Electromagnetic Sounding sensor development for the geophysical investigation and exploration of planetary subsurface structure

H.A. Fuqua[1,2], G.T. Delory[1], I. de Pater[2], R.E. Grimm[3]

[1]*Space Sciences Laboratory, University of California, Berkeley, CA 94720*
[2]*Department of Earth & Planetary Science, University of California, Berkeley, CA 94720*
[3]*Department of Space Studies, SWRI, 1050 Walnut St. #300, Boulder, CO 80302*
Contact: heidi.fuqua@ssl.berkeley.edu

Abstract. Plasma waves interact with the Moon inducing electric and magnetic fields according to Faraday's law of induction in response to the frequency, apparent resistivity, and skin depth of the materials involved. Measurements of induced fields are inverted according to the branch of Electromagnetic (EM) Sounding known as Magnetotellurics.[1] EM Sounding is a powerful geophysical investigation technique capable of constraining planetary subsurface structure, including core size, mantle and crust temperature profiles, and the distribution of electrical conductivity at depth.[2] The lunar surface, exposed directly to the sun's radiation and space environment, imposes challenging operational constraints for an electric field sensor due to the surrounding photoelectron sheath and variable plasma conditions. While direct measurements of the electric field have never been taken on the surface of the Moon using the double probe technique, this project seeks to improve the capability of EM Sounding on airless bodies through the development of a surface electric field sensor. This project, in its initial stages, builds upon heritage UC Berkeley Space Sciences Lab electric field technology from spinning spacecraft platforms operating in a similar environment. This poster will detail the development plan for this instrument from component level to a fully functional instrument assembly highlighting operational requirements, required testing, anticipated results and challenges to overcome. A portion of the instrument design, the deployment mortar shown in Figure 2, is available and was developed previously for Martian applications.

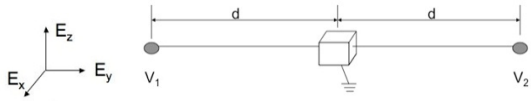

Figure 1. A double probe electric field sensor deployed on a planetary surface.

Figure 2. A prototype of a deployment mortar, developed at SSL, which can be used as a component of the lunar surface EFI developed by this project. (Image courtesy of G. Delory).

[1] Vozoff, K. In *EM Method in App. Geophy.*, ed. M.S. Nabighian, 641-711. Tulsa: Soc. Explor. Geophys (1991).
[2] Grimm, R. E., and G. T. Delory. *Advances in Space Research* (2011).