GEOPHYSICAL INVESTIGATION OF THE INSIGHT LANDING SITE. L. Ojha[1], S. Smrekar[2], and D. Nunes[2], [1](luju@gatech.edu) Georgia Institute of Technology. [2]Jet Propulsion Laboratory CalTech Pasadena, CA.

Introduction: InSight (Interior Exploration using Seismic Investigations, Geodesy and Heat Transport) will conduct an investigation of Mars' interior by placing a single geophysical lander on its surface. The principle science goal of InSight is to understand the formation and evolution of terrestrial planets through investigation of the interior structure and processes of Mars. InSight will achieve its goal through three suites of instruments: (1) single-station seismometer (SEIS) that will record Mars' internal activity, (2) heat flow probe (HP^3), that will dig more than 5 m into the Mars' surface and record Mars' internal heat, and (3) a radio tracking device (RISE) that will track Mars' reflexes due to gravitational perturbation.

Planetary heat flow measurement provides a constraint on radiogenic content and thermal evolution of a planet. Current constraints come from estimated elastic and thermal lithospheric thicknesses based on models of the loading of the lithosphere, which suggest both that there was a change in the heat flow during the early evolution of planet [1], and that the concentration of radiogenic elements may be lower than expected [2]. The InSight mission to Mars will provide the first direct measurement of heat flow. The measurement will be made in the Elysium Planitia area (4°N, 135°E), not far from the youngest sites of volcanism (Fig 1). A key

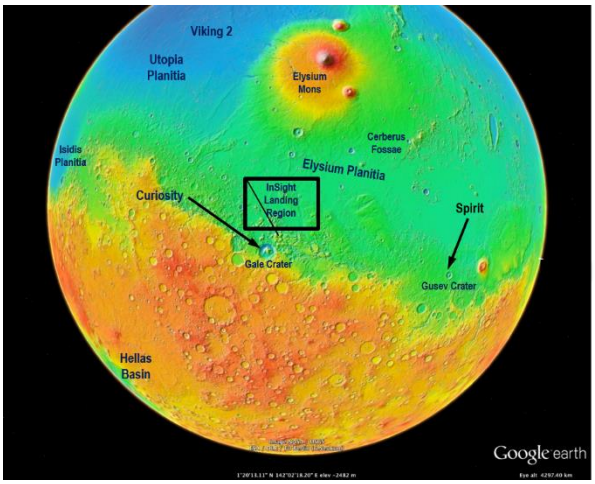

Fig 1. InSight landing overlaid on MOLA topography mosaic of Mars.

aspect of interpreting heat flow in a given area is estimating the local crustal thickness and density, and thus the associated radiogenic content. In this work we sought to conduct a local fit to the crustal thickness using admittance modeling, as well as examine the possible origin of gravity anomalies in Elysium Planitia. Since local variations in density can affect the heat flow to a given region, we sought to refine the estimate of heat flow at Elysium Planitia as a function of crustal thickness and structure.

Data and Methods: Free-air gravity and topography data were derived from the spherical harmonic models carried out to degree and order 110 and 180 respectively. Bouguer gravity anomaly was calculated from the free-air gravity data by removing the component due to the topography (Fig 2), assuming a crustal density of 2900 kg/m^3.

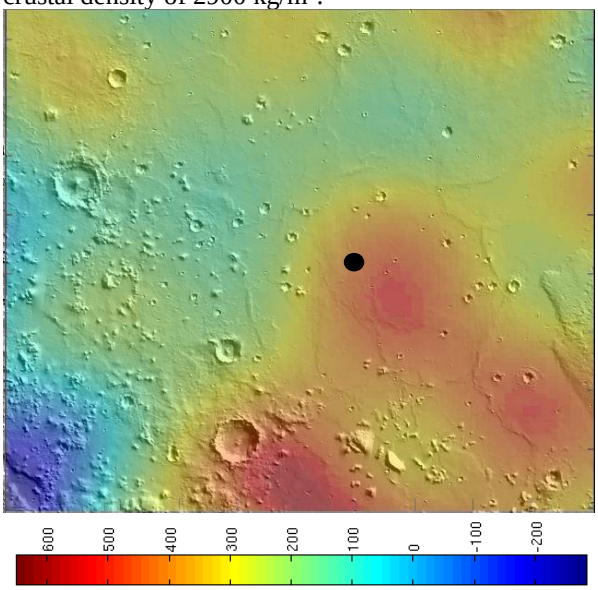

Fig 2. Bouguer anomaly observed around InSight landing site (represented by black dot). Background topography is MOLA shaded relief. The width of the figure is 10° in longitude.

Admittance examines the ratio between gravity (free-air for our analysis) and topography in the spectral domain, and is sensitive to the elastic thickness of the lithosphere and crustal thickness. We calculated observed admittance of the landing site using routines from SHTOOLS (M. A. Wieczorek http://shtools.ipgp.fr) at fixed window widths specified by harmonic degree L_{win} = 15. To seek a localized fit to the observed admittance we modeled predicted admittance by varying different elastic parameters and crustal and lithospheric properties. The modeled admittance enables us to put constraints on crustal and lithospheric thickness and density; the elastic thickness of the lithosphere, bottom to top loading ratios and their respective densities; reference depth to the bottom load; and the mantle density.

