# Multiple collisions on the southeastern margin of Sundaland: The tectonic evolution of Sulawesi

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## Laporan (Report)

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## Abstrak (Abstract)

It is now generally recognised that Southeast Asia (Sundaland) has been constructed since the Late Palaeozoic by the successive collision of continental fragments. Along the southern margins of Sundaland, in Sumatra and Eastern Indonesia, this process of accretion still continues at the present day. In the early Cretaceous the southeastern margin of Sundaland lay in Borneo. From that time until the present, subduction and accretion have added oceanic and microcontinental material to this margin. The history of collision and accretion is clearly documented in the Indonesian island of Sulawesi.

In Western Sulawesi the oldest basement rocks are serpentinite, pillow basalt, chert and sediments of oceanic origin, formed at a subduction trench by the offscraping of ocean floor materials in an accretionary complex. Some of these components were evidently carried down deep in the subduction zone to be metamorphosed under high pressures to form eclogites, gneisses and glaucophane schists which give cooling ages of 132–113 Ma (Early Cretaceous). Uplift and erosion was followed in the Late Cretaceous by subsidence and the development of a forearc basin on top of the accretionary complex, with the deposition of cherts and turbidites. In the Eocene the area became stabilised as part of the continental margin of Sundaland, with the development of rifts, filled with terrestrial sediments containing coal deposits in an extensional regime. The area then subsided to form part of an extensive carbonate platform, deposition of carbonates continuing until the mid-Miocene.

The accretion history can be followed in Central and Eastern Sulawesi. Central Sulawesi is composed of rocks of oceanic and continental origin now metamorphosed in the amphibolite, greenschist and glaucophane schist facies, overlain by mélange, and then by a major ophiolite complex, which forms the whole of the East Arm. Detailed petrographic, geochemical and isotopic analyses of the metamorphic rocks show that the amphibolite and

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greenschist facies rocks were formed by westward subduction of a microcontinental fragment. Isotopic ages from these rocks show that they were metamorphosed in the Early Cretaceous, at the same time as the basement in Western Sulawesi. Glaucophane schist metamorphism affects both earlier metamorphic rocks and the mélange, which is overlain to the east by a high temperature metamorphic sole beneath the East Sulawesi Ophiolite. Formation of the mélange and metamorphism were due to mid-oceanic subduction towards the east. Subduction ceased at 28 Ma (Oligocene), when Sundaland ran into the subduction zone, and the ophiolite was obducted onto the continental margin.

Westward subduction then commenced beneath the eastern margin of the ophiolite, terminating in the mid-Miocene when the Banggai-Sula microcontinent ran into the subduction zone. Banggai-Sula originated as a fragment of Australia separated in the Jurassic, which was carried westwards along the Sorong Fault Zone by the movement of the Philippine Sea Plate. This collision had repercussions throughout Sulawesi. The collision zone in the East Arm is marked by the imbrication of Banggai-Sula continental margin sediments with slices of the ophiolite. The metamorphic rocks of Central Sulawesi were thrust across Western Sulawesi, and uplifted blocks of the basement were thrust westwards across the Eocene-Mid-Miocene carbonate platform. The downgoing continental rocks subducted beneath Western Sulawesi gave rise to a volcanic arc in which the volcanic rocks reveal the geochemical signature of their Australian origin.

Evidence from the tectonic evolution of Sulawesi shows that the southeastern margin of Sundaland has grown since the Early Cretaceous by the process of collision and accretion, with the addition of material of both oceanic and older continental origin. It evidently does not matter whether subduction was eastwards, away from the margin, or westwards towards the margin, the net effect was that material was added to the continental margin. The next major event will be the collision of the Australian continent with the southeast margin of Asia.