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A new approach to modelling differentiation (with particular focus on granitic magmatism): Equilibrated Major Element Assimilation with Fractional Crystallisation (EME-AFC)

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We present the new approach to AFC modelling published as Editor's Choice in the July 2019 issue of *Journal of Petrology* [1].

Our new, Equilibrated Major Element – Assimilation with Fractional Crystallisation (EME-AFC) approach simultaneously models the major element, trace element, and radiogenic and oxygen isotope compositions during such magmatic differentiation (including a new approach to oxygen modelling); addressing the lack of current AFC modelling approaches for felsic, amphibole- or biotite-bearing systems. We discuss the application of this model to granitic magmatism in SE Asia and Antarctica, with particular focus on the Mt Kinabalu granitic intrusion of Borneo. We discuss the background to the model, and explain how it can be freely accessed via GitHub [2], and applied to other scenarios of magmatic differentiation; not just granitic magmatism.

We present new geochemical data for the composite units of the Mount Kinabalu, and use this to explore the discrimination between crustal- and mantle-derived granitic magmas. The isotopic data (oxygen, Hf, Sr, Nd, and Pb) indicate that the magma cannot be the result only from fractional crystallisation of a mantle-derived magma. Alkali metal compositions show that crustal anatexis is also an unsuitable processes for genesis of the intrusion. Using the new EME-AFC modelling approach, we show that the high-K pluton was generated by fractional crystallisation of a primary, mafic magma followed by assimilation of the partially melted sedimentary overburden. We propose that Mt Kinabalu was generated through low degree melting of upwelling fertile metasomatised mantle driven by regional crustal extension in the Late Miocene.

[1] Burton-Johnson, A., Macpherson, C.G., Ottley, C.J., Nowell, G.M., Boyce, A.J., 2019. Generation of the Mt Kinabalu granite by crustal contamination of intraplate magma modelled by Equilibrated Major Element Assimilation with Fractional Crystallisation (EME-AFC). *J. Petrol.* 60, 1461–1487.

[2] <https://github.com/Alex-Burton-Johnson/EME-AFC-Modelling>