U-Pb geochronology of grossular-andradite garnet

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We present new LA-ICP-MS and ID-TIMS based U-Pb geochonometric methodologies for dating grossular-andradite (grandite) garnet. Grandite garnet is a primary skarn mineral, therefore dating its growth provides a direct constraint on the timing of hydrothermal activity. As CA-ID-TIMS zircon U-Pb geochronometry has revealed pluton emplacement to be a multi-stage process, grandite U-Pb dating has the potential to provide a complementary, high-resolution record for hydrothermal systems. Grossular-andradite garnet incorporates between ~0.5-100 ppm U, with high andradite garnets generally possessing higher [U]. The non-radiogenic Pb (Pbc) content of grandite is extremely variable and zoned at the micron scale, often ranging from purely radiogenic Pb (Pb*) to > 90% Pbc over the space ${\sim}100\,\mu{\rm m}$. This variability in Pb*/Pbc produces well-constrained U-Pb isochrons that can precisely test the assumption that the garnet contains a single Pb* and Pbc component. Typical skarn grandites are large (>1 mm), so employing large laser ablation spots (>100 μ m), can compensate for low Pb concentrations, improving age precision, while maintaining spatial resolution. We have characterized three garnets of variable grossular-andradite content and age as potential reference materials: Willsboro Andradite (~1000 Ma. Adirondacks, USA), Mali Grandite (~200 Ma, Southern Mali), and Lake Jaco Grossular (~35 Ma, Coahuila, Mexico). We have also measured U-Pb IDdates of Willsboro Andradite and Mali TIMS Grandite for use as matrix-matched LA-ICP-MS U-Pb standards. Willsboro Andradite garnet is our preferred reference material due to its ppm level concentrations of U and Pb and ²⁰⁶Pb/²⁰⁴Pb over 1000. The precision of LA-ICP-MS weighted mean age data varies 1-10% (2 σ) for the analyzed garnets. Considering the short estimated lifespans of plutonrelated hydrothermal systems (tens of thousands to a few million years) [1], Neogene skarns present the best opportunity to test for and resolve separate episodes of garnet growth at these precision levels. As a performance test for the method, we present new U-Pb andradite data from a Late Miocene skarn system on Serifos Island, Greece.

[1] Chiaradia (2013) *Bulletin of Economic Geologists* Volume 108, 565-584.