The materials of the lunar Procellarum KREEP Terrane: A synthesis of data from geomorphological mapping, remote sensing, and sample analyses

Larry A. Haskin, Jeffrey J. Gillis, Randy L. Korotev, and Bradley L. Jolliff
Department of Earth and Planetary Sciences and McDonnell Center for the Space Sciences
Washington University, St. Louis, Missouri

Abstract. Major features of the Moon's Procellarum KREEP Terrane include subdued relief and extensive resurfacing with mare basalt, consistent with high concentrations of Th and other heat-producing elements at depth. We relate the chemistry of sampled materials to the geomorphology, Th surface concentrations determined by the Lunar Prospector (2° pixels), and FeO and TiO_2 concentrations derived from Clementine ultraviolet-visible spectral data. On the basis of geologic maps, each pixel was classified as mare, terra, or mixed. Near the periphery of the terrane, terra pixel compositions are relatively feldspathic; in the interior they mainly represent Imbrium basin rim or ejecta deposits and are mainly incompatible trace element rich norites and presumably represent materials from a thick section (tens of kilometers) of the pre-Imbrium crust of the terrane excavated by the Imbrium event. (Although Imbrium ejecta are the principal source of surface terra materials, the Imbrium event did not create the Th-rich Procellarum KREEP Terrane.) Broad, continuous expanses of mare pixels are observed, with little interruption from protruding terra or terra-penetrating craters. The mare-basalt-dominated regoliths of these areas have a wide range of TiO_2 concentrations (<1 – 15%) and higher Th concentrations (2 to 6+ ppm) than most sampled mare basalts. Traverse profiles show high Th over broad regions of highest FeO (>18%), leading to the conclusion that the high Th concentrations are in the mare basalts and are not present in the regoliths as terra-derived materials. Volcanic glasses and impact glasses of mare basalt composition collected from the Procellarum KREEP Terrane support this conclusion.