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Sourcing granitic melts through basalt fractionation and the problem with crustal anatexis: Evidence from Mt Kinabalu, Borneo, and Equilibrated Major Element AFC modelling (EME-AFC)

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Despite hundreds of years of research into granites, the derivation of their magma and consequently the development of the continental crust remains a subject of contention. Geochemical data collected from the multiple units of the composite, 4000m high granitic intrusion of Mt Kinabalu in Sabah, Malaysian Borneo, provides an opportunity to test some of these potential processes and explore their implications.

Anatexis of crustal sources is shown not to be a suitable mechanism to generate Mt Kinabalu based on experimental evidence. Collated experimental data reveals that no crustal sources, nor mixture of sources, would produce a primary melt with a suitable major element composition. An earlier hypothesis of incongruent dehydration melting of tonalites is disproven based on new Pb isotope data. Fractionation of an OIB-like basaltic mantle-derived melt, generated by regional Neogene extension and resembling late Miocene to Pliocene erupted basalts from elsewhere in Borneo, is proposed as the source. Felsic melts were produced through the crystallisation of plagioclase and hornblende-rich cumulates with simultaneous incongruent assimilation of immature, biotite-rich metasediments. A new method for modelling major element fractionation is presented (EME-AFC) and compared with published experimental data, revealing that the principal controls on chemical variation between the units of Mt Kinabalu are the extent of differentiation, the amount of assimilation and the effect of both of these on water content and mineral stabilities in the melt.