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Garnet Oxygen and Lithium Isotope Records of Metamorphic Reactions and Fluid Infiltration: UHP Metapelites at Lago di Cignana, Italy

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We investigated the $\delta^{18}O$ of garnets (HR-SIMS) in ultrahigh-pressure Lago di Cignana metasedimentary rocks, relating these observations to reconstructed prograde devolatilization history and recent study of $\delta^{7}Li$ and trace element behavior in the same garnet crystals [1].

Each of the four garnets shows core-to-rim shift (of 1-2‰) to higher $\delta^{18}O$ consistent in direction and magnitude with O isotope fluid-mineral fractionation during prograde devolatilization. The overall $\delta^{18}O$ ranges for the garnets reflect protoliths, with garnet in a more siliceous sample LHN18B (likely with a siliceous ooze protolith component) having $\delta^{18}O_{VSMOW}$ of +18 to +21‰, higher than that of garnet in more pelitic rocks (+15 to +18‰). Sharply developed annuli in concentrations of Y, HREE, and Li (in some cases with deviations in $\delta^{7}Li$) attributed previously to release of HREE from breakdown of titanite (to produce rutile) show no clear O isotope signature, perhaps resulting from internal rock buffering of the $\delta^{18}O$ of fluids released by this reaction and conveying the REE to surfaces of the growing garnets. In one of the four garnets (in LHN18B), a region with resorption/re-growth textures, contrasting major element concentrations, and anomalous $\delta^{7}Li$, has $\delta^{18}O$ higher than that elsewhere in the garnet at similar distances from the garnet rim, perhaps reflecting the $\delta^{18}O$ of externally derived fluids not fully buffered in their $\delta^{18}O$ by exchange with the local rock matrix. Rims on the higher-$\delta^{18}O$ garnet in LHN18B show strong downward shifts in $\delta^{18}O$, of nearly 3‰, to values matching those of the rims of garnets in the metapelitic samples, consistent with infiltration of fluids from the metapelites, the latter containing carbonate with $\delta^{18}O$ roughly in isotopic equilibrium with the garnets at near-peak temperatures.

This O dataset complements Li isotope data for the same garnets, providing additional constraints on prograde and retrograde reaction history, kinetics of porphyroblast growth, intracrystalline diffusion, and fluid-rock interactions. This project has as its foundation a detailed *regional-scale* framework for devolatilization and fluid transport in the Schistes Lustrés/Cignana metasedimentary complex [2, 3].

1. Bebout et al. (2022) Geosphere 18(3) 1020-1029.
2. Cook-Kollars et al. (2014) Chemical Geology 386, 31-48.
3. Epstein et al. (2020) Lithos 354, 105229.