THE MOUNT KINABALU GRANITE OF NORTH BORNEO: RESULT AND CAUSE OF OROGENIC DEFORMATION

Rober Hall

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Department of Geology, University of Malaya

Prof. Dr. Robert Hall is Professor of Geology and Director of the SE Asia Research Group at Royal Holloway University of London. His talk entitled "The Mount Kinabalu granite of North Borneo result and cause of orogenic deformation" was well attended by about 40 geoscientists from the industry and academic. The talk is a joint project by Robert Hall, Michael Cottam and Christian Sperber from SE Asia Research Group, Department of Earth Sciences, Royal Holloway, University of London and Richard Armstrong from PRISE, Research School of Earth Sciences, The Australian National University. The abstract of the talk is given below:

Abstract: Mount Kinabalu is a granite body in north Borneo that intrudes rocks deformed in the Early Miocene Sabah Orogeny following subduction of the South China continental margin beneath the north Borneo margin. It is the highest mountain in SE Asia at 4100m and ice action during Pleistocene glaciations has resulted in excellent exposure of the summit area. It has an unusual position at the end of the mountain range and rises dramatically above the nearby peaks of the Crocker Ranges 2000 m below. The granite has previously been interpreted as a compositionally zoned, steeply sided pluton with a central biotite granodiorite, surrounded by hornblende granite and a marginal porphyritic facies. New zircon U-Pb SHRIMP ages record emplacement and crystallization. Zircon fission track data and apatite (U-Th)/He dates record the development and exhumation of the orogen. The age data with field, petrological and geochemical observations suggest a new interpretation of Kinabalu's structure, emplacement history and links to regional tectonics.

U-Pb SHRIMP analyses of growth zones in zircon record crystallisation of the granite between 7.85 and 7.22 Ma. Age data support models relating the Kinabalu granite to deep crustal anatexis not subduction. Inherited zircon ages suggest melting of deep crust, including South China continental crust and arc basement rocks. SHRIMP dating also provides insight into rates of magmatic processes. The entire pluton was emplaced and crystallised within a period of less than 700,000 years, with at least four pulses of magmatism, each lasting about 100,000 yrs. Zircon fission track data record post-crystallisation cooling but abundant dislocations make apatite fission track data unreliable. Apatite (U-Th)/He ages have a broadly concentric pattern. The thermochronological data indicate cooling of the granite was a response to growth of topography and rapid exhumation of the orogen.

We interpret all these data to indicate that Kinabalu has a sheet-like character with the oldest biotite granite near the summit. The porphyritic facies represents the last and deepest major intrusive pulse. There was significant topographic expression by around 6 Ma with subsequent NE-SW trending extensional faulting on the south side of the body. The unusual tectonic setting of Kinabalu suggests links between granite formation, exhumation, offshore sedimentation and deformation, and the mantle. After Early Miocene collision and emergence much of Sabah subsided and shallow water sediments were deposited over most of the area. Probable Late Miocene emergence of most of Sabah was associated with a change in character of magmatism in South Sabah as well as melting of the deep crust beneath Kinabalu. We suggest the granite is the product of collision-related crust and lithospheric thickening in the Sabah orogeny, but is now itself driving fold and thrust deformation offshore after rapid uplift and exhumation following loss of a deep lithospheric root.

Photographs of Mount Kinabalu curtesy of Prof Dr. Robert Hall.

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