Reconciling the detrital zircon record with continental tectonic histories: case studies from India and South America

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Detrital zircon geochronology has become a standard tool in paleotectonic and sedimentary provenance studies of various scales. However, fundamental questions regarding controls on the fidelity of the detrital zircon record and the utility of the method remain unresolved. Contrasting views exist for the meaning behind the long-term "peaks" and "troughs" regularly observed in zircon age distributions. It has been postulated that these peaks and troughs correspond to intervals of episodic continental growth and variation in plate tectonic regimes; conversely, it has been suggested that they result from preservational biases related to continental collision during supercontinent formation. Here we present a review of new and published detrital zircon U-Pb age data from sedimentary successions that span the Paleoproterozoic to the modern from India and South America. These data are considered in a stratigraphic context and age distribution variation is evaluted relative to depositional age, which is compared to independent tectonic records for these regions. Age peaks indicative of large age populations in the detrital zircon record directly correspond with intervals of regional continental arc magmatism, whereas age troughs correspond to intervals lacking continental arc activity. Arc-related zircon grains introduced at the surface are often transported across the continent, archived in numerous basins, and recycled through subsequent exhumation and erosion, thus yielding great longevity in the continental crust. We contend that an apparent bias towards supercontinent cyclicity is an artifact of the inherent importance of subduction and continental arc magmatism during supercontinent formation, in which ocean lithosphere must be removed prior to continental collision. The process of collision itself, however, does not enhance the preservation of zircon in the sedimentary record. Therefore, when considered in a stratigraphic context, the detrital zircon record can be effectively used as proxy for tracking regional variation in tectonic regimes.