GRAIL Refinements to Lunar Seismic Structure

Renee C. Weber[1]

1. NASA MSFC, Huntsville, AL, United States.

Gravity field measurements are perhaps the most numerous of the indirect observations relevant to the Moon's internal structure. Multiple recent missions have mapped the global lunar gravity field, each one improving upon the resolution of the last. The details of the Moon's deepest structure, including the parameters that define the lunar core, however, were still largely unaddressed by pre-GRAIL gravity measurements, which were not high enough resolution to resolve the tidal coefficients at a sufficient degree of accuracy. Current constraints on core size and state arise from other indirect measurements, including lunar laser ranging, magnetic induction studies, and analyses of elemental abundances in depth-derived mare basalts. These inferences vary widely, but when considered together with structure models derived from the seismic data gathered during the Apollo missions, a schematic of the lunar interior containing a partially molten deepest mantle layer overlying molten outer and solid inner core layers was obtained.

Seismology provides the most direct constraints on the variables that govern the dynamic properties of the body. However, the GRAIL mission's high-resolution measurements of the lunar gravity field are being used to constrain the interior structure of the Moon using a "crust to core" approach. GRAIL's constraints on crustal thickness, mantle structure, core radius and stratification, and core state (solid vs. molten) therefore complement seismic investigations. This work focuses on expanding our knowledge of the Moon's internal structure using joint gravity and seismic analyses, which will improve constraints on the deep lunar mantle and core.