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Evolution of the Cape Fold Belt, South Africa: high-precision dating of detrital and metamorphic muscovite from the Palaeozoic Cape Supergroup

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The Cape Fold Belt (CFB) is a 1300 km long fold and thrust belt that forms a significant portion of the western and southern coastlines of South Africa. It comprises basement rocks of the Pan-African Saldanian Orogeny, and extensive sediments of the Palaeozoic Cape and Karoo Supergroups. The CFB is considered to represent a central component of a continuous Permian-Triassic orogenic belt within the interior of west Gondwana, which extended from the Sierra de la Ventana Belt of South America, across southern Africa and into the Falkland Islands and the Ellsworth-Whitmore Mountains of Antarctica. Understanding of the sedimentary provenance history, and the timing of deformation is limited, which has restricted the ability to provide a coherent tectonic model for the evolution of the CFB.

The source of the Cape Supergroup sediments is suggested to lie in the N-NW, based on palaeocurrent directions and the wedge shape geometry of the Cape Basin. Two previous detrital zircon studies identified broad age populations, but were unable to determine specific source terranes [1]. Past structural geology studies have focused on the local complex relationships between fold and fault development within the CFB. However, a broader understanding of the generation of structural features is lacking due to limited constraints on the timing and duration of orogenesis.

Figure 1: Complex relationship between folding and thrusting in Cape Supergroup sediments of the Swartberg Pass, South Africa.

We present new high-precision, $^{40}Ar/^{39}Ar$ data from muscovite-bearing samples from the Cape Supergroup. The single grain, step-heating method employed has identified a significant detrital age population and a suite of younger ages relating to Cape Orogenesis. The detrital muscovite data provide insights into the most recent and proximal sources of sediment for the Cape Supergroup sequence, identifying rocks of Pan-African-age as major sources. $^{40}Ar/^{39}Ar$ analyses of recrystallised or overprinted muscovite grains provide constraints on the timing and duration of Cape Orogenesis.

Supporting geochemical and petrographic studies provide geochemical and morphological constraints on detrital versus metamorphic muscovite grains. The variety of muscovite grain populations observed highlights the importance of conducting single-grain step heating analyses on muscovite from low-grade metamorphic terranes such as the CFB.

References:

[1] Fourie P et al. (2011) Int J Earth Sci 100: 527–541; Vorster C (2013) unpublished PhD