

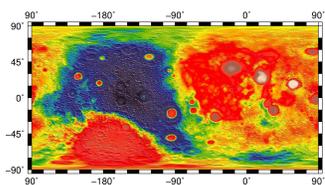
# Are Density Variations in the Lunar Mantle Detectable with GRAIL Gravity Data?

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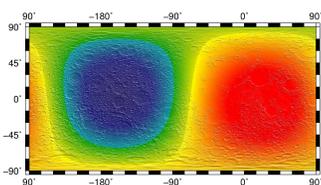
When the lunar topographic contribution is removed from a lunar gravity model it provides a Bouguer disturbance that indicates mass excesses and deficiencies in the crust and possibly the upper mantle. Identifying gravity signals that originate at greater depth is a challenge. We try to determine if some of the larger lunar Bouguer disturbances are below the lunar crust and what affect that might have on the global Bouguer signal. We look at South Pole-Aitken basin and try to see if it can be represented as a density contrast in the upper mantle.

## GRAIL900C GRAIL Lunar Bouguer Gravity Model



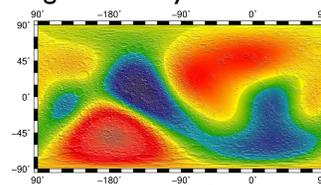
$l = 1-600$

The full Bouguer field is dominated by the degree 1 coefficients in the lunar topography



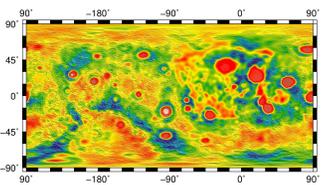
$l = 1$

The degree 1 shows the lunar dichotomy between the near and far sides



$l = 2-4$

At degrees 2 to 4 South-Pole Aitken and the lunar highlands are visible

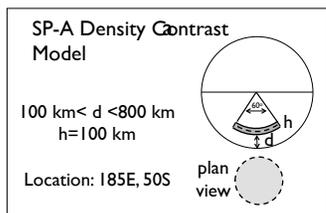


$l = 5-64$

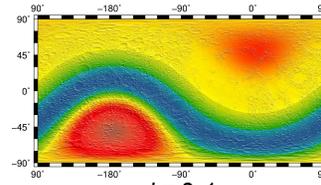
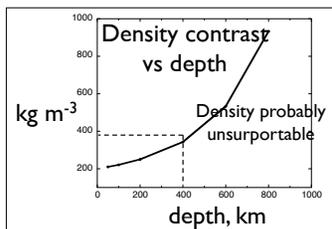
Minimal evidence of SP-A and the highlands in degrees 5 to 64. Mascons and major basins evident

## Model of South Pole-Aitken Basin Bouguer Gravity Anomaly

We have modeled then SP-A Bouguer gravity anomaly as a buried cap within the mantle with a positive density contrast. The depth of the cap was varied between the base of the crust, taken as 100 km to 800 km. The cap model has a full angle of 60 degrees and a 100 km thickness and is located at approximately the center of the SP-A basin. Below we show the results for the shallower depths of 100 and 200 km.

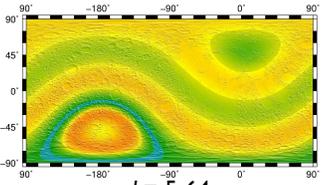


Below 200 km the density required contrast is 220 to 250 kg m<sup>-3</sup>, ~10% of local density



$l = 2-4$

Model shows SP-A and highlands

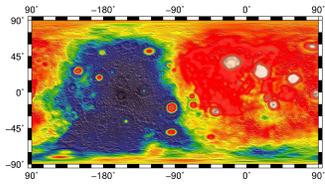


$l = 5-64$

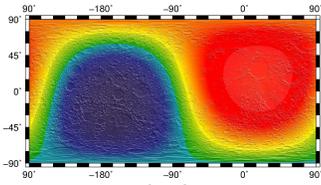
Small residual SP-A anomaly

## We Subtract our SP-A Model with d=200 km from Observed Bouguer Anomalies

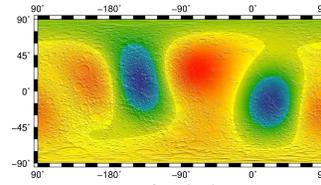
In the full field SP-A has been effectively "removed" and replaced with a large negative anomaly. The degrees 2-4 have been reduced by a factor of 6 and for degrees 5. Above degree 5 both the residual SP-A signal and the highlands have been further reduced.



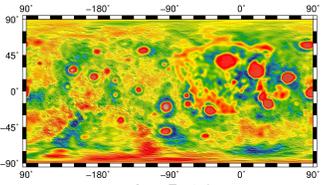
$l = 1-600$



$l = 1$



$l = 2-4$



$l = 5-64$

## The Effect of Modeling SP-A with a Density Contrast has Effectively Removed the Very Large Bouguer Anomaly Associated with SP-A

