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Garnet Constraints on Metamorphism and Fluid–Rock Interaction in the Greer Hollow Body, Ashe Metamorphic Suite (Southern Appalachians)

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Metasomatic reaction zones can provide a window into mass transfer processes at high pressures. Fluid-mediated exchange across chemically contrasting rocks can generate distinct hybrid lithologies, e.g. chlorite- and talc-rich rocks, which can affect rock mechanical properties at mid-crustal depths. However, determining the conditions at which these reactions occur and the sources of fluid can be challenging.

We investigate a metasomatic reaction rind developed around the Greer Hollow locality, one of a series (~30) of ultramafic bodies that stretch NE-SW along the Appalachian orogen. This ultramafic body is hosted within the pelitic Ashe Metamorphic Suite (AMS) in North Carolina, interpreted as part of a Taconic accretionary complex. Although previous work has recognized metasomatism at this site, the protolith of the metasomatized rocks and the nature of fluid-rock interaction remains enigmatic. The Greer Hollow body is comprised of three principal lithologies interpreted to record increasing degrees of metasomatism: a tremolite schist, a magnetite-chlorite schist, and a garnet-magnetite-chlorite schist. The latter, characterized by 2–3 cm garnet and 0.5–1 cm magnetite, represents the most altered assemblage. This work aims to use this garnet-bearing lithology to measure the degree, conditions, and timing of metasomatism.

Bulk Lu-Hf garnet geochronology on the garnet-chlorite-magnetite schist provides an age of 455 ± 2 Ma, consistent with Taconic subduction. Laser fluorination $\delta^{18}O$ values obtained from the core and rim of the garnets reveal low $\delta^{18}O$ (~0.9 ‰) in garnet cores, in contrast with garnet rims exhibit higher $\delta^{18}O$ values (~1.8 ‰). The anomalously low $\delta^{18}O$ cores likely suggest an inherited low-temperature serpentinization signature, preserved through prograde metamorphism.

Ongoing Sr-Nd isotopes analyses will further constrain protoliths of individual lithologies and assess the extent of potential seafloor alteration prior to metamorphism. Together, these data provide new constraints on fluid sources and mass transfer processes during mid-crustal metasomatism in subduction-related settings.