Late Paleozoic- Early Mesozoic tectonics of Hainan Island: Key to understanding Paleotethyan geology

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In Southeast Asia, establishing the origin and associated tectonic setting of Late Paleozoic-Early Mesozoic igneous rocks is complicated by structural overprinting and the complex tectonic evolution of the Paleotethyan regime. Hainan Island, located at the south-eastern margin of the Paleotethys, and lacking significant tectonic overprints is a key to understand amalgamation history of the Indochina and South China blocks and to constraining the tectonic evolution of Paleotethys ocean in southeast Asia.

The Late Paleozoic-Early Mesozoic record of igneous rocks on Hainan Island includes the following. 1) ca. 350 Ma island arc andesites and ca. 330 Ma metabasites, the latter with both MORB- and arc-like geochemical affinities, positive εNd(t) values of +5.86 – +9.85 and rare inherited zircons with a zircon age of 1400 Ma inferred to be derived from a MORB source with the input of a slab-derived component. Together with the ~350 Ma island arc andesites, the Carboniferous tectonic environment is supposed to be a continental back-arc basin setting. 2) Late Permian gneiss granitoids (272-252 Ma) characterized by a gneissic foliation and calc-alkaline I-type geochemical affinities with negative Nb-Ta and Ti anomalies, related to metasomatized mantle wedge modified by the sediment-derived component in a continental arc setting. 3) ca. 257 Ma arc-like andesites, which further validate a subduction-related setting. 4) Peraluminous Early-Middle Triassic massive granitoids (251–243 Ma) with slightly high A/CK ratios, δ18O values (up to 11.75 ‰) and Sr/Y ratios, inferred to have formed in a compressive regime from a mixed source of greywacke and metabasite. 5) Middle-Late Triassic (242–225 Ma) high-K calc-alkaline granitoids with high zircon temperatures (842–867°C) and geochemical signatures of A-type granites. They show slightly low whole-rock εNd(t) and zircon εHf(t) values, suggestive of the derivation from a metabasite–greywacke source in an extensional setting. 6) ca. 240 Ma gabbro-dolerites showing enrichment in LILEs, depletion in HFSEs, negative εNd (t)-εHf (t) values (–8.45 to –1.05 and –5.9 to –2.7, respectively) and crustal-like δ18O values (7.26–8.70‰), it is implied that the Hainan Island entered into post-collisional environment in response to the asthenosphere upwelling shortly after the closure of back-arc basin.

Thus, Hainan Island provides a record of Carboniferous back-arc basin opening, followed by an extended Permian–Triassic history of subduction-related consumption leading to orogenic assembly and extensional collapse between the South China and Indochina blocks. Such a tempo-
spatial pattern is consistent with that along the Song Ma-Ailaoshan suture zone rather than the magmatic history of eastern South China and indicates that the Paleotethys extended west to at least Hainan Island in the Late Paleozoic-Early Mesozoic.