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Detrital Zircon Record and Continental Growth: Differentiating Crustal Generation versus Preservation

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The detrital (and magmatic) zircon record is being increasingly used to understand the rate, duration and process of formation of continental crust. Compilations of zircons have identified peaks of ages of crystallisation and crust formation. Taken at face value these peaks suggest that continental crust formation is episodic with significant pulses of juvenile magmatism and crustal growth in the late Archean and Paleoproterozoic (2.7 Ga and 1.9 Ga), and with only subdued addition in the Phanerozoic. Punctuated crustal growth remains difficult to explain by global changes in plate tectonic regimes, and so it is typically attributed to mantle plume activity. However, the andesitic composition of continental crust and evidence that plate tectonics has been active since at least 3.0 Ga suggests magmatic arcs should be the major site of continental growth. Alternatively, we argue that peaks reflect variations in preservation potential in relation to tectonic setting and that peaks correspond with phases of supercontinent assembly: collisional belts have high preservation potential whereas magmatic arcs, which are sites for significant crustal generation, have a low preservation potential.

The detrital zircon record can also be used to unravel tectonic setting. The key features of zircons sampled in different tectonic settings are (i) the time between crystallisation and incorporation into the sedimentary record, and (ii) the age distributions. The detrital record from magmatic arcs yields zircons with crystallisation ages close to that of the host sediment, and little range in ages. Other settings yield large differences between the ages of crystallisation and that of sedimentation, reflecting the history of the pre-existing crust, and the extent to which there was magmatism close to the time of sedimentation. The most marked example is for divergent margins that may be associated with little magmatism that crystallises zircon, and simply record peaks of older ages. Thus, the record from detrital zircons offers new insights into the tectonic setting in which the sediments were deposited, and in the identification of arc magmatism.