^{186}Os systematics of Hawaiian picrites

T.J. IRELAND[1,2,*], R.J. WALKER[2] AND A.D. BRANDON[3]

[1]Origins Lab., Dept. of Geophys. Sci., Univ. of Chicago, Chicago, IL 60637 USA (*email: tireland@uchicago.edu)
[2]Dept. of Geol., Univ. of MD, College Park, MD 20742 USA
[3]Dept. of Earth and Atmos. Sci., Univ. of Houston, Houston, TX 77204 USA

Nineteen Hawaiian picrites (MgO > 13 wt.%) and three related basalts, which have previously been characterized for their highly siderophile element (HSE) concentrations, were analyzed for their ^{186}Os/^{188}Os and ^{187}Os/^{188}Os compositions. Variations in these ratios reflect long-term Pt/Os and Re/Os differences in the mantle source regions of the Hawaiian volcanoes. ^{187}Os/^{188}Os ratios vary from 0.1290534 ± 19 to 0.1361215 ± 16 ($2\sigma_m$), consistent with the range defined by previous studies of Hawaiian basalts. ^{186}Os/^{188}Os ratios vary from 0.1198332 ± 26 to 0.1198480 ± 19 ($2\sigma_m$), with some compositions clearly resolved from current estimates of the ambient upper mantle (0.1198365 ± 55 2σ).

Earlier studies of Hawaiian picrites reported coupled enrichments between ^{186}Os/^{188}Os and ^{187}Os/^{188}Os ratios that defined a well-correlated linear relationship. This trend has been interpreted by several different studies as evidence for the interaction of the Hawaiian mantle source with the outer core, the incorporation of recycled oceanic crust or Fe-Mn crusts in the mantle source, or as metasomatic enrichment of the mantle source via base-metal sulfides (BMS).

Our expanded ^{186}Os-^{187}Os database for Hawaiian picrites no longer defines a single linear trend, and the new observation of variance of isotopic compositions within volcanic suites may pose problems for all models proposed to date. For example, the addition of recycled components likely produces much of the observed variations in ^{187}Os/^{188}Os between Kea- and Loa-trend volcanoes (consistent with variations in other isotopic systems), but is not likely to generate the substantial ^{186}Os/^{188}Os variations. Interaction of a complex plume source with a common, Os- and ^{186}Os-enriched reservoir, such as the outer core, can account for the isotopic variations. However, there is little evidence for a common source of Os in the relative abundances of HSE estimated for the mantle sources of Hawaiian picrites. Metasomatic enrichment of the Hawaiian mantle source with BMS that have variable Pt, Re and/or ^{186}Os- and ^{187}Os compositions can also produce the observed variations, but again there is no evidence for large scale mobilization of these elements suggested in the relative HSE abundances of these rocks.

New lunar discoveries from the Moon Mineralogy Mapper on Chandrayaan-1

PETER J. ISAACSON[1]*, CARLE M. PIETERS[1], LAWRENCE A. TAYLOR[2] AND THE M^3 TEAM

[1]Department of Geological Sciences, Brown University, Providence, RI 02912 (*correspondence: Peter_Isaacson@Brown.edu, Carle_Pieters@Brown.edu)
[2]Planetary Geosciences Institute, University of Tennessee, Knoxville, TN 37996 (lataylor@utk.edu)

The Moon Mineralogy Mapper (M^3) on Chandrayaan-1 provided high spatial and spectral resolution data showing the presence of extensive water and hydroxyl-bearing phases across the surface of the Moon. More intense, broad 3-micron absorptions were observed within small, localized outcrops at all latitudes, often associated with fresh craters. A temporal relation to lunar day/night appears to exist, leading to speculation that the source of this OH is solar-wind proton bombardment.

M^3 is designed primarily to map surface mineralogy. The canonical characeterization of the lunar crust, based principally on available Apollo, Luna, and meteorite samples, is based on an anorthosite-rich float cumulate (FAN) produced by crystallization of the lunar magma ocean (LMO). Portions of this initial FAN crust likely were infused with and assimilated by secondary magmatism to form the Mg-Suite and gabbro-norite rocks. Much of this upper crust has been mixed and redistributed during the late heavy bombardment and basin-forming events.

Within this context, M^3 characterizes lunar surface mineralogy at high spatial resolution (140 m/pixel). We report a new rock-type detected on the farside of the Moon, which occurs as one of several discrete areas along the western inner ring of the Moscoviense Basin. These areas exhibit unusual compositions relative to their surroundings but have no morphological evidence for separate processes leading to exposure. These rocks are dominated by Mg-spinel with no detectible pyroxene or olivine present (<5%), and may represent a cumulate portion of a magmatic systems from the lower highland crust.