Paper Number: 1445

Mapping Off-Craton Subcontinental Mantle Lithosphere Growth and Destruction in the Southwest United States Using Os isotopes

Brandon, A.D.[1]

[1]Department of Earth and Atmospheric Sciences, University of Houston, Houston, TX, USA, 77204, abrandon@uh.edu

---

Current understanding of how continents have grown out from their cratonic roots include production of subcontinental mantle lithosphere (SCLM) and associated juvenile crust from plume meltin, or in subduction zones along growing continental margins, or by oceanic lithosphere capture, [1]. Later removal of mantle lithosphere can occur through destabilization resulting from refertilization and vigorous upwelling of convecting mantle. Each of these mechanisms will result in distinct geochemical and chronological records within the produced SCLM fragments. The Southwest United States (SWUSA) has an abundant and wide geographic distribution of mantle xenolith locales making it an ideal region of off -craton SCLM to examine mechanisms of continental lithosphere growth. To address the origin of SWUSA off cratonic SCLM, the ^{187}Re-^{187}Os isotope chronometer is applied to determining the timing of melt extraction recorded in mantle peridotite xenoliths. The timing of melting is consequent to emplacement of residual peridotite into the SCLM and place constraints on the mechanisms of their formation. A second chronometer, ^{190}Pt-^{186}Os, has not been applied to subcontinental mantle lithosphere peridotites. First results will be presented here for direct comparisons to the results from ^{187}Re-^{187}Os. The 5 locales studied, Dish Hill, California, San Carlos and Grand Canyon, Arizona, Lunar Crater, Nevada, and Kilbourne Hole, New Mexico span an ~900 kilometre-wide region within the 2.0-2.3 Ga Mojavia, and the 1.7-2.0 Ga Yavapai-Mazatzal crustal provinces.

For 3 locales, correlations between ^{187}Os/ ^{188}Os and Al_2O_3 as a melt depletion indicator, were obtained. This 'alumincrhon' approach uses Al_2O_3 as a proxy for Re which is affected by weathering. The aluminchron model age for one distinct group of Dish Hill peridotites is 2.1 Ga and is consistent with the crustal age for the overlying Mojavia province [2]. This old age of melting and formation of mantle lithosphere is inconsistent with previous suggestions that some samples from this locale could be fragments of the ≤ 200 Ma Farallon oceanic mantle lithosphere [3]. The aluminachron ages for the Grand Canyon and Kilbourne Hole peridotite suites are 2.31 Ga And 1.96 Ga, respectively. These ages also overlap the ages of their overlying crustal provinces. Combined with the aluminacrhon age for the Dish Hill suite, these results confirm that the predominant mechanism for SWUSA subcontinental mantle lithosphere production was melting in the convecting mantle, likely associated with subduction zone orogenesis and consequent juvenile crust production.

A second distinct group of Dish Hill peridotites have an aluminachron model age of 1.4 Ga. Two locales, San Carlos and Lunar Crater, do not have correlations between ^{187}Os/^{188}Os and Al_2O_3 or other melt depletion indicators. Their lowest ^{187}Os/^{188}Os values give minimum melt depletion ages of 1.23 Ga and 1.4 Ga respectively, and overlap in timing with the second group of Dish Hill samples. Both locales lie within the Basin and Range province where present-day mantle upwelling occurs over a broad area of western USA. These ages likely represent removal of original juvenile SCLM that was followed by replacement with younger partially melted mantle. The fact that Basin and Range mantle upwelling appears to remove SCLM rather than produce it, also points towards subduction zone orogenesis as the primary mechanism for producing the SWUSA mantle lithosphere.

References:

[1] Lee et al. (2010) Annu. Rev. Earth Planet. Sci. (39): 59-90
[2] Armytage et al. (2014). Geochim. Cosmochim. Acta (37):113-133
[3] Luffi et al. (2009). J. Geophys. Res. (114):B3