Geophysical Research Abstracts
Vol. 19, EGU2017-18244, 2017
EGU General Assembly 2017

Elucidating tectonic events and processes from variably tectonized conglomerate clast detrital geochronology: examples from the Hongliuhe Formation in the southern Central Asian Orogenic Belt, NW China

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This work expands upon detrital zircon geochronology with a sampling and analysis strategy dating granitoid conglomerate clasts that exhibit differing degrees of internal ductile deformation. As deformation textures within clastic material reflect the variation and history of tectonization in the source region of a deposit, we outline a dating methodology that can provide details of the provenance's tectonomagmatic history from deformation-relative age distributions. The method involves bulk samples of solely granitoid clasts, as they are representative of the magmatic framework within the provenance. The clasts are classified and sorted into three subsets: undeformed, slightly deformed, and deformed. LA-ICPMS U-Pb geochronology is performed on zircon separates of each subset. Our case study, involving the Permian Hongliuhe Formation in the southern Central Asian Orogenic Belt, analyzes each of the three clast subsets, as well as sandstone detrital samples, at three stratigraphic levels to yield a profile of the unroofed provenance. The age spectra of the clast samples exhibit different, wider distributions than sandstone samples, considered an effect of proximity to the respective provenance. Comparisons of clast data to sandstone data, as well as comparisons between stratigraphic levels, yield indications of key tectonic processes, in addition to the typical characteristics provided by detrital geochronology. The clast data indicates a minimal lag time, implying rapid exhumation rates, whereas sandstone data alone would indicate a 90 m.y. lag time. Early Paleozoic arc building episodes appear as Ordovician peaks in sandstone data, and Silurian–Devonian peaks in clast data, indicating a younging of magmatism towards the proximal provenance. A magmatic hiatus starts in the Devonian, correlating with the latest age of deformed clasts, interpreted as timing of collisional tectonics. Provenance interpretation using the correlations seen between the clast and sandstone data proves to be more detailed and more robust than that determined from sandstone samples alone. The variably tectonized clast detrital geochronology method offers a regional reconnaissance tool that can address the practical limits of studying regional granitoid distributions.