Paper Number: 1464

Tectonic drivers of UHT metamorphism in Eastern Indonesia

Pownall, J.M.[1], Hall, R.[2], Forster, M.A.[1], Armstrong, R.A.[1] and Lister, G.S.[1]

[1]Research School of Earth Sciences, Australian National University, Canberra, ACT, Australia (jonathan.pownall@anu.edu.au)
[2]SE Asia Research Group, Department of Earth Sciences, Royal Holloway University of London, Egham, UK

Granulite-facies migmatites exposed on the island of Seram in Eastern Indonesia (Fig. 1) preserve evidence for metamorphism under ultrahigh-temperature (UHT) conditions [1,2]. In contrast to most currently-identified UHT metamorphic rocks, which are incorporated within ancient terranes, this UHT locality occurs in an active tectonic setting.

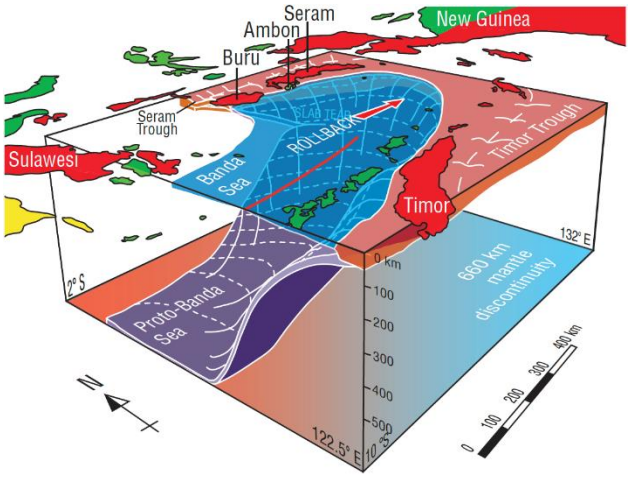

Figure 1: Tectonic setting of the Kobipoto Complex UHT granulites on Seram, northern Banda Arc, adapted from Pownall et al. [1].

During SE Asia–Australia collision, the Banda slab—an extension of the Java-Sumatra slab—rolled back into the Australian continental margin, forming the highly curved Banda Arc and the 7 km-deep forearc basin of the Weber Deep [3]. The island of Seram, along the arc's northern margin, was subject to considerable lithospheric extension that exhumed parts of the upper mantle to the current exposure level beneath a series of detachment faults [4]. Extreme crustal thinning and heat supplied by the adjacent ultramafic complex drove widespread anatexis across Seram and neighbouring islands under granulite-facies conditions.

Garnet-sillimanite granulites sampled from central Seram, which preserve coexisting spinel + quartz, were metamorphosed under ultrahigh-temperature (UHT; > 900˚C) conditions, as demonstrated by THERMOCALC 'Average *P–T*' reactions and melanosome-specific THERMOCALC T–M_{H2O}, T–M_O, and *P–T* pseudosections in the Na_2O–CaO–K_2O–FeO–MgO–Al_2O_3–SiO_2–H_2O–TiO_2–Fe_2O_3 (NCKFMASHTO) chemical system [1], supported by Ti-in-garnet thermobarometry. This modeling is permissive of the rocks having experienced a clockwise *P–T* path peaking at 925 °C and 9 kbar – thus narrowly reaching UHT conditions – before undergoing near-isothermal decompression to ~750 °C and ~4 kbar. U–Pb zircon [2], U–Pb monazite, and $^{40}Ar/^{39}Ar$ biotite dating [2] all yield *c.* 16 Ma ages, which are interpreted to post-date peak metamorphism. According to plate reconstructions for the East Indonesian region [3], this age corresponds to the timing of rollback initiation into the Banda region. We therefore explore the possbility that UHT metamorphism and melting on Seram, occurring at *c.* 16 Ma, was driven by extension and mantle exhumation during the early stages of rollback, when Seram was rifted from eastern Sulawesi.

The Seram granulites demonstrate that HT–UHT metamorphism may be achieved in a modern extensional tectonic setting, thereby offering a possible modern analogue for ancient UHT rocks whose formation mechanisms often cannot be so directly inferred. There is undoubtely more to learn from this important region: further fieldwork in Eastern Seram and on Buru is, at the time of writing, planned for May/June 2016.

References:

[1] Pownall J M et al. (2014) Geology 42(4): 279–282

[2] Pownall J M (2015) Journal of Metamorphic Geology 33(9): 909–935

[3] Spakman W and Hall R (2010) Nature Geoscience 3(8): 562–566

[4] Pownall J M et al. (2013) Solid Earth 4(2): 277–314