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Current Status of Triassic Stratigraphy of Thailand and Its Implication for Geotectonic Evolution

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INTRODUCTION

Triassic sedimentary sequences occur extensively in Thailand. They are predominantly marine except in northeast Thailand, where they are exclusively continental. The stratigraphy of the marine Triassic sequences and its biostratigraphic subdivision were discussed in detail by Chonglakmani and Grant-Mackie (1993). The geotectonic evolution of Thailand and her adjacent terriories has been discussed by many workers. Previous proposed models are varied and inconsistent because of the disagreement on suture identification, correlation of various suture belts, and closing time of remnant oceans. Parts of the confusion stems from Thailand's complex geology and from mis-interpretation of the Triassic marine strata. Detailed study of Triassic stratigraphy, paleontology and sedimentology including related volcanism, magmatism and structural development is critical for understanding the geotectonic evolution and imposing constraints on the proposed models.

TRIASSIC SEDIMENTARY FACIES

Four distinct Triassic sedimentary facies can be distinguished in Thailand. These are the continental facies, continental platform facies, marine associated with volcanic facies, and deep marine and oceanic facies.

Continental Facies.

The Triassic continental facies is widely exposed in northeastern Thailand along the edge of the Khorat plateau. In the subsurface of the plateau proper this facies is overlain by thick beds of the Jurassic-Cretaceous Khorat Group. This facies consists predominantly of siliciclastics rocks deposited in alluvial fan, fluvial and lacustrine environments. It is khown as the Huai Hin Lat Formation and was dated by fossils as Norian (Chonglakmani and Sattayarak, 1978). This formation contains typical *Dictyophylum-Clathropteris* warm climate flora (Kon'no and Asama, 1973). The Kuchinarai Formation, which occurs in the subsusface, is considered to be equivalent to the Huai Hin Lat Formation. In other parts of the country, this continental facies occurs as minor units intercalated with the marine shelf strata of the continental platform and marine associated with volcanic facies.

Continental Platform Facies.

The continental platform facies consists of shallow marine clastic and carbonate beds. It has no volcanic rocks. The facies was deposited in the Shan-Thai block.

The western part of the Shan-Thai block consists of Lower Mae Moei and Si Sawat groups. These groups are exposed extensively in the northwest and west areas of Thailand (Braun and Jordan, 1976; Hagen and Kemper, 1976; Kemper, Maronde, and Stoppel, 1976). Correlative units in the southern regions are the unnamed Triassic limestone in the upper peninsular Thailand (Fontaine *et al.*, 1993a) and Kodiang Limestone in northwest Malaysia (De Coo and Smith, 1975).

The Chiang Mai terrane of central Shan-Thai block consists of discontinuous exposures of shelf carbonate deposits that belong to the Phrao Limestone in the north, Klaeng Limestone in the east, and Sabayoi and Khlong Kon Formations in the south (Grant-Mackie *et al.*, 1980; Fontaine and Vachard, 1981; Hahn and Siebenhuner, 1982). The fauna found in these predominant shelf carbonates rocks ranges from Scythian to early Norian in age.

Marine Associated with Volcanic Facies.

The marine associated with volcanic facies occurs only in the eastern part of Shan-Thai block. It consists of the shallow marine siliciclastics and carbonates strata, basinal turbidites and the rhyolitic and andesitic volcanic rocks. These sequences are represented by the Scythian-early Carnian Lampang Group and the early Norian Phrae and Nam Pat groups in the north and by the early Carnian Pong Nam Ron Formation in the east. The correlative unit in Malaysia is the Semantan Formation of the Central Belt (Jaafer, 1976).

Prolific invertebrate faunas occur in the shelf clastic and carbonate strata and in the turbidites. These faunas include ammonites, bivalves, conodonts, algae, foraminifera, and brachiopods and have been divided into five ammonite, six bivalve and six conodont zones. The fossils in these zones suggest an early Induan to early Norian age.

Deep Marine and Oceanic Facies.

