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Western- and Eastern-type ultramafic massifs of the Mirdita ophiolite, Albania: structural evidence for lower-plate (Western-type) - upper-plate (Eastern-type) relationships and formation of a Jurassic oceanic core complex

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The Jurassic Mirdita ophiolite of Albania contains distinctive Eastern- and Western-type mantle rocks. Eastern-type massifs are dominantly harzburgites with a thick arc-related intrusive and extrusive crust and late intrusive suites. In contrast, Western-type mantle massifs are harzburgitic to lherzolitic, and have a thinner crustal sequence of MORB-like tholeiites and locally prominent gabbros. Geological mapping of selected sections combined with geochemical and structural studies suggest that the Western lherzolite-rich ultramafic massifs are relicts of a fossilized oceanic core complex (OCC). Further geochemical studies suggest that both crustal sequences of Western and Eastern massifs were generated in the same tectonic environment and represent a gradational magmatic series evolving from MORB to IAT to boninites, respectively. Both massifs have metamorphic sole amphibolites with similar 40Ar/39Ar ages (171 to 162 Ma), and similar timing of obduction is thus inferred. However, the relationship between Western and Eastern ultramafic massifs and their respective crustal covers are still debated, as is the position of the spreading center associated with the crustal sequence(s) and the OCC's genesis. A key question is whether the preserved OCC was generated at a spreading center located eastwards (present coordinates) in the Vardar Zone more than 100 km away; or westwards within a marginal oceanic basin formed between Adria and Pelagonia.

The Western-type mantle/crust transition is exposed in the Puka and Krabbi massifs. Here, the upper part of the mantle sequence and the lower crust display zones of lithospheric ductile flow 10s of m wide, which are marked by amphibolitized layers of crustal and mantle rocks affected by intense NNW to NE dipping ductile shearing. The amphibolite layers are locally associated with cataclastic breccias developed within peridotite, gabbro and basalt. The amphibolite-breccia complexes are interpreted as slivers of crust/mantle entrained into syn-oceanic extensional detachments. The ductile foliation is offset by NE steeply dipping normal faults which are possibly also syn-oceanic. At the northern end of the Puka massif, the amphibolitized layers are affected by NW-trending, moderately plunging isoclinal folds interpreted as syn-oceanic or syn-obduction structures. A late Alpine, NW-SE cleavage, genetically related to open folding and brittle faulting, locally affects the amphibolites and isoclinal folds. The southeastern border of the Puka massif is marked by syn-oceanic, moderately-dipping and ENE-dipping large-scale normal faults at the mantle/crust transition. The thicker Eastern-type ultramafic massifs, display a classical Moho mantle/crust transition, marked by a succession of mantle peridotites and lower-crustal rocks made up of ultramafic and mafic cumulates. Conjugate, moderately to steeply, NE-SE dipping normal faults also affect the Eastern-type crustal rocks, consistent with east-west trending extension.

The lack of time gaps for the formation of Eastern- and Western-type massifs, the presence of ENE-dipping extension-related structures marking the mantle/crust contact in the Western-type massifs, and the thickening of the ophiolitic nappe from west to east are more consistent with east-over-west emplacement of the Mirdita ophiolite and thus an easterly spreading center, possibly located in the Vardar zone.