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Geochemical, Metamorphic and Geodynamic Evolution implications from subduction-related serpentinites and metarodingites at East Thessaly (Central Greece)

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In Central Greece, the East Thessaly region encompasses ophiolitic and metaophiolitic formations emplaced onto Mesozoic platform series rocks. Metaophiolitic thrust sheets are characterized either by the predominance of serpentinites or metabasites. Serpentinites have been distinguished into three groups, representing distinct metamorphic degrees. Group-1 serpentinites (East Othris region) are characterized by the progressive transformation of lizardite to antigorite, estimated to have been formed under greenschist facies conditions ($\sim$320-340 ˚C, P$\approx$6-8 kbar) [1]. Group-2 serpentinites (NE Othris and Agia-Agiokampos region) are marked by the further prevalence of antigorite over lizardite, suggesting upper-greenschist to low-blueschist facies metamorphism ($\sim$340–370 ˚C, P$\approx$9-11 kbar) [1]. Group-3 serpentinites (Agia-Agiokampos region) are characterized by the predominance of antigorite and Cr-magnetite, as well as by their relatively low LOI (10.9-12.6 wt.%), corresponding to blueschist facies metamorphism ($\sim$360–400 ˚C, P$\approx$12 kbar) [1]. These metamorphic conditions are highly comparable with the P-T estimates from the Easternmost Thessaly metabasic rocks, strongly indicating that the entire metaophiolitic formation (excluding East Othris) underwent blueschist facies metamorphism.

Serpentinites from East Thessaly were formed from serpentinization of highly depleted harzburgitic protoliths under extensive partial melting processes (>15%), pointing to a hydrous subduction-related environment. Group-1 serpentinites exhibit higher Mg/Si ratio values and LOI compared to serpentinite Groups-2 and -3. Differences in the trace element behavior amongst the three serpentinite groups are also consistent with increasing metamorphic conditions (e.g. Pb, La enrichments, Ti, Y, Yb depletions) [1]. The East Thessaly serpentinites reflect highly oxidizing conditions (-0.4< FMQ<1.2) [1]. These serpentinites appear to have also been subjected to deserpentinization retrograde metamorphic processes (P<8 kbar and T<350 ˚C) [1]. Retrograde metamorphism also resulted in the occurrence of late-stage rodingitization and derodingitization processes upon the rodingite intrusions hosted within the serpentinites. Late-stage derodingitization processes (T=250-300 ^{o}C) account for the formation of metarodingites (vesuvianite and/or chlorite bearing). Chlorite-serpentinite schists represent a reaction zone between the serpentinites and the hosted metarodingites [1].

Exhumation of the high-pressure serpentinite- and metabasic-bearing metaophiolitic occurrences may have occurred from either one or even from both of the bilateral oceanic basins (Pindos and Vardar) that coexisted besides the elongated Pelagonian zone. The Middle-Late Jurassic Pindos oceanic SSZ model appears to successfully interpret not only the geochemical and structural data recorded in the western Hellenic-Dinaric ophiolitic complexes, but additionally seems to explain the formation and emplacement for many of the East Thessaly metaophiolite occurrences. In this context, the exhumed metaophiolites represent parts either of a serpentinized subduction channel or of the serpentinized wedge, located on the hanging wall side close to the slab in the forearc system of the Pindos Ocean. The Hellenic-Dinaric ophiolitic units, as well as the metaophiolitic occurrences, were likely remobilized during thrusting of the flyschic nappe at the main Alpine orogenetic phase of the Upper Cretaceous-Paleogene period.

References. [1] Koutsovitis 2016: Lithos, Special Issue, in Press. DOI: 10.1016/j.lithos.2016.11.008