MSL LANDING SITE SELECTION BASED ON ORGANIC COMPOUND ANALYSES OF TERRESTRIAL MINERAL ANALOGUES

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Introduction: One of the goals of the 2009 Mars Science Lander (MSL) mission is to detect organic biomolecules *via* a highly sensitive state of the art GC-MS, similar to that included on the Viking mission. The selection of a landing site in an appropriate mineralogical setting is equally as important as initial instrument selection. We observe marked differences in the concentrations of organics in hematite and sulfate mineral samples which may indicate the relative levels of organics in similar geological settings on Mars.

Analogue Studies: Concentrations of organics in mineral samples depend on a number of factors. Certain minerals trap organic molecules while others do not. The preservation of these included organics depends on diagenesis, a function of time, temperature, and matrix. Terrestrial analogue studies can approximate the inclusion and preservation of organics in minerals. The examination of terrestrial samples with mineralogies similar to Mars offers a powerful method of inferring the concentrations and locations of organics which may be detected on Mars.

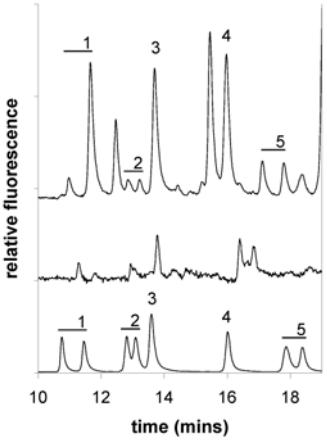
The investigation of Mars analogue minerals reveals distinct differences in the organic contents of certain classes, namely in calcium sulfate minerals versus hematites. We have thoroughly analyzed five calcium sulfates [1], jarosite, and nine hematite samples in order to determine their concentrations of organic molecules. Our analyses include x-ray diffraction, amino acid, nucleobase, total organic carbon, and total organic nitrogen measurements. These protocols are sufficient to determine and characterize each field sample.

Calcium sulfate minerals show abundant amino acids, even in the oldest gypsum samples analyzed. The hematite samples, including four concretions analyzed from Utah [2] and two from Sunset Cliffs, CA, show very low organic matter and traces of amino acids around blank levels (table 1, figure 1).

Table 1. Amino acid concentrations in field samples.

Location	*Mineralogy*	*Amino Acids*
Panoche, CA	Gypsum	~246 ppb
Borrego, CA	Gypsum	~302 ppb
Utah Cliffs	Concretions	Trace
Sunset Cliffs	Concretions	Trace

Figure 1. Chromatograms of amino acid abundances in Anza-Borrego Gypsum (top trace) and a Utah hematite concretion (middle) stacked against a standard. The blank levels were identical to the hematite concretion trace. The labels are as follows: 1=D/L-aspartic acid, 2=D/L-serine, 3=D+L-glutamic acid, 4=glycine, 5=D/L-alanine.



Conclusion: Results from Mars analogue sulfate and hematite analyses clearly show that the sulfate minerals investigated include organics at the mid ppb levels while the hematite samples include them at sub-ppb levels. In order to give the highly-sensitive organic detector on the 2009 MSL mission the best probability of finding organics on the surface of Mars from extinct or extant life, we must use data from terrestrial analogs. Sulfate-rich areas, especially 1-2 meters below the surface shielded from ionizing radiation [4], have a greater probability for the detection of intact biomolecules than hematite areas. Studies on Mars mineral analogues are currently being performed on iron and magnesium sulfate minerals along with continued investigation of calcium sulfate minerals and hematites.

References:

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