

## Tectonic framework of the Neogene basins of Sabah

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The ophiolitic basement of Sabah is of Neocomian age (lowermost Cretaceous), which has yielded K:Ar ages on gabbro (137 Ma) and on banded meta-gabbro (131 Ma). These ages are consistent with the dating of the overlying ribbon cherts by radiolaria as Barremian. The gabbro layer contains ophiolitic plagiogranite bodies in the Segama area. However there is at least one Jurassic potassium-rich granite, which has yielded K:Ar dates as old as 156 and 210 Ma, suggesting that the Lower Cretaceous oceanic Danau Sea contained continental microcontinents, which have been tectonically incorporated in the obducted ophiolite. The Rajang Group of Sarawak continued into Sabah as the Trusmadi Formation and was metamorphosed and uplifted by late Eocene time.

Oligocene through early Miocene time experienced extensive deep water sedimentation across Sabah. The West Crocker Formation has deep water equivalents occurring extensively between Telupid and the Sulu Sea coast as the redbed Kulapis and Labang formations, which both have deep water characteristics. Within the Labang outcrop occur an E-W zone of shallow water Gomantong Limestone.

Mount Kinabalu and its satellite intrusions have yielded K:Ar dates as old as 14 to 19 Ma. The 500–300°C cooling history of the Kinabalu batholith is now recognized from fission track data to have occurred from 13.7 to 10 Ma at rates greater than 55°C per million years. This suggests extremely rapid exhumation rates of  $600 \pm 100$  metres per million years, similar to those observed on Mount Everest. This is consistent with the exposed sandstones and pillow basalts near Telupid which contain porphyroblasts of glaucophane and piemontite. The region had been under glaucophane-epidote high pressure static metamorphism before this dramatic exhumation.

The spectacular uplift of the Crocker Ranges and their rapid erosion provided the nearby provenance for the Baram Delta. The cause of the uplift may be sought in southeastwards underthrusting of continental crust along the Northwest Borneo Trough.

By strong contrast, the fission track data from the eastern province (Sandakan and Tanjong Formations) indicate that these formations have never been heated to  $> 90^\circ\text{C}$  and have never been buried by more than 2 km of overburden since their Miocene deposition.

Volcanic rocks of the Semporna Peninsula are also older than previously thought, with K:Ar ages as old as 10 to 18 Ma. This has strong implications for sandstone reservoir quality in the Miocene basins of this province.

The two regions of Sabah with strongly contrasting uplift histories are separated by the major Labuk ophiolite, which outcrops extensively around Telupid, and it exhibits thrust contacts with the Miocene Garinono Formation *mélange*.

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