Nd isotopes as tracers as crustal rejuvenation

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Neoproterozoic rocks in SW Iberia are largely exposed in the Central Iberian and the Ossa Morena zones. Though different to each other, both areas witness for development within, or adjacent to, an active margin setting during the Late Neoproterozoic (Cadomian orogen). In the Palaeozoic, the following tectonic stages are recognised: 1) rifting event (Cambrian-Early Ordovician), 2) passive margin stage (Ordovician-Silurian-Early Devonian), and 3) Variscan Orogeny. Nd isotopic composition has been determined on fine grained, low-to very low-grade metasedimentary rocks, mainly shales. εNd(*T*) values range from +2.1 to -13.9. Significant excursions to less negative values between -3 to +2.1 are interpreted to record periods when the corresponding basins were significantly supplied of juvenile components from mantle sources. The $\varepsilon Nd_{(t)}$ values are negative in both areas and do not display any sharp changes during the Palaeozoic; a signature commonly found in recycled crustal-derived sediments.. The isotopic data are consistent with the Ossa Morena and Central Iberian Palaeozoic successions being derived from a polycyclic mixture of old crust (≈ 2 Ga) and younger crustal components, coeval with the recorded orogenic and rifting phases. In summary, Nd isotope systematics points to clear differences between the two zones in Neoproterozoic times and significant similarities during the Palaeozoic.

Do orogenic peridotites preserve platinum-group element systematics of mantle melting processes?

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Most recent estimates of the Primitive Upper Mantle (PUM) composition allow significant deviation of Ru/Ir (2.03) and Pd/Ir (2.06) above chondritic values. The rationale behind PUM estimates is that fertile and refractory peridotites are products of a single episod of partial melting and melt extraction. The paradigm has now been questionned for a number of orogenic peridotite massifs such as Lanzo (Italy), Ronda (Spain), Beni Bousera (Morocco), Horoman (Japan) and Lherz (France), the type-locality of lherzolites. Harzburgites of residual origin (Ir_N > 1.0; Re/Os_N= 0.10-0.15; Pd/Ir_N = 0.1-0.4; N = PUM-normalized) have been identified in every massif. They contain little or no base-metal sulfide (BMS) : at Lherz, the PGE budget is accounted for by refractory discrete platinum-group minerals (laurite-erlichmanite; malanite-cuprorhodsite; Pt-(Ir)-rich alloys). Orogenic lherzolites display PGE concentrations and PGE patterns close to PUM estimate while showing many features of extensively percolated abyssal peridotites with regard to BMS. The BMS occur as ameboïdal, angular bodies (up to 500 μm) showing morphologies of blebs of metal-rich sulfide melts. These blebs (pentlandite + chalcopyrite ± bornite ± pyrrhotite) preferentially nucleated onto (or inside) the opx and Al-spinel (or on the cpx in the cpx-rich lherzolites). Extensive reactions between a S-saturated basaltic melt and olivine and Cr-spinel at 1-2 Gpa could produce such associations. Neither harzburgites nor lherzolites show mineralogical evidence of trapped Mss inside olivine, as one would expect from incongruent melting of BMS. Harzburgites, fertile lherzolites and websterites display broadly similar Cu/S ratios (1.5 x PUM estimates) while defining linear correlation trends in S vs. Al plots. Osmium, Ir, Ru and Rh (IPGE) negatively correlate with fertility indices, as predicted by $D^{mss/sulfide\ melt}$. However, harzburgites, lherzolites and websterites are aligned on the same regression lines which are therefore more likely mixing lines. Discrete laurite (less than 500 nm across) discovered in Lherz lherzolites (FEG-SEM data) may have been inherited from harzburgitic protoliths. Platinum concentrations do not correlate with fertility indices, nor with Pd, despite similar $D^{mss/sulfide\ melt}$, reflecting saturation in refractory Pt-rich alloys at mantle temperatures (FEG-SEM data). Palladium positively correlates with Cu, S, Ca and Al, in agreement with its almost exclusive partitioning in sulfide melt. The latter correlations are consistent with refertilisation reactions of refractory peridotites by variable amount of basaltic melts that precipitated Cu-rich sulfide melt, cpx, Al-spinel and opx.