Zircon oxygen and hafnium isotope decoupling during metamorphism of sedimentary rocks in the Albany Fraser Orogen, SW Australia.

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The oxygen isotope composition of zircon provides an extremely sensitive and generally robust tracer of its petrogenetic history (Watson and Cherniak, 1997). Measurement of U-Th-Pb, Lu-Hf and oxygen isotopes as well as select trace and rare earth elements were carried out on zircons from high-grade metasedimentary rocks from the Albany-Fraser Orogen in southwest Australia. Oxygen isotopes from the detrital grains yield values ranging from 5.8 ‰ to 8.0 ‰ and exhibit coupled Hf and O isotope systematics. In contrast, metamorphic zircon grains show considerably less variability with a median $\delta^{18}O$ (VSMOW) value of 5.6 ± 0.5 ‰ and have completely decoupled Hf and O isotope systems.
The decoupling of oxygen and hafnium isotope systems in metamorphic zircon suggest the sedimentary protolith was altered by externally derived meteoric fluids sometime between sediment deposition and high-temperature metamorphism. We suggest alteration of the sedimentary protolith is likely related to the proximity to the Fraser Shear Zone, a major crustal scale structure within the orogen. The Fraser Shear Zone and related structures are interpreted represent an older network of structures that accommodate extensional strain during basin formation, facilitated hydrothermal alteration of the basin infill, and was subsequently reactivated during the compression associated with the Albany-Fraser Orogeny. Occurrences of low $\delta^{18}O$ metamorphic zircons, and possibly also low $\delta^{18}O$ igneous rocks, in ancient collisional settings may therefore delineate long-lived structures and fluid pathways within the crust.

<u>References</u>

Watson, E.B. and Cherniak, D.J. (1997) Oxygen diffusion in zircon. Earth and Planetary Science Letters 148, 527-544.