Proto-South China Sea and South China Sea Early History: A View from Sarawak

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Sarawak contains important information concerning the crust that rifted to form the South China Sea, and the pre-rifting history of the region. We report results of new field investigations, sediment provenance studies including U-Pb dating of detrital zircons, U-Pb dating of zircons from granitoid rocks, and Ar-Ar dating of metamorphic rocks, that require significant revision of previous interpretations.

Haile (1974) divided Sarawak (Figure 1) into the predominant terrestrial Kuching Zone (West Sarawak and Northwest Kalimantan), the deep marine Sibu Zone (Central Sarawak) and the marginal marine to fluvial Sibu Zone (North Sarawak). The West Borneo Basement or Pontianak Zone (Hutchison, 2005) is located south of Sarawak and is composed of the Schwaner Mountains.

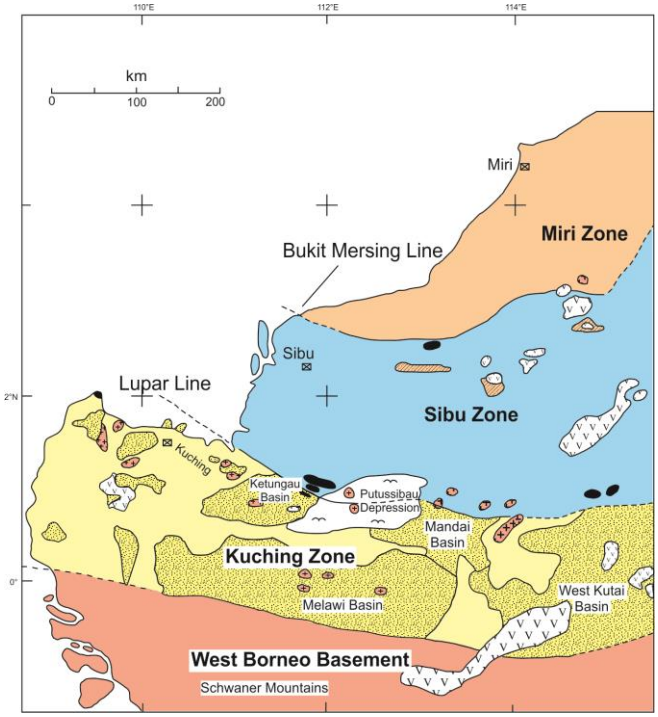

Figure 1 Structural divisions of Sarawak (modified after Haile, 1974).

Undated metamorphic rocks in Sarawak were assumed to be Palaeozoic basement and older than unmetamorphosed Permo-Carboniferous limestones although contacts with younger rocks have not been observed. Fossils indicate Cathaysian affinities for the limestones (e.g. Vachard, 1990). New Ar-Ar dating of white micas from two samples of supposed basement schists in West Sarawak yielded Triassic ages. Triassic volcanic and volcaniclastic rocks are widespread in West Sarawak, and we obtained Triassic U-Pb magmatic ages from zircons in the Jagoi granodiorite. Triassic U-Pb magmatic ages have recently been reported from zircons in metatonalites of NW Kalimantan (Setiawan et al., 2013), and earlier K-Ar dating of NW Kalimantan granitoids obtained many Triassic ages (Bladon et al., 1989). We suggest that metamorphism was associated with contemporaneous volcanic arc magmatism recording Triassic subduction and collision. Figure 2 displays the revised stratigraphy for Sarawak.

