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How far can we trust provenance and crustal evolution information from detrital zircons? A South African case study.

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ABSTRACT

U-Pb and Lu-Hf data are routinely used to trace detrital zircon in clastic sediments to their original source in crystalline bedrock (the protosource), to map out paths of sediment transport, and characterize large-scale processes of crustal evolution. For such data to have a provenance significance, a simple transport route from the protosource in which the zircon formed to its final site of deposition is needed. However, detrital zircon data from Phanerozoic sedimentary cover sequences in South Africa suggest that this "source to sink" relationship has been obscured by repeated events of sedimentary recycling. Phanerozoic sandstones (Cape Supergroup, Karoo Supergroup, Natal Group, Msikaba Formation) and unconsolidated, Cenozoic sands in South Africa share major detrital zircon fractions of late Mesoproterozoic (940-1120 Ma, $\varepsilon_{Hf}\approx 0$ to +15) and Neoproterozoic age (470-720 Ma, $\varepsilon_{Hf}\approx$ -10 to +8). A Permian age fraction (240-280 Ma, $\varepsilon_{Hf}\approx$ -8 to +5) is prominent in sandstones from the upper part of the Karoo Supergroup. All of these sequences are dominated by material derived by recycling of older sedimentary rocks, and only the youngest, late Palaeozoic fraction has a clear provenance significance (Gondwanide orogen). The virtual absence of Archaean zircon is a striking feature in nearly all suites of detrital zircon studied in the region. This indicates that significant events in the crustal evolution history of southern African and western Gondwana are not represented in the detrital zircon record. South Africa provides us with a record of recycling of cover sequences throughout the Phanerozoic, and probably back into the Neoproterozoic, in which the "sink" of one sedimentary cycle will act as the "source" in subsequent cycles. In such a setting, detrital zircon may give information on sedimentary processes rather than on provenance.

Keywords: Zircon; U-Pb; Lu-Hf; Provenance; Crustal evolution, South Africa