Constraints on the age of the Earth's inner core and the origin of the $^{186}Os/^{188}Os$ "core signal" in plume-derived lavas

J.C. LASSITER[1]

[1] Dept. Geol. Sci., Jackson School of Geosci., Univ. Texas, Austin, TX; lassiter1@mail.utexas.edu

The possibility that some mantle plumes may carry a geochemical signature of core/mantle interaction has rightly generated considerable interest and attention in recent years. Correlated ^{186}Os-^{187}Os enrichments in some plume-derived lavas (Hawaii, Gorgona, Kostomuksha) have been interpreted as deriving from an outer core with elevated Pt/Os and Re/Os ratios due to the solidification of the Earth's inner core (c.f., [1] and references therein). Conclusive identification of a "core signal" in plume-derived lavas would profoundly influence our understanding of mantle convection and evolution. The hypothesis that ^{186}Os enrichments in plume-derived lavas reflect core/mantle interaction may be tested by examining other geochemical constraints on core/mantle interaction, geophysical constraints on the thermal evolution of the outer core, and geochemical and cosmochemical constraints on the abundance of heat-producing elements in the core. Additional study of metal/silicate and sulfide/silicate partitioning of K, Pb, and other trace elements is needed to more tightly constrain the likely starting composition of the Earth's core. However, available data suggest that the observed ^{186}Os enrichments in Hawaiian and other plume-derived lavas are unlikely to derive from core/mantle interaction. 1) Core/mantle interaction sufficient to produce the observed ^{186}Os enrichments would have significant effects on other tracers such as Pb- and W-isotopes that are not observed. 2) The core is unlikely to contain significant quantities of K or other heat-producing elements because core formation conditions necessary for partitioning of K into the core (e.g., sulfide segregation or high-pressure core/mantle equilibration) would produce a "core depletion" pattern in the Silicate Earth very different from that observed. 3) Therefore, core/mantle heat flow of ~6-15 TW estimated from several independent geophysical constraints requires that the inner core is too young ($<\sim 1.6$ Ga) for the outer core to have developed significant ^{186}Os enrichment from the decay of ^{190}Pt. Core/mantle thermal and chemical interaction remains an important problem that warrants future research. However, because the magnitude of Os-isotope contrast between the core and mantle is a function of inner core age, Os-isotopes may have only limited utility to detect core/mantle intteraction due to the relatively young age of the Earth's inner core.

References

[1] Brandon, A.D., Walker, R.J. (2005) *Earth Planet. Sci. Lett.* **232**, 211-225.