Composition of the Martian Crust and Geophysical Constraints from the InSIGHT Mars Lander

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The composition of the Martian crust is very important for understanding the chemical evolution of Mars, but is poorly constrained. Most models call for ≥50% of the planet's radiogenic heat production to be concentrated in the early crust (>3-3.5 Gyr), which has profound implications for the thermal and geodynamic history of Mars. Models range from incompatible (including heat producing element, HPE)-depleted (e.g., early models based on shergottites) to highly incompatible element-enriched (e.g., based on analogies with terrestrial continental crust). One model uses Odyssey gamma ray (GRS) elemental mapping combined with regolith analyses by various Mars rovers to arrive at a moderately incompatible element-enriched composition. All of these compositional models are based on near-surface analyses and make a major (but untested) assumption that the composition persists throughout the ~45-65 km thick Martian crust. GRS interrogates only to a few 10s of cm depth and regolith only samples to approximately the average depth of impact excavation. On the other hand, curent understanding of igneous petrogenesis allows for significant amounts of crustal underplating and/or resurfacing and so there may be reasons to believe that the crust is, in fact, compositionally layered.

The InSight Mars Lander has the potential to place major constraints on our understanding of the composition and compostional structure of the Martian crust by measuring heat flow at the landing site and constraining crustal structure and density. At the time of writing, InSight has fully deployed the seismometer experiment (SEIS) and is in the process of deploying the heat flow probe (HP^3). In this presentation, we will examine the available approaches to determining Martian crustal composition and report on early InSight seismological and heat flow results relevant to this problem.