Director's Discretionary Fund

"Astrobiology Sample Analysis Program (ASAP)"

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Project Progress:

Scientific ground-truth measurements for near-term Mars missions, such as the 2009 Mars Science Laboratory (MSL) mission, are essential for validating current *in situ* flight instrumentation and for the development of advanced instrumentation technologies for life-detection missions over the next decade. For this reason, the NASA Astrobiology Institute (NAI) funded a one-year pilot study called the Astrobiology Sample Analysis Program (ASAP).

Under ASAP, a consortium of researchers (GSFC, ARC, CIW, and JPL) analyzed an identical set of homogenized martian analog materials in a "round-robin" style using both state-of-the-art laboratory techniques and *in-situ* flight instrumentation. The latter included the SAM gas chromatograph mass spectrometer (GCMS) and CheMin X-ray diffraction/X-ray fluorescence (XRD/XRF) instruments on MSL and the Urey amino acid analyzer under development for the 2013 ExoMars missions. The analog samples studied included Atacama Desert soil from Chile, the Murchison meteorite, a gypsum sample from the 2007 AMASE Mars analog site, jarosite from Panoche Valley, CA, a hydrothermal sample from Rio Tinto, Spain, and a "blind" sample collected during the 2007 MSL slow-motion field test in New Mexico. Each sample was distributed to the ASAP team for analysis to: (1) determine the nature and inventory of organic compounds, (2) measure the bulk carbon and nitrogen isotopic composition, (3) investigate elemental abundances, mineralogy and matrix, and (4) search for biological activity. The experimental results obtained from the ASAP Mars analog research consortium will be used to build a framework for understanding the biogeochemistry of martian analogs, help calibrate current spaceflight instrumentation, and enhance the scientific return from upcoming missions.

For the Team, D. Glavin presented a summary of results at the 2008 Astrobiology Science Conference in Santa Clara, CA. An example of data obtained from the Atacama Desert soil sample is shown below. XRD/XRF analysis of surface and subsurface samples by the CheMin instrument showed that the bulk mineralogy of the subsurface sample was distinct, with much higher levels of carbonate and clay than the surface sample (Fig. 1). CheMin analyses on MSL will be critical for identifying similar minerals on Mars that may preserve organic compounds. The SAM pyrolysis mass spectrometer instrument will also provide evolved gas data to help constrain the bulk chemistry and organic composition of the sample. Analysis of the Atacama sample by SAM showed that the subsurface sample contained water and simple hydrocarbons (Fig. 2). In addition, the CO_2 peak at 700-800°C is consistent with the presence of calcite, and was confirmed by CheMin. The analysis of a variety of Mars analogue samples by CheMin and SAM will be important for building a library of mineralogy and chemical data that can be used for the interpretation of results obtained by MSL.

FIGURE 1

FIGURE 2