A low–temperature thermochronologic insight into the thermal and exhumation history of the eastern Musgrave Province, South Australia

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A LOW-TEMPERATURE THERMOCHRONOLOGIC INSIGHT INTO THE THERMAL AND EXHUMATION HISTORY OF THE EASTERN MUSGRAVE PROVINCE, SOUTH AUSTRALIA

EXHUMATION OF THE EASTERN MUSGRAVE PROVINCE

ABSTRACT

Multi–method thermochronological data are presented for 12 Mesoproterozoic granitoid samples collected from the eastern Musgrave Province within South Australia. Interpretation of these data with the aid of time–temperature modelling allows inference of multiphase cooling histories. Apatite fission track (AFT) results indicate four discrete exhumation events that induced cooling through AFT closure temperatures (~60–120°C), supported by additional apatite (AHe) and zircon (ZHe) (U-Th-Sm)/He data. Late Neoproterozoic cooling from deep crustal levels to temperatures <200°C was observed, which is thought to be related with the Petermann Orogeny. Subsequent cooling events at ~450–400 Ma (Silurian – Devonian) and ~310–290 Ma (Late Carboniferous) are thought to represent exhumation associated with the Alice Springs Orogeny. The latter event exhumed the sampled eastern Musgrave plutons at shallow crustal depths. An additional Triassic – early Jurassic thermal event was observed throughout the study area, thought to be related to elevated geothermal gradients at that time. The high sample density across the structural architecture of the study area furthermore reveals patterns of differential exhumation and preservation of the thermal record, indicating more shallow exhumation levels in the centre and deeper exhumation towards the margins of the sampled transect. The observed differential exhumation patterns match with a model of an inverted graben system, demonstrating how low temperature thermochronological techniques can reveal fault reactivation patterns. The results highlight that the eastern Musgraves record a complex Phanerozoic low-temperature thermal history revealing the poorly appreciated tectonic evolution of inland Australia.

KEYWORDS

Low–Temperature Thermochronology, Exhumation, Eastern Musgrave Province, Apatite Fission Track, South Australia, Apatite Helium, Zircon Helium.

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