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Oxidation state of the lithospheric mantle beneath the Massif Central,France

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The Tertiary and Quaternary volcanism of the French Massif Central sampled the underlying subcontinental lithospheric mantle (SCLM) in the form of xenoliths over a wide geographic area of $\sim$20.000km^2. Such an extensive distribution of xenoliths provides an unique opportunity to investigate regional variations in mantle structure and composition. On the basis of textural and geochemical differences, Lenoir et al. (2000) and later Downes et al. (2003) identified two distinct domains in the SCLM lying north and south of latitude 45˚ 30' N, respectively. The northern domain is relatively refractory, but has experienced pervasive enrichment of LREE. The southern domain is generally more fertile, exhibiting depletion in LREE. A metasomatic overprint has developed to variable extents in many xenolith suites.

The different histories of these two juxtaposed blocks of SCLM should also be reflected in their oxidation state, with local variations also to be expected due to metasomatic interactions. For example, if carbonate-melt metasomatism played a role in the LREE enrichment of the northern domain (Lenoir et al. 2000; Downes et al. 2003), then such mantle should be relatively oxidised. Since surprisingly little redox data are currently available, we are undertaking a study to determine the oxidation state of the SCLM beneath the Massif Central over the largest geographical area possible.

All xenoliths investigated are spinel peridotites, mostly with protogranular textures (although some samples are porphyroclastic or equigranular). Most samples are nominally anhydrous although minor amphibole is present in some xenolith suites. Major element compositions of the individual minerals were determined by microprobe. Two-pyroxene temperatures (BKN) range from 750˚ to $\sim$1200˚C.

Ferric iron contents of spinel were determined by Mössbauer spectroscopy and gave a range of Fe^{3+}/ Fe_{tot} from 0.191 to 0.418, with a conservative uncertainty of $\pm$0.02. These data were used to calculate oxygen fugacity (fO_2) of the peridotites using the Nell-Wood calibration for the equilibrium between olivine, orthopyroxene and spinel (Wood et al. 1990) and are referenced to the fayalite-magnetite-quartz (FMQ) redox buffer. Preliminary results yield $\Delta\log(fO_2)$ values between FMQ-0.17 and FMQ+1.65 log units. In this fO_2 range propagated uncertainties are on the order of 0.1 log units. Although there is some overlap, localities from the northern block tend to record higher values (>FMW+0.9). In the south, fO_2values from a number of localities cluster around FMQ+0.3 to FMQ+0.6, with higher values associated with the occurrence of amphibole in the xenoliths. The higher values (>FMQ+1) testify to localised metasomatic interaction in the SCLM, possibly related to melt migration during earlier phases of magmatic activity in the region. This hypothesis is also consistent with lower fO_2 values observed at one locality (Fraisse) on the northern block that is significantly older and thus sampled the mantle prior to the subsequent metasomatic activity in this block of SCLM.

Downes H., Reichow M.K., Mason P.R.D., Beard A.D., Thirlwall M.F. (2003) Mantle domains in the lithosphere beneath the French Massif Central: trace element and isotopic evidence from mantle clinopyroxenes. Chem. Geol., 200, 71-87.

Lenoir, X., Garrido, C.J., Bodinier, J.-L., Dautria, J.-M. (2000) Contrasting lithospheric mantle domains beneath the Massif Central (France) revealed by geochemistry of peridotite xenoliths. Earth Planet. Sci. Lett. 181, 359–375.

Wood B.J., Bryndzia L.T., Johnson K.E. (1990) Mantle oxidation state and its relation to tectonic environment. Science, 248, 337-345.