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Structure and Tectonics of Subophiolitic Mélanges in the Western Hellenides (Greece) and Implications for Ophiolitic Root Zones in the Balkans

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The Jurassic Vourinos ophiolite is part of the Western Hellenide ophiolite belt in Greece and rests tectonically on the Pelagonian ribbon continent. The Vourinos and coeval Pindos ophiolite to the west display suprasubduction-zone geochemical affinities, and represent remnants of oceanic lithosphere formed in a rifted incipient arc–forearc setting within the Pindos Basin. In structurally descending order, and from west to east, the subophiolitic mélange beneath the Vourinos ophiolite contains the Agios Nikolaos Formation (ANF) and a rift assemblage, both of which display ENE-vergent thrust faults, shear zones, and folds. The ANF comprises schistose mudstone with pebbles, cobbles, and boulders of arenite and wacke derived from the crystalline basement of Pelagonia. Imbricated along ENE-directed thrust faults and metamorphosed up to lower amphibolite facies, the ANF represents continental rise deposits of the rifted Pelagonian margin. The rift assemblage includes blocks of basaltic lavas, ribbon chert, micritic cherty limestone, metagabbro, dolerite dikes, and serpentinite breccia that are commonly in thrust contact with each other and are tectonically imbricated with the Pelagonian carbonates; however, primary intrusive and depositional contacts are locally well preserved. Gabbro and dolerite dikes are locally intrusive into the recrystallized carbonates and metapelitic rocks of Pelagonia. Lavas display mid-ocean ridge basalt–within plate basalt affinities and represent Upper Triassic rift units that erupted during the separation of Pelagonia from Apulia. Gabbro, dolerite, and serpentinite breccia are the products of a magmatic rifting episode prior to the onset of seafloor spreading in the Pindos Basin. The Vourinos subophiolitic mélange thus consists of passive margin and rift assemblages that were tectonically overridden by the Vourinos ophiolite in the middle Jurassic. Its internal structure and evolutionary history represent a tectonic mélange character of the Vourinos mélange. The Avdella mélange beneath the Pindos ophiolite to the west includes a chaotic matrix including ophiolitic clasts and blocks, reefal to pelagic limestones, and olistostromal turbidites that range in age from Triassic to Jurassic–Cretaceous. The Avdella mélange rests tectonically on a Cretaceous-Eocene flysch unit and the Cretaceous–Eocene shelf and slope deposits of the pre-Apulian margin along west-directed thrust faults. In comparison to its counterpart beneath the Vourinos ophiolite, the Avdella mélange has a longer, polyphase history of development and can be described as a block-in-matrix, polygenetic mélange, whose evolution involved both sedimentary and tectonic processes. The evolutionary history of the Vourinos and Avdella subophiolitic mélanges indicates diachronous tectonic emplacement of the Mesohellenic oceanic slab, first in the east as a result of a trench-continent (Pelagonia) collision in the middle Jurassic, then in the west due to the Eocene collision of Apulia with Eurasia. These structural observations, coupled with the existence of the parautochthonous igneous and sedimentary rift units along the western margin of Pelagonia, rule out those interpretations and models suggesting the westward tectonic transport of the Vourinos ophiolite and its subophiolitic mélange from the Vardar Zone to the east of Pelagonia. The Pindos ophiolite and the Avdella mélange beneath it were displaced westwards and emplaced onto the pre-Apulian platform carbonates as a result of the oblique collision between Eurasia and Apulia later in the Eocene.