Goldschmidt 2024 Abstract
https://doi.org/10.46247/gold2024.23919

New constraints on the secular evolution of continental crust using combined U/Th-Pb and Hf-O/Nd isotope systematics of detrital zircon and monazite

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Detrital accessary minerals represent powerful archives of the formation and evolution of continental crust. Detrital zircon (DZ) has been predominantly employed, through U-Pb and Hf-O isotopic analyses. However, the insights provided by this archive may be skewed due to the selective representation of felsic magma and sedimentary recycle(s). Monazite typically forms in peraluminous granitoids and metamorphic rocks with diverse bulk-rock compositions. U/Th-Pb and Sm-Nd isotopic compositions of detrital monazite (DM) can potentially complement the DZ record. In this presentation we demonstrate the power of integrating multiple isotope systems in DZ and DM to provide a more comprehensive crustal evolution history.

We present DZ U-Pb-Hf-O and DM U/Th-Pb-Sm-Nd isotopic compositions from sand samples of the Yellow River to retrieve a more holistic crustal growth and reworking record for the North China Craton and its peripheral orogens. The results show that the U-Pb age clusters of DZ are consistent with magmatic episodes in the catchment areas, while the sharp peaks in DM Th-Pb age spectra correspond to the timing of high-grade orogenic metamorphism and S-type granite magmatism. Precambrian DZ have varied $\delta^{18}O$ values, with ca. 80% of the data above the mantle range (5.3 ± 0.6 ‰) and ca. 5% below it, suggesting extensive incorporation of supracrustal materials into their host magmas. Both the DZ-Hf and DM-Nd model ages consistently record a major juvenile crust extraction event at 2.9-2.7 Ga. The DM-Nd data reveal an additional prominent crustal growth event at 2.5-2.4 Ga, which aligns with the Sm-Nd isotopic compositions of widespread Paleoproterozoic granulite-amphibolite facies metabasic rocks. DZ from the Phanerozoic orogens show mantle-like to high $\delta^{18}O$ values and highly negative to positive $\varepsilon_{Hf}(t)$ values, reflecting the accretion of juvenile crust and reworking of the Precambrian continent. In contrast, Phanerozoic DM predominately recorded crustal reworking processes during the collisional stage.