The evidence of Palaeotropics and the Gondwana-derived terrane: an alternative scenario of the Palaeotethys divide in SE Asia

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Along the Northern part of the West Thailand Region (NWTR), a long-lasting belt of radiolarian cherts, separates Pennsylvanian to Permian palaeotropical limestones of the Inthanon Zone to the east from Permian limestones in the west containing a temperate marine fauna in the Roadian and a biogeographically distinctive fusulinid fauna in the Wordian. Highly abundant but low diversity of Kungurian radiolarians in silicified shales as well as temperate faunas in limestones from the south and the west of Thailand, respectively support constrains in the temperate environment during the period of deglaciation in peri-Gondawana. The well-known underlying diamictite and overlying temperate sediments with the succeeding fully tropical limestone sequences support a gradational palaeoclimate transition. Devonian faunas found in condensed sequences of the NWTR were deposited in a deep platform or ramp environment. A lack of basalts in the NWTR does not suggest oceanic environments for any Palaeozoic sequence within the NWTR and a paucity of basalts in the northwestern part of the Inthanon Zone also does not provide good evidence of an oceanic realm. Indeed, 'continental margin' Carboniferous sandstones appear to underlie the palaeotropical limestones and their plant fossils and their benthonic faunas do not suggest oceanic conditions in the northwestern Inthanon Zone. We, therefore, suggest that an autochthonous or para-autochthonous Inthanon Zone origin for these Carboniferous sandstones is more likely than deposition within a subducting Palaeotethyan Ocean.

A strong contrast between the 'temperate' Permian limestones of the NWTR and the tropical limestones of the Inthanon Zone further emphasises the Mae Yuam/Mae Sariang Fault Zone (MYMS FZ) as a reactivated oceanic boundary between Gondwana and 'Cathaysia' and is supported by the oceanic lithosphere origin of the detrital Cr spinels in the Triassic foreland basin siliciclastics of the NWTR. The limestones of the Inthanon Zone range from Visean to Permian and possibly Triassic and were deposited in shallow, tropical seas for over 90 million years. This longevity is either not possible or highly unlikely for shallow marine carbonates on volcanic seamounts supported on subducting (and therefore cooling and sinking) ocean crust (Huppert *et al*., 2020) but is possible on isolated carbonate platforms on continental crust separated by narrow basins with limited volcanism. Carboniferous sandstones and Devonian-Permian radiolarian cherts from the Inthanon Zone are continental marginal and are neither pelagic nor oceanic and are interpreted as deposited in extensional, deeper basins between the isolated carbonate platforms.

We suggest an alternative hypothesis to the overthrust/allochthon model where the NWTR is the eastern platform margin of the Sibumasu Terrane from the Devonian through to the Triassic and separated from the Inthanon Terrane by an ocean in the position of the MYMS FZ. It is suggested that Inthanon rifted from Gondwana in the Early Devonian and the NWTR, as part of the Sibumasu Terrane, rifted off in the early Permian. As the Inthanon Terrane ribbon continent drifted northwards the continental crust thinned and extended and small rift basins allowed basalts to be extruded associated with deep-water, continental margin, hemipelagic, non-hydrothermal radiolarian oozes. Isolated carbonate platforms were established on Carboniferous sandstone bases and were separated by deep-water but non-pelagic extensional basins. Turbidites originating on the carbonate highs supplied carbonates clasts containing Devonian through Permian conodonts, to the adjacent basins (Udchachon *et al*., 2018). We provisionally suggest that the Sukhothai Terrane rifted with Inthanon with its older siliciclastic successions of the Siluro-Devonian (?) Khao Kieo Formation and the unconformably overlying Carboniferous (Dan Lan Hoi Group) (Bunopas, 1982; Ueno & Charoentitirat, 2011) supplying siliciclastic and volcaniclastic debris to the Inthanon Zone. This hypothesis is broadly in accord with Dew *et al*.'s (2018) 'explanation A' for the crustal geochemistry of the northern Thailand terranes. In the early Permian (Kungurian) Sibumasu was probably in cool to temperate seas but by the middle Permian, the NWTR had rifted from Gondwana and was in the southern hemisphere tropics (13° ±2° S, Zhao *et al*., 2020). Terrane collision occurred during the Triassic (Ishida *et al*., 2006; Mitchell *et al*., 2012; Cai *et al*., 2017; Hara *et al*., 2021) with the establishment

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of a thrust front along the Mae Sariang Thrust Zone and the deposition of the mainly siliciclastic Mae Sariang Group on the NWTR within a foreland basin.

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