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# Macrocrystal populations retrieved from lamproites indicate accretion of young SSZ oceanic lithosphere in the assembly of W. Anatolia, Turkey

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Western Anatolian lithosphere comprises several sutures and major continental fragments with Laurasian and Gondwanan affinities, assembled prior the Oligocene. One of the major tectonic features shaping its structure is the Menderes metamorphic massif, which consists of several assembled and imbricated terrains exhumed by the Late Miocene during the extension that affected the entire Aegean province. A predominant opinion is that the Menderes is a core complex delineated by low-angle detachment faults. An alternative explanation associates it with shallow subduction of Neotethyan oceanic lithosphere that was later delaminated. To distinguish between these possibilities, direct evidence from the Western Anatolian mantle lithosphere would be ideal, because of the compositional differences of the continental and oceanic mantle lithosphere. In the absence of mantle xenoliths, mantle-derived volcanics and their macrocrystal populations, offer the only information about the composition of the mantle-lithosphere under the Menderes.

In this contribution, we constrain the mineralogy of the lithospheric mantle based on a dataset for Western Anatolian lamproitic lavas and a systematical investigation of the major and trace element distribution in their macrocrysts. The host lamproites are ultrapotassic, high-Mg mantle-derived rocks, which show geochemical resemblance with the rest of the Mediterranean lamproites. Two types of olivine macrocrysts are recognized: Phenocrystal olivine has high-Fo cores (Mg# up to 94), very high NiO contents up to 0.8 wt.%, low $Cr_2O_3$ (<0.18 wt.%) and CaO (≤0.20 wt.%). Its trace element compositions show high Li contents (up to 17 ppm) and relatively high Sc (up to 5 ppm) and Mn (up to 900 ppm) concentrations. It hosts Mg-chromite inclusions with extremely high Cr# as high as 0.84. Large (>1 mm) mantle xenocrystal olivine contains homogeneous core with plateau-like compositions (Mg# around 0.92, but NiO and CaO contents <0.4 and <0.1% wt.%, respectively), which abruptly change into compositions similar to phenocrystal olivine, resulting in reversed zoning. Their Li contents exceed 2 ppm in all investigated grain profiles. Macrocrystal phlogopite also comprises two main populations analogous to olivine: Phlogopite phenocrysts typically have uniform core compositions with Mg# (atomic Mg/Mg+Fe) ≥ 90, $Al_2O_3$ 10.0-15.0 wt.%, and $Cr_2O_3$ less then 1.00 wt.% plotting in the field of lamproitic phlogopite core compositions. Its trace element compositions show elevated Ba and Li ranging up to 15000 ppm and 70 ppm, respectively, and low Sr (<75 ppm). Mantle xenocrystal phlogopite shows core compositions characterized by high Mg#, $Cr_2O_3$(up to 2.5 %), relatively high $Al_2O_3$ and F, and low $TiO_2$. Its high $Cr_2O_3$ and MgO contents closely overlap with mantle phlogopites from classical localities like Bearpaw Mountains and Finero. Its trace element composition is characterized by considerably lower Ba and Li contents around 1500 and 8 ppm, respectively, and sometimes elevated Sr and Nb concentrations up to 600 and 37 ppm, respectively.

The above complex macrocrystal assemblages can be used to constrain the lithospheric mantle beneath the Menderes Massif. Phlogopite xenocrysts document metasomatism of the lamproitic mantle source by hydrous K-enriched melts. This extreme $K_2O$ and trace element enrichment is in stark contrast with the ultra-refractory character of olivine-spinel pairs which reflect the previously existing ultra-depleted harzburgitic lithospheric mantle. The presence of high-Fo (up to 92% Fo) xenocrystal olivine in some samples indicate a depleted mantle source as well. This is a feature which can only be explained by a mantle that experienced an episode of strong depletion in melt components with subsequent K-enrichment. Our data support the interpretation that the mantle under the Menderes massif is a phlogopite bearing ultradepleted harzburgite, requiring a complex multistage geodynamic model to explain the origin of this lithospheric mantle. The first episode resulted in ultradepletion of the mantle

in a SSZ environment during the closure of the Neotethyan Ocean in the Mesozoic. The second episode includes shallow subduction, accretion of forearc mantle and its interaction with subducted sediments, during which the observed complex composition of the lithospheric mantle was achieved. If our inferences about the W. Anatolian lithospheric mantle are correct, then the connection between accretion-shallowly subducted oceanic forearc lithosphere and later uplift of the Menderes massif might not be coincidental.