The deep marine and oceanic facies occurs in two linear belts. One belt is discontinous between the Chiang Mai (central Shan-Thai) and Sukhothai (eastern Shan-Thai) terranes. This belt originates in Chiangrai, where it occurs as isolated sheets of pelagic Fang Chert overthrust on shallow marine carbonate and siliciclastic strata of the Chiang Mai terrane. It ranges in age from the Devonian to Middle Triassic (Jaeger *et al.*, 1969; Sashida *et al.*, 1993; Caridroit, 1993). This belt extends southward and is exposed at Chantaburi, where pillow basalt occurs associated with Middle Triassic radiolarian chert of the Laem Ngop Formation (Hada *et al.*, 1997). The long age range of this oceanic realm is supported by the Carboniferous radiolarian chert that also occurs in this area (Salyapongse, 1992). The other belt is exposed in Mae Sariang as the Mae Sariang Group and extends southward to Tak, Mae Sot, Kanchanaburi, and to Songkhla, where it is known as the Na Thawi Formation. This facies consists maninly of radiolarian chert, pelagic limestone, and turbidites (Caridroit *et al.*, 1993; Chonglakmani and Grant-Makie, 1993; Tofke *et al.*, 1993). It can be correlated with the Semanggol Formation of the Kulim-Taiping zone in northwest Malaysia. An equivalent facies consisting of chert, meta-argillite, red shale, limestone and deepwater rhythmite occurs in central Sumatra (Eubank and Makki, 1981).

LATE PALEOZOIC – TRIASSIC GEOTECTONIC EVOLUTION OF THAILAND

It was generally accepted by geologists engaged in the study of geotectonic evolution of Southeast Asia that the region is built up by two distinct continental blocks, the Shan-Thai block on the west and the Indochina block on the east (Bunopas, 1982). The Paleo-Tethyan ocean between these two blocks was closed in the Late Paleozoic – Triassic by the processes of subduction and continental collision. It was represented by the Nan-Uttaradit suture zone.

However, the well-known Nan-Uttaradit suture can not be regarded as the remnant of the main Paleo-Tethys dividing the Indochina block (Cathaysian domain) from the Shan-Thai block (Peri-Gondwana domain). The Carboniferous and Permian fauna (fusulinid and coral) found in northern Thailand is closely allied with those of central Thailand (Baum *et al.*, 1970; Fontaine *et al.*, 1993b). The Shan-Thai block should be included in the Cathaysian domain and paleogeographically was close to the Indochina block at that time.

The candidate for the main Paleo-Tethyan ocean should be located west of the Shan-Thai block. In southern Thailand, the stratigraphic sequence comprises Devonian-Early Permian glacio-marine diamictites with Gondwana-related brachiopod faunas (Phuket Group) succeeded by Middle to Late Permian carbonates (Ratburi Group) with poor foraminifera (*Monodiexodina*, *Eopolydiexodina*, and *Shanita*) and rare coral. This sequence is markedly different from those known in the Shan-Thai and Indochina blocks. The boundary between the Phuket terrane (including southern Thailand and northwest Malaysia) and the Shan-Thai block should be regarded as the main Paleo-Tethyan remnant representing the oceanic realm from Devonian to Late Traiassic. This boundary extends northwestward from the Three Pagoda Fault in western Thailand to Mandalay in eastern Myanmar (Mitchell, 1992).

Paleobiogeographically, the Indochina and the Shan-Thai blocks were in warm tropical province in the Permian period. The Phuket terrane in the Early Permian was still close to the Gondwana province and translated northwards approaching the Shan-Thai in the Middle to Late Permian time. The Late Permian brachiopod and fusuline and Early Triassic bivalve faunas of the Shan-Thai block are closely allied to the South China faunas suggesting the paleogeographic proximity of these two regions in the northern Tethys province at that time.

The marine Triassic strata distributed in Lampang and Phrae areas were predominantly shallow marine deposited in the intramontane basins subsequent to the closure of Nan-Uttaradit suture in Middle-Late Permian time. In the Devonian to Late Triassic, the sequences consisting of platform carbonate, siliciclastic turbidite, and thin-bedded chert were deposited on the western margin of the Shan-Thai block bordering the main Tehtyan ocean basin. This basin was closed in Late Triassic – Early Jurassic by subduction of the Shan-Thai block beneath the Phuket terrane. The Triassic radiolarian chert recently found in the vicinities of Chiang Mai and Nan may have been translated eastward from the western part of the Shan-Thai block.

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