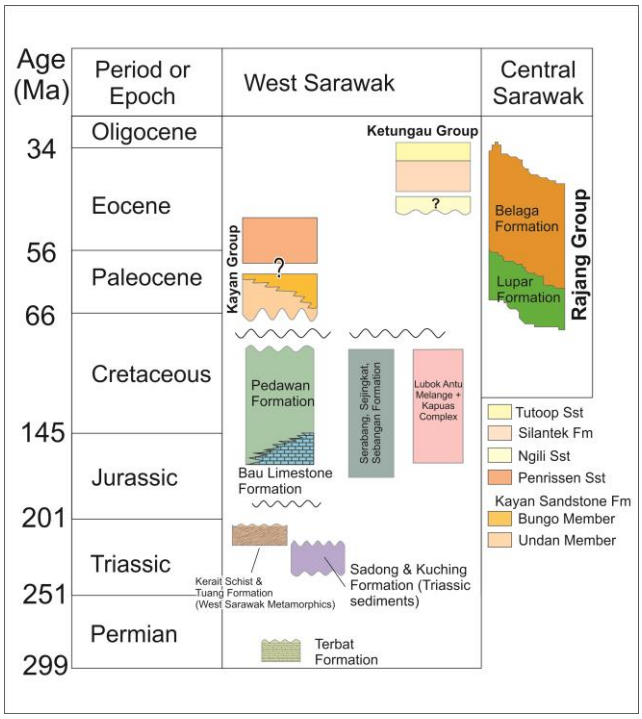

Figure 2 Stratigraphy of West and Central Sarawak.

A change in tectonic setting is indicated by the deposition of the shallow marine Bau Limestone and deep marine Pedawan Formation between the Late Jurassic and Early Cretaceous. The clastic Pedawan Formation has very different zircon age populations from Triassic volcaniclastic sediments. We infer subduction below West Sarawak from the Late Jurassic until the early Late Cretaceous. One sample of supposed basement schist in West Sarawak yielded Early Cretaceous Ar-Ar ages from white micas. The variety of rock types, range in ages, and their distribution in Sarawak, offshore wells, and dredge samples from the Dangerous Grounds, suggest that

northwards from Sarawak and northern Kalimantan is a complex heterogeneous basement that formed by accretion of material at the East Asian subduction margin between the Triassic and early Late Cretaceous.

Collision of the SW Borneo Block, rifted in the Late Jurassic from Australia, terminated subduction in the early Late Cretaceous. Deep marine sedimentation ceased, and the area was subsequently uplifted resulting in the Pedawan–Kayan regional unconformity.

After subduction ceased, from the Late Cretaceous to the Late Eocene, fluvial to shallow marine sediments of the Kayan Group and Ketungau Group were deposited in West Sarawak (and NW Kalimantan), and deep marine sediments of the Rajang Group were deposited in Central Sarawak. These two sedimentary provinces are separated by the Lupar Line (e.g. Tan, 1979). Heavy mineral and U-Pb detrital zircon ages indicate a similar provenance for the sediments to the north and south of the Lupar Line and suggest a connected large-scale sedimentation system. Heavy mineral assemblages and detrital zircon ages indicate an alternation of Cretaceous and Triassic sources. The Schwaner Mountains are interpreted to be the main Cretaceous source, and the Malaysian Tin Belt, and possibly rocks in Borneo, was the Triassic source (see Figure 3). Detrital input from the Indochina margin can be excluded.

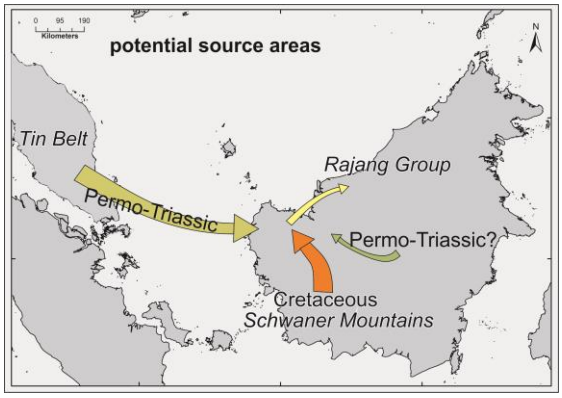

Figure 3 Transport and potential source regions for Late Cretaceous to Cenozoic sediments.

Deep marine sedimentation ceased in the Late Eocene. Hutchison (1996) interpreted this change to record the so-called Sarawak Orogeny, which he interpreted as the result of collision of a Balingian-Luconia microcontinent with SW Borneo after closure of the Proto-South China Sea. However, syn-depositional deformation in the Rajang Group indicates a tectonic history more complex than a single orogenic event. We suggest the major Late Eocene change followed the renewal of subduction around Sundaland. The Crocker Fan of Sabah was deposited during Late Eocene to Early Miocene subduction of the Proto-South China Sea beneath Sabah, northeast of the West Baram Line. In Sarawak, to the southwest of the West Baram Line, there was shallow marine to fluvial sedimentation and no subduction.

Acknowledgements

This study was supported by the Southeast Asia Research Group (SEARG). We thank consortium members: ENI, INPEX, GDF Suez, Murphy Oil, Repsol, Shell, and Statoil.

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