Detrital garnet geochronology as a complement to detrital zircon and monazite ages from the French Broad River, southern Appalachians

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Garnets in modern alluvium from a tributary of the French Broad River in the southern Appalachians were analyzed using a new Sm/Nd detrital garnet geochronometer to generate the first known suite of single-grain detrital garnet ages. We compare these data with published detrital ages from monazite and zircon from the same sediment sample [1-3]. The project serves as proof-of-concept for the new geochrometer by utilizing a well-characterized sample for comparison of garnet ages with known prograde metamorphic events in the source area of the river.

This work is pushing the boundaries of size and precision for small sample NdO^+ analysis. Due to garnet's low Nd concentations (generally <0.4 μg/g) and starting sample weights for single grains of <1.5 mg, the resulting TIMS NdO^+ loads range from 17–445 pg. A 400 pg in-house standard yields a long-term external precision of 36 ppm (2σ), though internal precisions for the smallest samples can be several hundred ppm. Full procedural Nd blanks of 4.6 +/- 0.7 pg are significant for these small samples. Rigorous statisical propagation of blank corrections (and related uncertainties) were incorporated into the age determination.

Twenty individual garnet grains (0.8-1.5 mm diameter) were dated by Sm/Nd TIMS analysis using clean garnet and leached inclusion analyses extracted from each grain to determine single-grain ages. The weighted mean of the full population of detrital garnet ages is 443 +/- 18 Ma (2σ).

The tributary sample analyzed contains a single monazite age population (~450Ma) and multiple zircon age populations [1-3]. Garnet ages appear to agree with the age peak for monazite and primary peak in zircon rim ages. Detrital garnet geochronology could also be applied to old sediments and sedimentary rocks when the source area is uncertain, since garnet records the prograde metamorphic histories of orogens.

[1] Hietpas, et. al (2010), *Geology* 38, 167-170. [2] Hietpas, et. al (2011), *J Geol Soc* 168, 309-318; [3] Moecher et. al (2011) *Geosphere* 7, 494-512.