Constraining the Lunar Interior through Electromagnetic Induction measured with ARTEMIS and Apollo Seismic Normal Modes

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Abstract. Geophysical investigations of the Moon are central to our understanding of planetary formation, differentiation, and evolutionary processes (Jaumann et al., 2012). The lunar interior remains a key area of investigation highlighted as a top priority for NASA within the next decade (NRC, 2011). This project seeks to address the nature and global extent, including lateral and vertical compositional variances, of the crust, mantle, and core regions of the lunar interior through electromagnetic and seismic methods.

Electromagnetic (EM) Sounding is performed through isolating induced magnetic fields from the lunar interior, measured with NASA's twin ARTEMIS (*Acceleration, Reconnection, Turbulence, and Electrodynamics of the Moon's Interaction with the Sun*) satellites currently in orbit around the Moon. The ARTEMIS mission architecture and instrumentation suite uniquely enables an EM sounding survey capable of distinguishing lateral as well as vertical compositional constraints. In this project, we display preliminary results from a time domain EM sounding analysis performed with nightside low altitude periselenes measurements. The corresponding Solar Wind driving field is measured by the second satellite well outside of any lunar effects. Our forward model, developed with COMSOL, is presented and displays good coorellation with the observations. Plasma effects are currently being studied with the assistance of hybrid plasma models allowing isolation of the induced fields. Data collection, model development, and analysis will continue through the end of the mission.

A release of seismic energy resonates at the frequencies of the Moon's normal modes that are sensitive to global interior structure. There are several challenges to identifying these free oscillations due to the limit of large magnitude events and poor instrument sensitivity of the Apollo era technology. Free oscillations are able to constrain the deep lunar interior more definitively than any other geophysical analysis method. This proposal seeks to answer the fundamental question regarding the existence of a lunar core through forward modeling of lunar free oscillations. This project will address the previous lunar Normal Mode analysis performed (Khan & Mosegaard, 2001) and subsequent critiques (Gagnepain-Beyneix et al., 2006; Lognonné, 2005).

References:

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