

EGU22-9073

<https://doi.org/10.5194/egusphere-egu22-9073>

EGU General Assembly 2022

© Author(s) 2022. This work is distributed under the Creative Commons Attribution 4.0 License.



Improving the precision of garnet Sm-Nd ages using aqua regia leachate analyses

Shreya Mukherjee, Ankita Nandi, Avishek Adhikari, and Ravikant Vadlamani
(shreyamukherjee3394@gmail.com)

Garnet chronology, with Sm-Nd and Lu-Hf isotope systems, can yield precise dates of metamorphic and tectonic events which can be directly linked to specific pressure-temperature conditions during its growth. Presence of inclusions within garnet porphyroblasts alters the inherent parent/daughter ratios resulting in erroneous ages and Sm-Nd ages can be severely affected by monazite and phosphate inclusions, whereas, Lu-Hf ages can be strongly influenced by inclusions of zircon with its high Hf content. The various leaching protocols to remove micro-inclusions from garnet include mixtures of HNO₃+HCl to remove monazite inclusions in metabasic garnets, single step H₂SO₄ leaching to eliminate phosphate inclusions; the zircon inclusions were eliminated by partial dissolution technique with HF-HCl. Inspired from previous studies, we carried out sequential H₂SO₄ (discarded) followed by aqua regia leaching (collected) to increase the spread in the ¹⁴⁷Sm/¹⁴⁴Nd ratios and thus improve the precision on the Sm-Nd ages.

Experiments were performed on garnet porphyroblasts separated from two samples of garnet-orthopyroxene-cordierite granulite enclaves from around Karimnagar, Eastern Dharwar craton, India. Three garnet fractions from each of the samples were separated and sequentially leached with concentrated H₂SO₄ and concentrated aqua regia to remove the phosphate and oxide inclusions respectively. Regressing the leached residual garnet fractions along with their whole-rock yielded ages (at 2SD) of 2696±10 Ma and 2683±15 Ma. The residual garnet fractions yielded higher ¹⁴⁷Sm/¹⁴⁴Nd ratios, indicating cleaner garnet fractions. An even greater improvement on the precision of the Sm-Nd ages was observed when the aqua regia leachates were analyzed and regressed along with the whole-rock and leached garnet fractions, with higher ¹⁴⁷Sm/¹⁴⁴Nd ratios than the analyzed garnets yielded ages with improved precisions of 2695±8Ma and 2682±9 Ma, thereby improving the precision of the fitted isochron. The ¹⁴⁷Sm/¹⁴⁴Nd ratios in the aqua regia leachate fractions range ~ 1.955-2.934, which improves the precision on the age. The garnet aqua regia leachate fractions contain very high Sm concentrations (11.6-20.4 µg/g) and lower Nd concentrations (3.18-4.18 µg/g) compared to the garnet leached residue (Sm 4.35-5.02 µg/g and Nd 1.61-4.13 µg/g) and, therefore, likely represent co-genetic fluid phase released during aqua regia partial dissolution from the garnet lattice and appear to represent the metamorphic fluid compositions.

The Y+REE in metamorphic garnets would track the equilibration between garnet and the fluid environment in which it grew. As Y+REE are incorporated in garnet as trivalent ions replacing

divalent ions in dodecahedral sites, likely explanations of our results are either introduction of menzerite-like components via the exchange vector $[Y_{M_{.1}}(Mg, Fe)Al_{.1}]$ or substitution of Y+REE by alkali components via the exchange vector $[Y(Na, Li)M_{.2}]$. Since the aqua regia leachate fractions lie on the same isochron with the whole-rock and residual (leached) garnet fractions, we consider that the leachates do not involve elemental partitioning. It is likely that metasedimentary protoliths yield higher concentrations of leached LREE and may be applicable more for those compositions.