



40Ar/39Ar cooling history of the Albany Mobile Belt, Albany-Fraser Orogen, Western Australia

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The Albany-Fraser Orogen of southwestern Australia is a Grenville-age orogenic belt that marks the suturing of the Yilgarn Craton of Western Australia to the Mawson Craton of South Australia and Antarctica. The Albany Mobile Belt is situated in the west of the orogen and consists of three geological domains: the Nornalup Zone, the Biranup Zone and the Northern Foreland. The crustal genesis and nature of boundaries between these domains is unknown. $40\text{Ar}/39\text{Ar}$ thermochronology of biotite and muscovite grains from a 250 km transect across all three domains in the Albany Mobile Belt is used to study the exhumation and cooling history of the amphibolite to granulite facies orogenic root. Previously published geochronological data dates peak amphibolite or granulite facies metamorphism in the Nornalup Zone, Biranup Zone and Northern Foreland at ca. 1170 Ma, ca. 1180 Ma and ca. 1210 – 1180 Ma respectively. All samples reported in this study yielded well defined plateau ages consistent with Stage II of the Albany-Fraser Orogeny (1215 – 1140 Ma). Four biotites from the Nornalup Zone give cooling ages ranging from 1144 ± 5 Ma to 1168 ± 5 Ma, one biotite from the Biranup Zone gives a cooling age of 1159 ± 5 Ma, and four muscovites from the Northern Foreland give statistically indistinguishable cooling ages ranging from 1157 ± 6 Ma to 1164 ± 5 Ma, with a weighted mean age of 1159 ± 6 Ma ($P = 0.10$). The new cooling ages imply that the three domains had been brought to a similar structural level (12 – 17 km depth) by ca. 1158 Ma, and have shared a common geological history since that time. This suggests that Stage II tectonic activity may have ended at ca. 1158 Ma in the Albany Mobile Belt, 20 Myr earlier than previously assumed.

A cooling rate of $25^\circ\text{C}/\text{Myr}$ for the Biranup Zone was calculated based on the 20 Myr interval between peak granulite-facies metamorphism and the cooling of the domain through the estimated biotite closure temperature (ca. 300°C) by ca. 1159 Ma. This is much faster than calculated ca. $5^\circ\text{C}/\text{Myr}$ cooling rates for granulite-facies domains in the Grenville orogen. The fast, mobile-belt scale exhumation of the Albany Mobile Belt inferred from rapid cooling is interpreted as the result of transpressional tectonic driving forces. This is distinctly different to models for the exhumation of the Grenville and Sveconorwegian orogens, which were driven by post-orogenic extension and gravitational collapse related to extension, respectively.