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Tethyan ophiolites: Products of rift-drift, seafloor spreading & subduction zone tectonics of marginal basin evolution following the Gondwana breakup

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The Mesozoic ophiolites occurring along ~E –W-oriented, multiple strands of Tethyan suture zones extend from the Alpine–Apennine orogenic belt in the west through the Eastern Mediterranean orogenic belts in the Balkan, Anatolian and Arabian Peninsulas in the centre, to the Zagros, South Tibetan and Indo–Myanmar orogenic belts in the east. Some of the Tethyan oceanic lithosphere formed during the rift-drift stages of embryonic ocean basin development as the Gondwana supercontinent was dismantled in the Permo-Triassic through early Jurassic. The ophiolites magmatically constructed at this stage constitute *Continental Margin Ophiolites (CM*) and are commonly found as highly dismembered oceanic assemblages either tectonically intercalated with passive margin sequences and flysch units or within ophiolitic mélanges structurally beneath the younger ophiolites. Also included in these mélanges are thrust slices of high- to low-grade metamorphic rocks displaying inverted field gradients (granulite–amphibolite–greenschist) and representing metamorphic soles. The majority of the Tethyan ophiolites have internal structures (e.g. sheeted dikes, mineralized oceanic faults), exhibiting a seafloor spreading crustal architecture, and multiple generations of intrusions & volcanic sequences with distinctly different chemical affinities, as constrained by their crosscutting relationships, igneous stratigraphies and compositional variations. These features, combined with the geochemical fingerprints of both crustal and upper mantle rock units, suggest mid-ocean ridge (*MOR*) to suprasubduction zone (*SSZ*) tectonic settings of their igneous formation with increasingly depleted–ultradepleted mantle peridotite characteristics through time. These *MOR* to *SSZ* ophiolites may have formed either continuously in highly extended, external subduction zone environments in subduction rollback systems [1], or during different tectonic phases involving a geodynamic switch from MOR to forearc–embryonic arc development via internal SSZ evolution [2]. The *CMO* types within the Tethyan realm contain volcanic rocks showing N-MORB and G-MORB affinities with strong HREE/MREE depletion representing the products of partial melting of a heterogeneous sub-continental lithospheric mantle, and/or alkaline to calcalkaline extrusive rocks with E-MORB (enriched mid-ocean ridge basalt) and P-MORB (plume-influenced mid-ocean ridge basalt) affinities pointing to previous subduction and plume events in the Tethyan mantle dynamics [3, 4]. Mineral chemistry and textural relationships in *SSZ* ophiolites (e.g. interstitial cpx and amphibole in cpx-rich harzburgites) indicate refertilization of a MOR mantle by percolating hydrous melts at subduction initiation stages [2]. Both plume-driven and rollback-induced mantle updrafts played a major role in integrating ultrahigh-pressure (UHP) minerals, in-situ diamonds and native elements emanating from the mantle transition zones into rising peridotites and their chromitite deposits beneath oceanic spreading centres within Tethys [6]. Tectonic accretion of the Tethyan ophiolites was driven by a series of continent–trench collisions and continental underplating beneath intraoceanic arc-trench systems, prior to the terminal continent–continent collisions and the completion of the Wilson cycle evolution of the multiple Tethyan seaways.

References:

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