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Insights from easternmost Tethys: Slab rollback, mantle exhumation, and UHT metamorphism in Eastern Indonesia

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The collision of Australia with SE Asia around 23 million years ago marked the closure of the eastern Tethys. Continued convergence of these two continents has since resulted in a complex array of active subduction zones, young mountain belts, and newly-forming oceanic basins that comprise the Indonesian archipelago. In contrast to more mature Tethyan orogens such as the Himalaya in which remnant arcs and oceanic fragments have been overprinted by multiple phases of intense deformation, eastern Indonesia still features several active subduction zone systems. Therefore, it is possible to study transient tectonic processes driven by oceanic subduction—rollback, extension, and orocline formation—that precede continent–continent collision and the formation of large Himalayan- or Alpine-style mountain belts. Critically, in eastern Indonesia it is possible to link seismic and mantle tomographic data to modern arc systems that also expose young metamorphic rocks.

The Australia–SE Asia collision triggered the Java subduction zone to roll southeast towards the Australian continental margin and form the Banda Arc. Extreme lithosphere-scale extension above the rolling-back slab exhumed subcontinental lithospheric mantle to shallow depths, driving ultrahigh-temperature (UHT; $>$ 900˚C) metamorphism. The resulting UHT complex, which at 16 Ma is the youngest so far identified, provides a rare opportunity to study how the Modern Earth is able to produce extreme thermal metamorphic conditions. U–Pb and ^{40}Ar/^{39}Ar dating of the UHT granulites and associated diatexites, which record identical ages, demonstrate that these granulites remained at UHT conditions for less than $c.$ 2 million years before being rapidly exhumed. The final stages of Banda Arc rollback formed the 7.4 km-deep Weber Deep forearc basin. Extension was accommodated along the vast Banda Detachment which floors the Weber Deep. The detachment also facilitated the final stages of mantle exhumation around the northern and eastern Banda Sea.

The Banda region is important because it preserves information about the early stages of orogenic development that has been obscured or erased elsewhere in the Tethyan belt.