Structure and Thermochronology of an E-W profile through the Mount Painter Province, Northern Flinders Ranges, South Australia: is this a southern example of deformation and exhumation driven by the Alice Springs Orogeny?

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ABSTRACT

The Mount Painter Province in the Northern Flinders Ranges, South Australia is composed of Palaeoproterozoic to Mesoproterozoic basement overlain by 7-12 kilometres of Neoproterozoic to Cambrian sedimentary rocks and is associated with high lateral geothermal gradients. During the Early Paleozoic, deformation and metamorphism reached greenschist to amphibolite facies during the ~500 Ma Delamerian Orogeny. This study focuses on the subsequent thermal history of the area by studying an E-W profile through the Mount Painter Province using the widely used techniques of structural mapping, micro-structural analysis and $^{40}Ar/^{39}Ar$ thermochronology to characterise and date deformation and cooling (as a proxy for exhumation). The E-W trending profile, known as the Hamilton Fault, is south dipping oblique slip with a normal and dextral component overprinted by younger brittle structures and brecciation which is seen in the structural and micro-structural analysis.. It is proposed to have a very active past and there is evidence of movement in the Adelaidean due to an apparent formation offset of ~600 m. The regional context of the Hamilton Fault having a dextral and normal component suggests an ε_3 uplift, an ε_2 extension SW to NE and ε_1 NW-SE shortening. This is similar in character to the N-S shortening which is seen in the Alice Springs Orogeny (ASO). Results from the $^{40}Ar/^{39}Ar$ thermochronology show the basement metasedimentary rocks have cooling ages of around ~350 Ma between 300 to 400 °C and 312 Ma at 150 °C. Interestingly, the younger Adelaidean metasedimentary rocks have an older cooling age of 390 Ma between 300 to 400 °C. The thermochronology data suggests differential cooling has occurred. The observations suggest that exhumation is driven following the Delamerian folding event and forced the earlier cooling of shallower samples at a slower rate and later cooling of the deeper samples at a faster rate, a process caused by differential tilting. The cooling paths are well represented in this example as shown by converging cooling paths. Overall I attribute this subsequent thermal history and structural similarity to the ASO, a major widespread dramatic orogenic event which has not been widely recognized as a significant tectonic event in the Adelaide Fold Belt.

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