Sulfur isotopic composition of the Sub-Continental Lithosphere Mantle

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Due to the multiple geochemical affinities of S (volatile, chalcophile, siderophile, incompatile) its abundance and isotopic composition in the Earth mantle have been affected by primorial Earth forming and differenciation events (e.g. core segregation, late accretion) but also by ongoing melt percolation/reaction and recycling processes. In the upper mantle, S forms sulfides which are also the main redepository phases for highly siderophile elements (HSE: Os, Ir, Ru, Rh, Pt, Pd, Au, Re). The S-isotopic composition of the Earth's mantle has been dimmed to be chondritic ($\delta^{34}S=0\pm2‰$; [1,2]). However in details, mantle data show large variability ($-7\leq\delta^{34}S<10‰$; [2,3]) and rescent studies have suggested a non chondritic $\delta^{34}S$ ($\leq-1.6‰$, [4,5]).

Here, by coupling EMP, SIMS, LA-ICPMS and LA-MC-ICPMS, major elements, $\delta^{34}S$, siderophile and chalcophile (Se, Te) trace elements, and Os isotopes have been obtained in-situ on 200 sulfide grains from ≥30 mantle samples.

Almost all sulfides from alkaly basalts hosted xenoliths or orogenic massifs have $\delta^{34}S<0‰$ ($-7\leq\delta^{34}S\leq0.5$). Further, the results unfold broad correlations between $\delta^{34}S$ and HSE abundances and $^{187}Os/^{188}Os$. However, peridotite sulfides in inclusion in diamonds and in refractory olivines, having unradiogenic $^{187}Os/^{188}Os$ compositions (yielding archean model ages) show heavyer $\delta^{34}S$ (-1 to +2‰). These features may suggest that the $\delta^{34}S$ of the Earth mantle has evolved through time from a broadly chondritic composition to $\delta^{34}S<<0‰$ through accumulated metasomatic processes and/or crustal material recycling.

References: [1] Chaussidon *et al*., EPSL 92 (1989) 144-156. [2] Chaussidon & Lorand, GCA 54 (1990) 1-12. [3] Ionov *et al*., EPSL 111 (1992) 269-286. [6] Cabral, *et al*., Nature 496 (2013) 490-493. [7] Labidi *et al*., Nature 501 (2013) 208-211.