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Modeling of Lunar Mantle Features

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The availability of a high-resolution and high-accuracy Bouguer gravity model for the Moon based upon GRAIL free air gravity and LRO topography from the LOLA laser altimeter provides the opportunity to investigate the depth to which Bouguer gravity features penetrate the mantle. Although inverting gravity does not lead to a unique mass distribution or density contrast, the power of the Bouguer field can provide the wavelength dependence of Bouguer features as seen on the surface and thus whether the feature is primarily a near-surface anomaly or more likely a deep-seated mantle anomaly for which the short wavelengths have been attenuated at the surface. We have modeled several hypothetical features in the mantle and derived the gravity signal on the surface that shows how the total power varies with depth and how the power is distributed across the wavelength spectrum. The lunar Bouguer anomaly for the South Pole-Aitken basin, for example, is only observed in the wavelengths less than degree and order 6, while some of the nearside mascons are only detectable in the wavelength band of degree and orders 8 to 32, and farside basins are only evident in wavelengths corresponding to degree and order 32 and higher. We attempt to forward model density contrasts in the mantle that might explain the Bouguer observations and constrain their depth within the mantle as well as plausible origins of the mass anomalies.