Highly Siderophile Elements as Tracers for the Subcontinental Mantle Evolution Beneath the Southwestern USA: The San Carlos and Kilbourne Hole Peridotite Xenoliths Revisited

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Peridotite xenoliths from San Carlos, Arizona, and Kilbourne Hole, New Mexico, have been studied since the 1970' to give insights into melting and metasomatism in the subcontinental mantle beneath the southwestern USA. More recently, the highly siderophile elements (HSE; Os, Ir, Ru, Rh, Pt, Pd, and Re) and the included Re-Os isotope system have been established as powerful tools for the study of mantle processes because of their range in compatibility during mantle melting and their siderophile and chalcophile geochemical behavior. Model aluminachron Re-Os ages for San Carlos and Kilbourne Hole, as well as for the nearby Dish Hill and Vulcan's Throne sites, give consistent depletion ages of around 2.2 Ga. This age can be interpreted as a single large scale mantle melting event linked to crustal formation and continental growth under the southwestern USA. Highly siderophile elements, however, may be added to depleted peridotites via melt-rock interaction, especially the more incompatible and hence mobile Pt, Pd, and Re. This may result in overprinting of the signature of melt extraction, thus abating the usefulness of Re-Os mantle extraction model ages. A comprehensive characterization of the suite of mantle xenoliths from the SW USA in terms of HSE concentrations is thus necessary to re-assess the Re-Os system for dating purposes.\\
San Carlos peridotites are depleted to moderately fertile, as indicated by their bulk Al_2O_3 contents between 0.66 wt% and 3.13 wt%. Bulk $^{187}Os/^{188}Os$ in San Carlos peridotites range from 0.1206 to 0.1357. In contrast, Kilbourne Hole peridotites tend to be more fertile with Al_2O_3 between 2.11 and 3.78 wt%, excluding one extremely depleted sample with 0.30 wt% Al_2O_3, and have $^{187}Os/^{188}Os$ between 0.1156 and 0.1272, typical for mantle peridotites. No large fractionation between the more compatible HSE Os, Ir, and Ru are observed. The more incompatible HSE Re, Pd, and to a minor extent, Pt, however, are depleted in a number of samples by factors of up to 4 for Pt, 6 for Pd, and 20 for Re, compared to primitive mantle estimates. This is in agreement with previous studies from the same locales, which demonstrated the presence of different populations of mantle xenoliths having undergone various degrees of melt extraction. The depletion of the more incompatible elements (Re, Pd, and Pt) also suggests that the HSE budgets of the SW USA peridotites were primarily established by extraction of basaltic melt, and reflect only minor influence from later episodes of metasomatism. Model Re-Os ages obtained from San Carlos and Kilbourne Hole xenoliths may thus reflect ages of crustal formation and mantle depletion in the SW USA region.\\