LUNAR MASCON BASINS: ANALYSIS OF EFFECTIVE ELASTIC LITHOSPHERE THICKNESS USING GRAVITY ANOMALY MODELS; *K.K. Williams*[1], *G.A. Neumann*[1] and *M.T. Zuber*[1,2], [1]Department of Earth and Planetary Sciences, Johns Hopkins University, Baltimore, MD 21218, [2]Laboratory for Terrestrial Physics, NASA/Goddard Space Flight Center, Greenbelt, MD 20771.

Analysis of data collected by the Clementine spacecraft now provides more accurate global topographic and gravitational fields than were previously available [1]. These data provide a detailed view of the internal structure of the moon, showing marked redistribution of the crust under lunar mascon basins. Thinning of the crust is an important factor for explaining the large mascon gravity anomalies associated with these basins. The gravity anomaly results from upwarp of a higher-density mantle, infilling by dense mare basalts, and crustal topography. The new Clementine lidar data is used to remove the effects of surface topography. The resulting Bouguer gravity anomaly over a basin is modeled assuming flexural isostasy. Such models constrain the effective elastic thickness of the lithosphere at the time of loading. The results of this study will provide information about the thermal history and mechanical structure of these lunar basins.

The lithospheric thicknesses beneath the mascon basins have been estimated in the past using the geometry of tectonic features associated with the basins, giving the effective elastic thickness as a function of time for several basins [2,3,4]. The current structure of the basin reveals the mechanical structure of the moon due to the combined loads associated with crustal thinning due to the impact process and later stage mare flooding. The Bouguer gravity anomaly over a mascon basin on the moon is modeled by calculating the gravity anomaly due to the density contrasts associated with a load at the crust-mantle interface, a mare load at the surface, and the deflections of the elastic lithosphere caused by these two loads. The lithosphere is assumed to be a thin elastic plate overlying a viscous substrate. The crust and mantle are assumed to have constant densities of 2.8 g/cm^3 and 3.3 g/cm^3, respectively [1].

The topography of the crust-mantle interface is calculated from a crustal thickness data set [1]. Relief on the Moho is represented by a stack of cylinders that are then used to model the load due to the upwarping of the interface. The depth of the crust-mantle boundary is taken to be the mean crustal thickness outside the basin, which on the near side is approximately 60km [1]. The mare load at the lunar surface is modeled using a set of stacked cylinders whose dimensions are the same as those used in previous work [3].

The effect of these loads on the elastic lithosphere is a deflection at the surface of the lithosphere and at the crust-mantle interface. It is assumed that deformation of the lithosphere due to loading occurs purely by bending, such that the deflection at the crust-mantle boundary is the same as that at the surface. The deflections due to the cylindrical loads on a thin elastic spherical shell are calculated by numerically evaluating zero-order Bessel-Kelvin functions and their first derivatives using solutions derived by Brotchie [5] and applied by Comer et al. [6].

The total model gravity anomaly is computed as the sum of four components. Two components result from the deflection of the surface of the lithosphere and of the crust-mantle interface. These deflections produce a gravity low as a result of a mass deficit under the load, relative to undeformed lithosphere. The remaining two components are gravity highs caused by the mass excess of the surface and Moho loads. The gravity anomalies are computed using the method of Parker [7] for 2-dimensional grids representing topographic deflections and distributed loads. The model Bouguer anomaly is then upward continued to a reference height of 15 km above the lunar surface. A profile taken across the center of the anomaly is compared to a best fit profile across the observed Bouguer anomaly. This calculation is repeated for different lithospheric thicknesses. The magnitude of the anomaly as well as the position of the flexural trough are matched, thus constraining the effective elastic thickness beneath the mascon basin.

Initial results are presented here for Mare Humorum. The topography of the Moho as determined from the global crustal thickness map is used to yield relief at the crust-mantle

interface with a thickness of 45 km, corresponding to a crustal thickness of 15 km. This differs from the Moho relief of 27 km previously used in an investigation of the structure of the lunar basins [8]. The mare load has a maximum thickness of 2.7 km and has the same density as the mantle [2,3]. The Bouguer gravity anomaly measured over Mare Humorum has a maximum magnitude of approximately 180 mGal with the gravity low trough occurs at a distance of about 375 km from the center of the gravity peak. By modeling the gravity anomaly as discussed above, the effective elastic thickness for Mare Humorum is approximately 125 km. This value is at the upper limit of the effective elastic thickness calculated by Solomon and Head [3], but they did not consider the effect of the load due to the upwarped Moho. To support the extra load, a thicker lithospheric thickness is necessary.

We are currently in the process of applying this method to other near-side mascon basins. These results will have implications into understanding the mechanical structure and thermal history of the moon.

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