

NAI Teams Annual Project Report
2008 Annual Report
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Mars Forward Contamination Studies Utilizing a Mars Environmental Simulation Chamber

An award from the 2007 Director's Discretionary Fund was provided to evaluate forward contamination of terrestrial organisms and molecules into "special regions" on Mars with potential for extant or extinct Martian biota. A variety of microorganisms were selected for Mars environmental simulation on the basis of desiccation resistance and psychrotolerance. The selected microorganisms will be exposed to simulated Martian surface conditions with representative and accurately known temperatures and partial pressure of water. Additionally, these experiments will help to evaluate the influence of long term storage on alteration of organic and inorganic constituents during sample caching on the Martian surface. These results will provide fundamental science for proposed sample caching prior to anticipated Mars Sample Return missions. Lastly, the experiment includes study of methane production from cultured terrestrial permafrost methanogens to determine survival potential at Martian temperatures and atmospheric composition.

In the past twelve months, 24 microbial species, including three nematode species and two species of fungi have been selected for viability at low temperature and resistance to desiccation. These organisms have also been tested for toxicity and survivability when inoculated within our Mars analog regolith simulant (MARS-2) which was developed at Indiana University specifically for use in this culturing study. The regolith is representative of measured elemental compositions for fine grained, weathered Martian basalts and andesitic basalts. Ferric oxides, magnesium sulfates, phyllosilicates, ferric sulfates and clinoptilolite are added to the powdered rock constituents in proportions relevant to surface materials analyzed by the Mars Exploration Rovers. Hardware development for the project has included vacuum canisters for methanogen studies that can tolerate the extreme (100°C) temperature variations within the simulation chamber. These canisters will utilize a Cavity Ring Down Spectrometer to measure methane at simulated Mars temperature and atmospheric conditions. We have tested and purchased a highly sensitive chilled mirror hygrometer that will allow measurements of dewpoints at temperatures below -100°C and water vapor concentrations down to parts-per-billion volume levels within the simulation chamber. The dessication-resistant strains of the following organisms have been selected for the Mars simulation experiment: *C. elegans* (a psychrotolerant nematode species) *Wangiella dermatitidis* (a melanin producing fungus), *Halorubrum chaoviatoris* (a halophilic Archaeon), *Methanobacterium bryantii* strain M2 (a methanogen isolated from Siberian permafrost), and six psychrotolerant bacterial strains. Naked deoxyribonucleic acid (DNA) and mixtures of common amino acids will also be added to Indiana Mars regolith and reacted in a Mars environmental chamber at the Techshot engineering company during October and November of 2008.

Keywords

Mars Environmental Chamber, Forward Contamination, Psychrotolerant, methanogens, microorganisms