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Remnants of the Rheic SSZ Oceanic Lithosphere (320 Ma) Within the Izmir-Ankara-Erzincan Suture Zone in NE Turkey: New Geochemical and Re-Os Isotope Data From the Rehafiye-Erzincan Ophiolite

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We report on new major-trace-REE and Re-Os isotope compositions and mineral chemistry data from upper mantle peridotites and ultramafic-mafic cumulate rocks in the Rehafiye-Erzincan ophiolite (REO) in NE Turkey, and discuss their siginificance for the tectonic evolution of various oceanic tracts in the eastern Mediterranean region. The REO is part of the Izmir-Ankara-Erzincan Suture Zone (IAESZ) between the Gondwana-derived Tauride-South Armenian ribbon continent to the south and the Rhodope-Pontide micro-continent to the north. It shows bidivergent thrusting along its southern and northern boundaries, resting tectonically on the margins of these continental masses. The IAESZ includes fragments of oceanic lithosphere with WPB, MORB, IAT-Boninite, OIB and LIP affinities that range in age from the Permo-Triassic to the latest Crecateous, although it is commonly interpreted as Neotethyan in origin. The REO consists of upper mantle peridotites including harzburgite with dunite bands/lenses and crosscutting dolerite dikes, ultramafic-mafic cumulate rocks making up a transitional Moho, isotropic gabbro, plagiogranites, and sheeted dikes. Extrusive rocks are missing in the ophiolite sequence but occur as blocks of pillow basalts in an ophiolitic mélange structurally beneath the REO.

We have identified two types of upper mantle peridotites, abyssal and SSZ, in the REO. Less depleted, clinopyroxene-rich mantle harzburgites have higher concentrations of Al (1.75–2.12 wt.% Al2O3) and Ca (0.43–1.53 wt.% CaO) and contain spinel phases with Cr# ranging between 33.2 and 37.8. These abyssal peridotites represent a mantle residue of low degrees of partial melting of primitive upper mantle during MOR-type oceanic crust formation. Some peridotite samples, on the other hand, are highly depleted in clinopyroxene and display extremely low contents of Al (0.16–0.89 wt.% Al2O3) and Ca (0.07–0.77 wt.% CaO), characteristic of SSZ peridotites. Spinel phases in these samples have Cr# ranging between 57.0 and 73.5, indicating high degrees of partial melting (in a mantle wedge) of previously depleted peridotites. Both types of peridotites are characterized by low REE contents. Abyssal-type peridotites display a flat pattern from Lu to Tb and negative-flat pattern from Tb to La, although some samples show slight LREE enrichment. SSZ-type, depleted peridotite samples are characterized by nearly similar LREE concentrations, whereas their HREE and especially MREE concentrations are significantly depleted with respect to those of the abyssal peridotites. These rocks show U-shaped REE patterns, reminiscent of forearc peridotites. The PGE content of mantle tectonites in the REO, although low, are significantly higher than those presented by the cumulate gabbros. The 187Os/188Os isotope ratio of these peridotites (0.1195–0.1240) is typical of the depleted mantle and much lower than those of the cumulate gabbros (0.2074–0.5842). Whole-rock samples from the mantle tectonites and cumulate gabbros display a well-defined linear trend in a 187Re/188Os vs. 187Os/188Os isochron diagram. These samples collectively define an isochron with a best-fit age of about 320$\pm$16 Ma, suggesting that the melt evolution and crystallization of the SSZ ultramafic-mafic units of the REO may be as old as the late Carboniferous. This new finding of a late Carboniferous SSZ mantle lithosphere between the Gondwana and Eurasia continental masses in NE Turkey indicates: (1) the existence of Rheic Ocean relics farther away in the Tethyan realm of the eastern Mediterranean region than previously considered; (2) a highly heterogeneous character of the IAESZ, containing some lithospheric material that evolved in rift-drift, plume and subduction-accretion tectonic settings of the Rheic, Paleotethyan and Neotethyan Ocean basins. We discuss the geodynamic implications of these inferences.