K–Ar dating of fault rocks from the Proterozoic Capricorn Orogen, Western Australia

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Synkinematic authigenic illite recovered from exposed fault rocks and drillcore including fault gouge, slickensides and quartz–ironstone breccias that dissect the Proterozoic Edmund and Collier Basins in the Capricorn Orogen of Western Australia, have successfully been dated using the K–Ar method. The dates obtained range from c. 1506 to 586 Ma and are coincident with known tectonic events in the orogen.

The 1679–1067 Ma Edmund and Collier Basins are the youngest depositional elements of the Capricorn Orogen, which is a tectonic zone 1000 km long by 500 km wide, that consists of deformed meta-igneous and metasedimentary rocks between the Archean Pilbara and Yilgarn Cratons. The orogen shows a long geological history, including the assembly of the two cratons to form the larger West Australian Craton, as well as over one billion years of intracratonic reactivation. The Edmund and Collier Groups comprise ~4–10 km of siliciclastic, carbonate and minor volcaniclastic low-grade metasedimentary rocks which were deposited in a variety of fluvial to deep-marine environments. U–Pb SHRIMP dating of detrital zircons from the sedimentary rocks, and of magmatic zircon and baddeleyite from numerous dolerite sills that intrude them, provide a robust temporal framework for their deposition. However, because of the low metamorphic grade of the sedimentary rocks, the timing and nature of basin inversion is less well constrained.

Illite K–Ar dating confirms that fault movement coincided with the timing of basin formation as well as dated tectonic events in the basement, including two major transpression events at 1321–1171 Ma and 1030–955 Ma. The data has also identified an additional significant period of fault movement at 900–800 Ma which has hitherto been unrecognized. This study demonstrates that K–Ar dating of synkinematic illite from fault zones can provide critical, and precise information on the timing of basin inversion, and demonstrates that this technique is as valid for Proterozoic fault movements as it is for much younger events.