THE MARS ENVIRONMENTAL COMPATIBILITY ASSESSMENT (MECA) WET CHEMISTRY EXPERIMENT ON THE MARS 2001 LANDER. S. M. Grannan[1], T. P. Meloy[2], H. Hecht[1], M. S. Anderson[1], M. Buehler[1], M. Frant[3], S. P. Kounaves[4], K. S. Manatt[1], W. T. Pike[1], W. Schubert[1], S. West[3], and X. Wen[3]. *[1]NASA Jet Propulsion Laboratory, Pasadena, CA, 91109; [2]West Virginia University, Morgantown, WV, 26505; [3]Orion Research, Inc., Beverly, MA, 01915; [4]Tufts University, Medford, MA, 02155.*

Introduction: The Mars Environmental Compatibility Assessment (MECA) is an instrument suite that will fly on the Mars Surveyor 2001 Lander Spacecraft. MECA is sponsored by the Human Exploration and Development of Space (HEDS) program and will evaluate potential hazards that the dust and soil of Mars might present to astronauts and their equipment on a future human mission to Mars. Four elements constitute the integrated MECA payload: a microscopy station, patch plates, an electrometer, and the wet chemistry experiment (WCE). The WCE is the first application of electrochemical sensors to study soil chemistry on another planetary body, in addition to being the first measurement of soil/water solution properties on Mars. The chemical composition and properties of the water-soluble materials present in the Martian soil are of considerable interest to the planetary science community because characteristic salts are formed by the water-based weathering of rocks, the action of volcanic gases, and biological activity. Thus the characterization of water-soluble soil materials on Mars can provide information on the geochemical history of the planet surface.

Wet Chemistry Cell Description: The WCE consists of four identical cells, each of which will evaluate a 1 cc sample of Martian soil added to 30 cc of water. A single wet chemistry cell has a mass of 600 g and consumes ~1-2 W average power during operation, with a peak power requirement of 15 W. All four cells are equipped with a mixing paddle for solution stirring, and a reagent dispenser which will be used for in situ calibration of the chemical sensors. Each cell has 26 sensors arrayed around the perimeter which will measure solution conductivity, pH, redox potential, dissolved CO2 and O2 levels, and concentrations of many soluble ions including trace metals, sodium, potassium, and the halides. In addition, cyclic voltammetry will be used to evaluate reversible and irreversible oxidants present in the water/soil solution.

Ion Selective Electrodes: The primary analytical tool of the wet chemistry experiment is the ion-selective electrode (ISE). ISEs are widely used on Earth for water quality monitoring, environmental contamination studies, and process water monitoring. ISEs possess some very desirable characteristics as an analytical tool because they are compact, rugged, and intrinsically simpler than other techniques used for solution analysis. ISEs are capable of surviving harsh chemical and physical environments, and are not subject to radiation damage. They require only a simple voltage readout system. In addition, samples differing by many orders of magnitude in ion concentration can be measured using the same sensors and readout electronics. Measurements are independent of sample volume, and analyses can be run on samples as small as a few milliliters. ISE responses are not affected by sample color, turbidity, suspended matter, or viscosity.

Experiment Goals: The primary goals of the MECA wet chemistry experiment are to assess a soil/water solution for (1) presence of halides; (2) acidic, neutral, or alkaline pH; (3) oxidizing or reducing character; (4) presence of heavy metal contaminants including Cu, Cd, and Pb; and (5) solution parameters (e.g. temperature, ion concentrations). These experiments will provide information on the corrosivity and reactivity of the Martian soil, as well as on soluble components of the soil which might be toxic to human explorers. The results of this experiment will also guide HEDS scientists in the development of high fidelity Martian soil simulants. Complementary to the Viking experiments, the WCL experiments will characterize the water/soil solution rather than emitted gases. Nonetheless, through analysis of the redox potential, dissolved oxygen levels, and cyclic voltammetric signatures, the WCL may be able to provide information related to oxidants present in the soil at depths to ~50 cm.

Additional Information: If you have questions or would like additional information regarding the MECA wet chemistry experiment, contact Dr. Sabrina Grannan at sgrannan@jpl.nasa.gov, phone (818) 354-1744.