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Metabasite with eclogite facies relics from Variscan NE Sardinia: within plate OIB-like melt with extremely high Sr and extremely low Nd isotopic ratios

Gabriele Cruciani (1), Andrea Dini (2), Marcello Franceschelli (1), Mariano Puxeddu (2), and Daniela Utzeri (1)

(1) Dipartimento di Scienze della Terra, Università di Cagliari, Via Trentino 51, 09127 Cagliari, Italy, (2) Istituto di Geoscienze e Georisorse, CNR Pisa, Via Moruzzi 1, 56124 Pisa, Italy

A retrogressed eclogite lens (metabasite from Punta Orvili, PO, near Posada south of Olbia) from Variscan NE Sardinia has proved to be the first case of WP basalt among the neighbouring tholeiitic metabasites with eclogite facies relics. The composition is characterized by SiO_2: 44.89-47.57 wt %; Al_2O_3: 7.53-9.59 wt%; MgO: 12.94-14.35 wt%; Fe_2O_{3tot} : 13.25-15.13 wt%; Na_2O: 0.75-1.38 wt%; K_2O : 0.54-0.88 wt%; Cr: 550-870 ppm; Ni: 273-420 ppm; Mg#: 68.1-70.4. A thorough examination of the geochemical data in the light of the chemical changes induced by alteration and/or metamorphic processes allow to exclude any modification of the protolith geochemistry. High normative contents of mafic minerals suggest a picritic nature for the protolith. The enrichment factor is 60-180 times for LREE, 30-60 times for MREE and 10-20 times for HREE. The remarkable fractionation (La_N/Sm_N : 3.0-3.9; Gd_N/Yb_N : 3.2-3.6 and La_N/Yb_N : 13.7-18.2) produces steep chondrite normalized abundance patterns strongly contrasting with the flat to LREE-depleted patterns of the other Sardinian eclogite-derived metabasites.

The prevalent mantle source is OIB-like as suggested by La/Nb : 0.77-0.94, La-Ta : 12.90-15.04, Ce/Nb : 1.59-1.84, Th/Nb: 0.10-0.11, all values far from those of average and upper crust. Isotopic values, calculated at 460 Ma, mean age of eclogite-derived metabasites from Sardinia, are: $(^{87}Sr/^{86}Sr)_i$: 0.708891-0.709050; ε_{Sr} : + 70-72; $(^{143}Nd/^{144}Nd)_i$: 0.511966-0.511970; ε_{Nd}: - 1.54 to - 1.47. The tholeiitic eclogite–derived samples from Posada Valley and from Punta de li Tulchi at 460 Ma are: $(^{87}Sr/^{86}Sr)_i$: 0.704328 - 0.704460; ε_{Sr} : +5.15 to +7.02; $(^{143}Nd/^{144}Nd)_i$: 0.512275 - 0.512418; ε_{Nd}: +4.48 to +7.28.

The strongly anomalous isotopic values, the very high Ba (1045-2530 ppm), Pb (9-12 ppm), Cs (1.92-4.38 ppm) contents and the chondrite normalized abundance patterns with negative peak for Rb, K and Sr seem to suggest a possible interaction of the main OIB component with an enriched subcontinental litospheric mantle similar in composition to kimberlites Group II. An alternative end member for the interaction with OIB-derived melts could be a mantle source resembling the mafic and ultramafic xenoliths from Streap Comlaidh, Scotland (Menzies and Halliday, 1988) and from Middle Ordovician (465 Ma) Fuxian kimberlites, China (Zhang et al., 2008). The strong horizontal shift of the $^{87}Sr/^{86}Sr$ towards the right side of the mantle array has been observed elsewhere, e.g. in peridotite xenoliths from Spitzbergen Islands (Ionov et al., 2002). According to Ionov et al.(2002), this "Sr-Nd isotopic decoupling" is a signature of metasomatic processes within the mantle source and is generated by chromatographic effects of melt percolation through the peridotite matrix.

The geodynamic model here proposed is in agreement with the widely accepted hypothesis that eclogite–derived metabasites from NE Sardinia are not related to a wide ocean basin but represent the witness of the incipient opening of a marginal basin within a thinned continental crust or of an intracratonic basin generated during an Early to Middle Ordovician rifting episode.

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