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Shallow angle subduction and mantle hydration beneath Central Anatolia, Turkey

MARY R REID[1] AND JANNE BLICHERT-TOFT[2]

[1]Northern Arizona University
[2]Ecole Normale Supérieure de Lyon
Presenting Author: mary.reid@nau.edu

Subduction-related processes have helped shape the chemistry of subcontinental mantle lithosphere. In central Turkey, middle Eocene to early Miocene shallow-angle subduction of the African slab could have broadly metasomatized mantle beneath the Eastern Taurides. Collision along the Africa-Eurasia margin and subsequent changes in mantle dynamics after slab break-off or rollback led to basalt generation at depths that increase from ~50 km to ~80 km over a distance of up to ~300 km from the suture zone [1]. Late Miocene and Pliocene mafic volcanism accompanied thermal relaxation of the lithosphere, with melts derived from ~65 km depths. Collectively, these basalts provide windows into the extent and preservation of flat slab subduction-related influences on widely and temporally distributed mantle sources. Given the relative antiquity of the African slab, these effects are expected to be dominantly those associated with hydrous fluids.

Water contents have been obtained by Ca-in-olivine hygrometry [2] on relatively Mg-rich Eastern Tauride basalts. Magmatic water contents range from 0.5 to 1.5 wt.%, values similar to those of OIB. H_2O/Ce values range up to 700 and broadly decrease to OIB-like (and MORB-like) values of <300 away from the suture zone. The range in source H_2O contents overlaps that of OIB and some volcanic arcs but, when compared to them at a given H_2O/Ce, H_2O contents are about a factor of two lower; there is no indication that they vary geographically or with eruption age. Some enrichments normally expected from slab-derived hydrous metasomatism, e.g., high Ba/La, are absent, but relative enrichments in alkalis and sediment-like Pb isotope signatures are more pronounced nearer the suture.

The H_2O/Ce-H_2O systematics of the Eastern Tauride basalts can be explained simply by addition of water to depleted mantle sources. Nearer the suture, melt sources may be MORB-like mantle lithosphere hydrated and enriched in some large ion lithophile elements by the effects of flat slab subduction. Further from the suture, melt sources appear to be dominated by upwelling mantle, in which case water either originated there or was assimilated during melt ascent through mantle lithosphere.

[1] Reid et al., 2019, Geology; [2] Gavrilenko et al., 2016, J. Petrol.