Goldschmidt 2000
September 3rd–8th, 2000
Oxford, UK.

Journal of Conference Abstracts
Volume 5(2), 130

Os Isotope Systematics of the Massif Central Mantle Lithosphere: In-situ and Whole-rock Studies

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The Re-Os isotopic system has the potential to date the main events of lithosphere formation. Several studies (e.g., Pearson, 1999) of Archean, Proterozoic and Phanerozoic terrains have shown mantle lithosphere Re-depletion ages to be in broad agreement with the age of the overlying crust, suggesting a strong genetic and mechanical link between the two reservoirs. Other Re-Os studies (Peslier et al., 2000) have suggested decoupling between mantle and crust, at least in Proterozoic and younger terrains. The French Massif Central (MCF) and the neighbouring southern volcanic provinces (i.e. Montferrier) are rich in peridotite xenoliths, allowing an extensive regional sampling. This lithosphere segment has been extensively reworked during two major orogenies, the Cadomian (=500-600 Ma) and especially the Variscan (350-280 Ma). More recently the lithosphere has been impinged upon by a plume, triggering thermal and chemical erosion, that enhanced sulfide mobility (Lorand et al., 1998, Alard et al., 1998). This sulfide is the main host phase for Os (Alard et al., 2000). The aims of this study are to decipher: (1) whether the mantle lithosphere is decoupled from the crust during major tectonic events such as the Variscan orogeny; (2) the effect on Os systematics of lithosphere-asthenosphere interaction.

Whole-rock $^{187}Os/^{188}Os$ in MCF and Montferrier xenoliths (n=36) range between 0.1130 and 0.1756, yielding T_{RD} ages spanning from 1.4 Ga to future ages. One sample yields a T_{RD} age of about 2.2 Ga. Radiogenic ratios are obtained for S-rich samples (200<S<600 ppm) while nonradiogenic ratios are obtained for S-depleted samples. Duplicate analyses of single xenoliths show high variability. Both observations suggest that unevenly distributed sulfides are the carrier of the radiogenic signature. Os isotope ratios of silicate-enclosed and interstitial sulfides have been determined in-situ using a Laser Ablation Microprobe coupled to a Nu-Plasma Multicollector-ICPMS as described by Pearson et al. (this volume). Sulfides enclosed in olivine (25<Os<200 ppm) contains nonradiogenic Os, while interstitial or pyroxene-hosted sulfides (Os<50 ppm) may display highly radiogenic $^{187}Os/^{188}Os$ (up to 0.159 ±0.003). Both sulfide types may occur in the same xenolith. T_{RD} ages for MCF (s.s.) and Montferrier sulfides range up to 2.5 Ga. However each sulfide populations displays a different age distributions (Figure 1). The MCF sulfide ages show a peak at 0.6 Ga and a more pronounced one at 1.6 Ga. The oldest sulfide age is 2.7 ±0.2 Ga. In contrast Montferrier sulfides show a major peak at 0.6 Ga, with ages ranging up to 2.3 ± 0.3 Ga. These Proterozoic ages are in agreement with U/Pb and Sm/Nd model ages for the overlying crust, suggesting that the lithosphere underlying the MCF has not been significantly replaced during the Variscan events. However, late addition of radiogenic sulfides has occurred and has strongly overprinted the whole rock signature, resulting in a very complex Re-Os systematics. The in-situ data suggest that the MCF (s.s.) lithosphere was formed during the middle Proterozoic with minor addition near the Proterozoic/Paleozoic boundary. In contrast the major lithosphere formation event in the south (Montferrier) took place during the last part of the Proterozoic. This study emphasizes the great potential of the in-situ Re-Os technique. Although this method is subject to larger errors than TIMS analysis (for the low-Os sulfides, Os<30 ppm), its simplicity and rapidity allow acquisition of statistically meaningful databases and its spatial resolution allows the data to be interpreted with less ambiguity. Most of all, this study highlights the key role of sulfide in the Os-isotope signature and the necessity of having at least basic information on sulfides before trying to interpret whole rock Re-Os data.

Alard O, Luguet A, Lorand JP, Powell WJ, O'Reilly, SY & Griffin, WL, *Min. Mag.*, **68A**, 30-31, (1998).
Alard O, Griffin WL, Lorand JP, Jackson SE & O'Reilly SY, *Nature*, **submitted**, (2000).
Lorand JP, Luguet A, Keays RR & Alard O, *Min. Mag.*, **68A**, (1998).
Meisel T, Walker RJ & Morgan JW, *Nature*, **383**, 517-520, (1996).
Pearson DG, *Lithos*, **48**, 171-194, (1999).
Peslier AH, Reisberg L, Ludden J & Francis D, *Chem. Geol*, **166**, 85-101, (2000).