Rapid but stepwise exhumation of a Miocene UHT migmatite complex by slab rollback in eastern Indonesia

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Eastern Indonesia, at the heart of the SE Asia–Australia convergence zone, is a region of active subduction incorporating young magmatic and metamorphic complexes that are preserved in their original tectonic settings. Within Eastern Indonesia, the northern Banda Arc incorporates ultrahigh-temperature (UHT; > 900˚C) metamorphic rocks as part of the Kobipoto Migmatite Complex, generated during the Miocene in response to rollback-driven extension.

Several geochronological (U–Pb zircon, U–Pb monazite, Lu–Hf garnet, Sm–Nd garnet, $^{40}Ar/^{39}Ar$ biotite, and $^{40}Ar/^{39}Ar$ white mica), microchemical (REE analysis of zircon and garnet), and thermobarometry techniques have now been applied to these UHT migmatites exposed on the island of Seram. Puzzlingly, the $^{206}Pb/^{238}U$ zircon, $^{206}Pb/^{238}U$ monazite, and $^{40}Ar/^{39}Ar$ (furnace step heating) biotite ages that relate to the UHT metamorphic event are all *identical within error* (15.9 ± 0.2 Ma), including those obtained from samples located > 200 km away within a different metamorphic complex. This result would appear to challenge conventional interpretations of high-grade migmatites experiencing long-lived metamorphic histories culminating in slow/moderate cooling, when distinct ages are expected to be recorded sequentially by isotopic systems of decreasing closure temperatures. We argue the tight synchroneity is accounted for by short windows of mineral growth during pulsed tectonic 'shuffling' (extension and shortening), driven in this instance by rollback of the adjacent Banda subduction zone.

However, the apparent rapidity of the entire metamorphic cycle is likely an illusion; high-temperature (800–925˚C) conditions in the northern Banda Arc must have persisted for > 12 Myr because U–Pb zircon ages from different parts the migmatite complex record ages as recent as 3.5 Ma. We show that the contraction of metamorphic ages for single localities is best explained by rapid but stepwise localised exhumation within low-volume bodies of migmatites for which zircon crystalized at lower-than-commonly-appreciated temperatures (~650˚C) and biotite formed with higher-than-commonly-appreciated Ar closure temperatures (shown by analysis of Arrhenius data).