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Analysis and Interpretation of Lunar Prospector Gamma Ray Spectroscopy Data

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Gamma ray spectroscopy data acquired by Lunar Prospector were analyzed to determine global elemental maps of the lunar surface for major oxides and trace elements, including MgO, Al_2O_3, SiO_2, CaO, TiO_2, FeO, K, Th, and U. A linear spectral unmixing algorithm similar to those used to analyze spectral reflectance data was developed to deconvolve gamma ray spectra to determine elemental composition. Data acquired during the high altitude (100 km) mapping phase have been analyzed to produce maps with a spatial resolution of roughly 150 km (maps with 5° equal area pixels). Here, we extend the analysis to include low altitude (30 km) mapping data, resulting in improved precision and spatial resolution (roughly 45 km, suitable for the production of maps with 2° equal area pixels). Systematic variations in lunar composition are compared with the lunar soil sample and meteorite collections. Significant results include: improved accuracy for the abundance of Th and K in the highlands; confirmation that SPA does not expose mantle material at the resolution of the measurements; identification of large regions, including western Oceanus Procellarum, that are not well represented by the sample collection; and the association of relatively high concentrations of Mg with KREEP-rich regions on the lunar near side, which has implications for the concept of an early magma ocean.