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GR Focus Review

Tectonic stress regime recorded by zircon Th/U

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ABSTRACT

Detrital zircon geochronology is a powerful tool for investigating sedimentary provenance, but U-Pb zircon ages alone cannot distinguish between source terranes with similar age signatures. We integrate recent developments in petrochronology with sedimentary provenance analyses by investigating the relationship between tectonic stress regime and zircon Th/U. In the North American Cordillera, zircons that formed in melts associated with extensional magmatism contain variable Th/U (0.3 to >3.5), including significant zircon populations with Th/U >1.0, whereas zircons that crystallized from compressional magmatism exhibit low variability and low Th/U (<1.0). Higher temperature, more-fractionated, short-duration, bimodal magmatism in extensional magmatic systems may produce highly variable and elevated zircon Th/U. In compressional magmatic systems, lower temperature, long-lived, granitoid, oxidizing melts are more conducive to low Th/U zircon crystallization. Therefore, zircon Th/U may be correlated with end-member tectonic stress regimes (continental extension vs continental arc) that correlate with distinct magmatic conditions.

To test the utility of this correlation, we evaluate U-Pb ages and Th/U ratios from the North American and southern Gondwanan zircon record. North American detrital zircon (<2.0 Ga; n=30,587) contain large components of zircon with elevated Th/U (>1.0) that are temporally associated with (1) the