Petrogenesis of the Early Indosinian Meiwu batholith from West Qinling, central China: implication for the cause of compositional diversity of composite batholith

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Field, geochemical, Sr-Nd-Hf isotope and geochronologic data have been used to evaluate the cause of composition diversity and the construction history of upper crustal composite batholiths. The Meiwu batholith is a zoned, calc-alkaline plutonic complex in the middle part of the west Qinling, central China. It is composed of quartz diorite, granodiorite and biotite granite, with abundant mafic enclaves and minor felsic enclaves in the granodiorites. The magma crystallization age of the Meiwu batholith is ~240-245 Ma. Geochemical and Sr-Nd-Hf compositions indicate that the magma source of the quartz diorites and mafic magma enclaves was dominantly derived from an enriched mantle-source, followed by variable degrees of hybridization with crustal melt. The hybridization occurred before the magma emplacement. The outer part (fine-grained) of the quartz diorite pluton has much larger zircon εHf(t) variation, suggesting that it crystallized at a rapid cooling condition and thus preserved its initial heterogeneities. While the inner part (medium-grained) of the quartz diorite pluton shows homogeneous εHf(t) variation, suggesting that it may crystallize from a convective homogenous magma chamber. The tonalitic enclave has adakitic geochemical signatures (e.g. high Sr/Y, low Yb and Y). Together with its Sr-Nd-Hf isotopic compositions, we suggest that its magma was most likely derived from partial melting of thickened mafic lower crust. The magma of the granodiorites and biotite granites was dominantly derived from crustal source. However, the granodiorites also show relatively high Mg#, Cr, and Ni suggesting a minor contribution from mantle source. The granodiorites were constructed by successive accumulate of the discrete melts generated at different depths; while the biotite granites consist of incrementally assemble magma batches that formed by the increase degree of partial melting of a common source. The different rock types exhibit distinct geochemical variation, indicating that the Meiwu batholith was constructed by multiple magma injection and pulses over a protracted period, rather than a single larger magma chamber. The compositional variations of the composite batholiths are mainly inherited from the source processes.