Results: A high bouguer anomaly of ~400 mgal is observed around InSight landing site (Fig 2). The region of high bouguer anomaly is south of Elysium Mons and in some regions overlaps with the western most extent of Medusa Fossae Formation. Observed and

modeled admittance from Elysium Planitia is shown in fig 3.

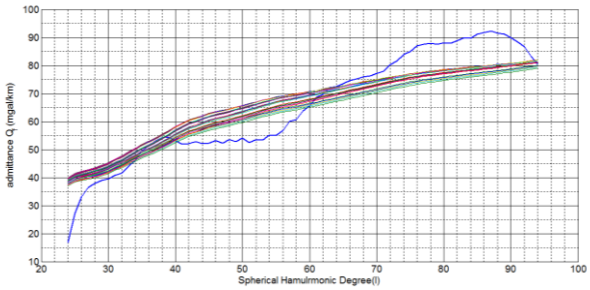

Fig 3. Observed (solid blue) and best fit modeled admittance as a function of spherical harmonic degree (l).

We also quantified the misfit between the observed and predicted admittance as a function of elastic thickness (Te) and bottom to top loading ratio (fbt) for a variety of crustal thickness and density values. A representative example of the misfit calculation is shown in Fig 4.

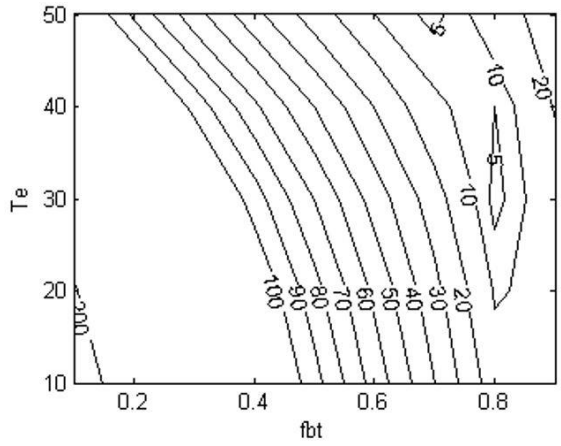

Fig 4. Misfit (r.m.s.) between the observed and predicted admittance as a function of elastic thickness and fbt.

The best-fit parameter observed for Elysium Planitia region is summarized in the table below:

Crustal Density	2900 kg/m3
Top Load Density	2400 kg/m3
Bottom Load Density	3000-4000 kg/m3
FBT	0.80
Crustal Thickness	10-50 km
Elastic Thickness	10-30
Reference Depth	50 km

Discussion and Conclusion: A high (positive) Bouguer anomaly beneath a measurement point indicates higher density material. Additionally, we also observed high bottom to top loading ratio of ~0.80. This along with high Bouguer anomaly implies possible tectonic processes, metamorphism, intrusion of volcanic material, phase change or crustal underplating. We also got small values for the elastic thickness estimate at Elysium Planitia (Table 1) that may indicate that this experienced significant heating recently, perhaps by a rising plume. This result would therefore be consistent with the young volcanism usually ascribed to this region. Additionally, our low value of Te at this region is consistent with Te estimates of Elysium Mons by [3], however when compared to studies by [4] and [5], our values is much lower. A low top loading density is also observed at this location. Based on HiRISE images, isolated layers of friable material (most likely MFF deposit [6]) possibly indicating presence of pyroclastic deposit is observe here, which would also explain the low top loading density. This is further supported by a pronounced chlorine anomaly (which may be due to acid fog related to pyroclastic eruption) observed with GRS data in this region (however we do not report this finding in detail in this abstract and is a topic of present and future research). Additionally, magnetic anomaly is also observed in this region at a range of 30-40 nT and is also a topic of future research.

Future work & Conclusion: We have carried out admittance analysis at Elysium Planitia region and have been able to put local constraints on the properties of the crust and lithosphere. We are also conducting a Cartesian admittance study of this region to understand possible phase difference between the top and bottom load. Preliminary look at GRS data also suggest possible Cl, H2O and Th enrichment at this site and is a subject of future research. Remnant crustal magnetic anomaly observed at this site will also be a topic of future study. The gravity/topography, elemental, and crustal magnetism study of this site together will be able to shed light on the lithospheric/crustal properties of this site, and may play a big role in interpretation of in situ data from InSight mission.

Acknowledgements: LO would like to acknowledge NSF GRFP and JPL SURP program for financial support.

References: [1]Guest & Smrekar, 2007. [2] Phillips, R.J. et al., 2010. [3]McKenzie et al., 2002. [4] McGovern et al., 2002. [5] Belleguic et al., 2005. [6] Carter et al., 2009.