Continental Recycling: The Oxygen Isotope Point of View

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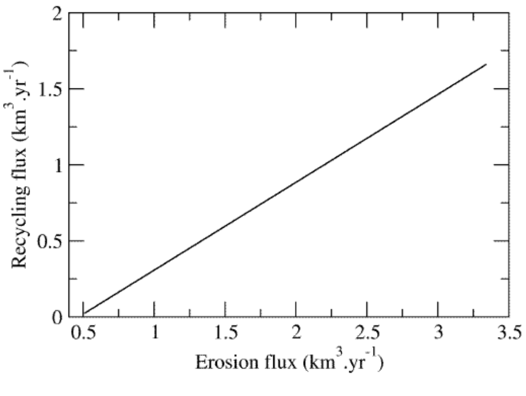
Based on an extensive data compilation, mass balance calculations lead to estimate that the continents have a $\delta^{18}O$ value of +8.7±0.5‰. This isotopic composition results from two competing processes that are the erosion and growth of continental masses. A part of the erosional flux corresponds to sediments that have exchanged oxygen isotopes at low temperature through the hydrologic cycle before to be laterally accreted to continental masses. This surficial recycling is responsible for a ^{18}O increase of continental rocks which can be quantified by a $\Delta_{rock\text{-}water}$ of +15‰ when corrected from the metamorphic cycle. The remaining part of the erosion flux corresponds to subducted sediments with $\delta^{18}O$ values of 11±2‰ that are replaced by an equivalent amount of mantle-derived rocks whose $\delta^{18}O$ values are only of 6.5±0.5‰. Box modeling of the oxygen isotope exchange between the continents, mantle and seawater lead to calculate that the average flux of subducted sediments into the mantle was less than 1.5 $km^3.yr^{-1}$ whatever the considered model of continental growth. Such low recycling rates imply that the role of continental-derived material on the development of deep mantle geochemical heterogeneities was overestimated. Computed fluxes of crustal recycling based on oxygen isotopes are lower than those previously deduced from studies devoted to radiogenic trace elements such as Nd (e.g. DePaolo, 1983). Reincorporation of subducted sediments during continental extraction is involved for explaining this apparent discrepancy between the oxygen isotope (no fractionation at high-temperature) and trace element (significant fractionation during melting) records.



DePaolo D.J. , (1983), *Geophys. Res. Lett.* **10**, 705-708.

The Lu-Hf isotope composition of cratonic lithosphere: disequilibrium between garnet and clinopyroxene in kimberlite xenoliths

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Characterisation of the Lu-Hf isotope systematics of Archean peridotites is being undertaken to evaluate the potential of the system for providing age information and the nature of the lithospheric mantle. Samples have been previously characterised for Re-Os isotope systematics & PGE abundances (Irvine et al. 2001) major/trace elements EPMA, LA-ICPMS and SIMS (Simon et al. 2002). Despite Archean Re depletion ages (T_{RD} > 2.5 Ga) and extensive textural equilibration in most samples, trace element disequilibrium between garnet and cpx is preserved and indicates a multistage metasomatic overprint of the lithospheric mantle. Calculated equilibrium liquids for cpx suggest that most diopside in the Lesotho xenoliths we have studied crystallised from an infiltrating kimberlite-like melt, shortly prior to eruption. This conclusion is supported for 2 samples by their Lu-Hf and Sm-Nd systematics (Fig. 1). One unusual sample has extremely radiogenic Hf, yet low Lu/Hf (Fig. 2), and is in gross inverse isotopic disequilibrium with co-existing garnet. Garnets in all rocks have high $^{176}Hf/^{177}Hf$ (ε_{Hf}) despite having relatively low Lu/Hf ratios. All garnet-cpx pairs show Nd isotopic disequilibrium, with garnets having consistently higher Sm/Nd but less radiogenic Nd than cpx. Decoupling of trace element systematics from Lu-Hf and Sm-Nd isotopic signatures, especially in garnet, requires a complete modification (extensive melt infiltration + re-homogenisation/re-crystallization) of the N. Lesotho lithospheric mantle relatively recently in its 2.5 Ga history.

References:

Irivine G.J., et al. (2001) *Geophys. Res. Lett.* **28**, 2505-2508.
Simon et al. (2002) submitted to *Lithos*.

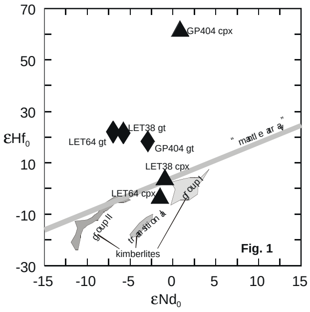

Fig. 1

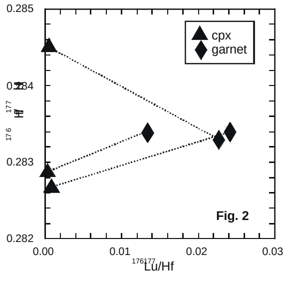

Fig. 2