European Mineralogical Conference
Vol. 1, EMC2012-672, 2012
European Mineralogical Conference 2012

Major element composition and origin of the lithospheric mantle in relation to Os isotope data on off-craton and cratonic xenoliths

D.A. Ionov (1), L.S. Doucet (1), and R.W. Carlson (2)

(1) Université de Saint Etienne, Geology, Saint Etienne, France (dmitri.ionov@univ-st-etienne.fr), (2) Department of Terrestrial Magnetism, CIW, Washington DC, USA (rcarlson@ciw.edu)

Peridotite xenoliths brought up by Cenozoic basaltic magmas in off-craton regions range from fertile (Mg#0.89-0.90) to refractory (Mg#0.91-0.92) and usually show whole-rock 187Os/188Os from 0.11 to 0.13. By contrast, cratonic kimberlites contain highly refractory peridotite xenoliths (Mg# 0.92-0.93) with lower 187Os/188Os and generally more ancient (>2.5 Ga) depletion ages. Yet, the meaning of the Os ages and formation mechanisms for both cratonic and off-craton lithospheric mantle continue to be debated. Fertile off-craton xenolith suites (e.g. in China, Mongolia and Siberia) have been interpreted to represent young asthenospheric mantle accreted after recent major lithospheric events [1]. Some of these xenolith suites, however, also include refractory xenoliths with low 187Os/188Os that yield 1.5-2.3 Ga Re-depletion and "alumichron" ages, similar to the oldest crust-forming events recorded in the crust and consistent with Sr-Nd and Lu-Hf isotope age estimates on cpx from fertile peridotites. These results may, alternatively, be viewed as evidence for the formation of the off-craton lithospheric mantle in Meso-Proterozoic melting events roughly coeval with the formation of the early crust [2]. Dating lithospheric formation is further complicated by "re-fertilization" hypotheses for the origin of lherzolites [3] and also because 187Os/188Os in the refractory ($Al2O_3$ <2%) peridotites from off-craton and cratonic xenolith suites are highly variable and may have been reset by processes that remain poorly understood [4]. Recent Os-isotope data on peridotite xenoliths from the central Siberian craton yield common Re-depletion ages of ~2 Ga [5], which are not very different from Re-depletion ages on nearby off-craton terrains [2,4]. It appears that lithospheric mantle with a broad range of major element compositions may have been formed in the middle Proterozoic.

References

[1] Gao S. et al. (2002) EPSL. [2] Pearson D.G. et al. (2002) Chem. Geol. [3] Le Roux V. et al. (2007) EPSL. [4] Ionov D.A. et al. (2006) EPSL. [5] Doucet et al. (2011) Miner Mag.