Abstract

Geochemical Analysis on Mars

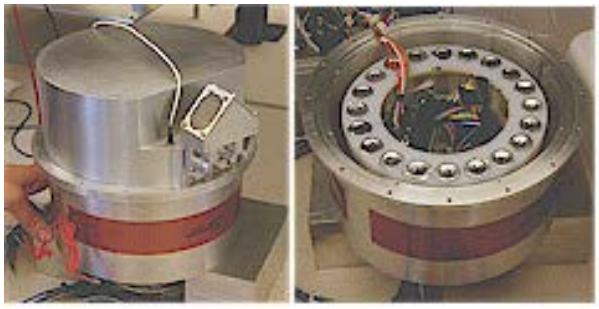
S. P. KOUNAVES[1] AND M. H. HECHT[2]

[1] Department of Chemistry, Tufts University, Medford, MA USA (samuel.kounaves@tufts.edu)

[2] Jet Propulsion Laboratory, 4800 Oak Grove Drive, Pasadena, CA USA (michael.h.hecht@jpl.nasa.gov)

A rigorous chemical analysis of the surface and subsurface material in a remote hostile environment such as Mars presents a truly daunting and unique challenge. To undertake such a mission, with the slightest hope of obtaining meaningful analytical data, requires instrumentation that can withstand rigors far beyond those encountered on Earth. In addition to mass, volume, and power constraints, the device must withstand temperature fluctuations that may range from -120 to 60^{o}C, and anticipate any unexpected chemistry such an environment might present. We report here the initial development and evaluation of a prototype *Robotic Chemical Analysis Laboratory* (RCAL) equipped with an array of electrochemical sensors for measuring in-situ a variety of ionic species and parameters in the Martian regolith.

The RCAL instrument, shown below, is based on the *Mars Environmental Compatibility Assessment* (MECA) wet chemistry lab (WCL), a payload developed and flight qualified for the now-cancelled Mars'01 Lander. Similar to the MECA, RCAL will contain an array of sensors which will allow for determination of a wide variety of inorganic ions and electrochemical parameters, including, Ag^{2+}, Br^{-}, Ca^{2+}, Cd^{2+}, Cl^{-}, ClO_4^{-}, Cu^{2+}, HCO_3^{-}, Hg^{2+}, I^{-}, K^{+}, Li^{+}, Mg^{2+}, Na^{+}, NH_4^{+}, NO_3^{-}, SO_4^{2-}, Pb^{2+}, pH, oxidants, reductants, redox potential, conductivity, dissolved O_2 and CO_2 .



The RCAL expands on the MECA concept by providing twenty individual sealed sample chambers mounted on a rotating carousel. The soil, after delivery by an external mechanism such as a robotic arm or sub-surface drill, is loaded into a dual soil hopper. Multiple small samples can then be taken from the hopper and delivered to the test chambers. After the chamber is punctured, one of a set of four electrodes mounted over the carousel can be inserted into the selected chamber.

The RCAL will enable bench-top wet chemistry analyses of the Martian regolith, assessing its interaction with water, and ultimately providing unique scientific information about the geochemical history of Mars.