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Geological evidence of multiple north-dipping Mesozoic subduction zones within a c. 1000 km-wide Tethyan ocean between Arabia and Eurasia

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Our aim here is to stimulate debate concerning a vexing geotectonic problem: how to rationalise field-based geological evidence of up to five different N-dipping subduction zones within the Mesozoic Tethys in an oceanic area region that may have been <1000 km by the Late Cretaceous at the longitude of central-eastern Turkey, the region mainly considered here.

In one scenario, apparently consistent with some published seismic tomographic data, N-dipping subduction migrated southwards from near the Eurasian margin towards Arabia during later Mesozoic-Early Cenozoic. However, this is inconsistent with the geological evidence of northward subduction in both northerly (i.e. Eurasian margin) and southerly (e.g. N Cyprus; S Turkey) settings during Late Mesozoic-Early Mesozoic time. Geological evidence is disparate: arc magmatism and HP/LT metamorphism are compelling evidence of subduction but these features are not always exposed along ancient convergent margins; some other evidence such as correlation of ophiolitic lineaments can be subjective. Also, the potential role of strike-slip at different scales within the orogen remains poorly constrained.

Four or five (potentially interlinked) oceanic strands are commonly inferred for the central-eastern Anatolia region of Turkey based mostly on geological evidence. From N to S: 1. Ankara-Erzincan-Kars Ocean (AEKO) (major ocean); 2. Inner Tauride Ocean (ITO) (regional-scale ocean); 3. Berit Ocean (BO)(small ocean; between microcontinents); 4. S Neotethys (SN)(major ocean). Within AEKO two subduction zones are documented: i) Cretaceous continental margin subduction zone (i.e. E Pontide arc) and ii) Jurassic intra-oceanic subduction zone (i.e. Jurassic supra-subduction zone (SSZ) ophiolites & related arc magmatism). Associated with the ITO, there is evidence of Late Cretaceous SSZ-ophiolite genesis/arc magmatism and Late Cretaceous-Palaeocene HP/LT metamorphism. Ocean 3 (BO) is evidenced by Late Cretaceous SSZ-type ophiolite genesis, Late Cretaceous & Eocene continental margin arc magmatism and Late Cretaceous HP/LT metamorphism (e.g. SSZ-Berit ophiolite; Malatya-Keban arc; N. Bitlis blueschists). The SN is evidenced by Late Cretaceous SSZ ophiolite genesis (e.g. Troodos; Hatay; Baer-Bassit), arc magmatism (Kyrenia, N Cyprus) and accretion (Koçali Complex, SE Turkey). Three of the subduction zones seem inescapable (AEKO x 2 and NT). Elimination of the remaining two (ITO, BO) requires complex structural emplacement and/or terrane displacement, which are difficult to reconcile with the known field relations and the timing of events.

Acceptance of most or all of the five possible subduction zones would imply the existence of multiple SSZ-spreading episodes in which the ophiolites formed during relatively short-lived convergence events, both within a wide oceanic basin and between relatively closely spaced microcontinents. If broadly correct, this type of tectonic model has implications for regions where a single subduction zone hypothesis is currently preferred by some workers (e.g. Aegean region and former Yugoslavia).