

Garnet reference material for in situ U-Pb dating

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Well-characterized matrix-matched reference materials (RMs) are essential for reliable and reproducible U-Th-Pb isotope analyses. Garnet U-Pb dating by LA-ICPMS is a relatively new technique with the first publications in 2017. Since then few potential garnet RMs have been investigated and published. Moreover, these garnet specimen are only available in small quantities, creating a discrepancy between demand and supply for LA-ICPMS community. This is partly due to the requirements that garnet RMs for U-Pb dating need to fulfill, owing to the fact that the garnet supergroup is compositionally highly diverse, as reflected in garnet U concentrations ranging from <0.001 to >30 µg/g. Published potential garnet RMs are grossular-andradite garnet derived from skarns, or Ca-Fe-Ti garnet derived from alkaline intrusions. U concentrations of >2 µg/g in such garnet crystals contrast with the low U concentrations (< 0.1 µg/g) characteristic for the most abundant garnet species of the almandine-pyrope-spessartine series. Garnet growth may also last millions of years, which complicates the discovery of age-homogenous crystals. Ideally, the garnet RM is similar in composition and U concentration to the investigated garnet unknowns to minimize matrix effects and analytical issues such as saturated detectors and too low signal.

In this contribution we investigate potential garnet RMs from Mali, Balochistan, and Mongolia. These garnet crystals belong to the grossular-andradite series and have U concentrations between 0.5 and 45 µg/g. We further investigate almandine-pyrope garnet specimen from Tanzania with $U_{\text{avg}} = 0.15 \mu\text{g/g}$.

The investigated garnet crystals have been cross-calibrated against garnet crystals of known age (ID-TIMS U-Pb, or Sm-Nd dating) and yield reproducible ages between different analytical sessions. However, many of the investigated garnet crystals exhibit different age domains that do not overlap within their analytical uncertainties. While this may be seen as a drawback, the range of U concentrations of the different domains allows for a more flexible use of these crystals in terms of garnet U-Pb dating. By combining the obtained age information from different domains with major element maps of the respective crystals, the most suitable garnet domains in terms of composition and U-concentration can be chosen for each analytical session.