Evidence for crustal recycling and refertilisation in the subcontinental lithospheric mantle: The peridotite-pyroxenite sequence from the external ligurides, Northern Italy

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Here we report petrological, geochemical and isotopic characteristics of a peridotite-pyroxenite sequence of subcontinental origin exhumed at a fossil continent-ocean transition. The peridotites are fertile lherzolites characterized by a widespread pyroxenite layering and plagioclase-facies mylonitic foliation related to emplacement at shallow levels. The most common pyroxenite layers are represented by thin (2-10 cm) boudinaged websterites, whereas meter-sized layers of pyroxenites displaying relics of a high pressure (~2.8 GPa) garnet-clinopyroxene (± graphite) assemblage locally occur. Garnet clinopyroxenites include (i) residual rocks characterised by extreme LREE depletion, positive Eu-Sr anomaly and nearly flat MREE and HREE likely derived from plagioclase-bearing mafic protholiths that underwent partial melting; (ii) garnet-rich cumulates enriched in HREE, Sc, V. Silicates and graphite from the pyroxenite layers encompass a narrow range of $\delta^{18}O$ and $\delta^{13}C$, close to typical mantle compositions. Sm-Nd and Lu-Hf isotopes ratios recalculated for the minimum age of the melting event vary in a wide range (ε_{Nd} = +2.3 to +31.5, ε_{Hf} = +2.4 to +12.6), although most values lie close to the Hf-Nd mantle array. The websterites have high mg# (87-90), high Cr and Ni, and lower Al_2O_3, CaO and Na_2O than the clinopyroxenites. Their REE patterns, characterised by moderate LREE depletion and lack of significant Eu anomaly, are subparallel at higher concentration levels to that of the peridotites. The websterite petrogenesis is most likely related to infiltration in the peridotites of partial melts derived from the nearby clinopyroxenites, through pyroxene (± garnet)-forming reaction and olivine consumption. A later melt infiltration under spinel facies conditions, preceeding ductile stretching and dispersion of pyroxenites into the host peridotite, is testified in both websterites and peridotites by olivine formation at the expenses of orthopyroxene porphyroclasts, often associated with Ti-pargasite + sulphide crystallization.

Evidence for long-term averaging of $^{87}Sr/^{86}Sr$ in bovine enamel using TIMS and LA-MC-ICP-MS

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High spatial resolution micro-sampling techniques for human and animal teeth offer the promise of diachronic isotope data with a high temporal resolution to reconstruct changes in climate, environment, diet and mobility over periods of, perhaps, days in the life of the subject [1]. It requires a material in which a chronological "time-line" is present coupled with a sampling technique that can obtain high-precision isotope data from very small samples. *in situ* laser ablation analysis clearly satisfies the second of these requirements, but whilst there is little argument that enamel matrix is *secreted* with a known high-resolution periodicity, there is equally little evidence that the progression of enamel *mineralization* follows matrix deposition either temporally or spatially [2-4].

LA-MC-ICP-MS analyses of surface enamel were compared to TIMS analyses of bulk transverse enamel sections of an archaeological bovine third molar [5]. Both profiles track the same gradual change from end-member one to end-member two and suggest long-term averaging of incorporated strontium impacts both sampling scales equally. The evidence thus indicates that increased sampling resolution may not recover a higher resolution input signal for strontium in bovine enamel and the same profile could be reconstructed using far fewer samples. The averaged signal obtained may result from a long maturation phase of mineralization at the microscopic scale or a long residence time of strontium in the body pool in comparison to the lighter stable isotope systems. In either event, it is unlikely that high-resolution sampling techniques can provide improved resolution of the strontium input signal over traditional TIMS analysis of bulk samples.

[1] Sponheimer *et al.* (2006) *Science* **314**, 980-982. [2] Suga (1982) *J Den Res* **61**, 1532-1542 [3] Hoppe *et al.* (2004) *PPP3* **206**, 355-365. [4] Tafforeau *et al.* (2007) *PPP3* **246**, 206-227. [5] Horstwood *et al.* (2008) *GCA* **72**, 5659-5674.