCIENCES: SOLID SURFACE PLANETS Surface materials and properties, 6225 PLANETARY SCIENCES: SOLAR SYSTEM OBJECTS Mars, 5494 PLANETARY SCIENCES: SOLID SURFACE PLANETS Instruments and techniques.

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