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Zoned Garnet Sm-Nd Geochronology With Sub Million Year Age Precision: And So Can You!

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Zoned garnet geochronology involves the physical extraction (i.e., by microdrill) of distinct growth zones within large (> 5 mm) single crystals. Pollington and Baxter (2010) [1] first showed that multiple concentric growth rings (akin to the rings of a tree) could be extracted and dated, with individual age precisions of less than 1 Myr. Such precision permits interpretations of growth duration, rate, and acceleration in response to tectonic and thermodynamic processes. Numerous other papers have since demonstrated sub-Myr precision in garnet Sm-Nd chronology [i.e., 2,3,4].

Here we highlight recent advances that have permitted sub-Myr age precision in three zoned garnet studies: a HP metapelite from the Betic Cordillera of Spain, an eclogite-facies metabasalt from the Servette Mine (Saint-Marcel Valley) in Italy, and a pyrope megablast within whiteschist from the famous Dora-Maira Massif in Italy. By collecting “leachates” from our partial dissolution procedures [as suggested by 5,6,7], we can evaluate whether inclusion populations are in age-equilibrium with the surrounding garnet and can therefore be included in age calculations to improve precision. The resulting multipoint isochrons often yield ages with sub-Myr precision given modern thermal ionization mass spectrometry, even when analytical sample sizes are very small (< 100 pg Nd) .

Three concentric growth zones from 1cm spiral garnets of the Betic Cordillera reveal individual age precisions ranging from 0.31 to 0.48 Myrs and a growth duration of 0.45 +0.51/-0.32 Myrs. Four concentric growth zones from 1cm garnets from Servette reveal individual age precisions ranging from 0.19 to 0.30 Myrs and a growth duration of 1.12 +0.34/-0.28 Myrs. Finally, the rim of a 10 cm garnet megablast from Dora-Maira produced an age of 37.66 +/- 0.36 Myrs with work in progress to reveal the growth duration of these spectacular crystals.

[1] Pollington and Baxter (2010), *EPSL* 293, 63-71; [2] Dragovic et al. (2012), *Chem Geol* 314-317, 9-22; [3] Dragovic et al. (2015), *EPSL* 413, 111-122; , [4] Starr et al. (2020), *Lithos* 376-377; [5] Zhou and Henson (1995), *Chem Geol* 121, 317-326; [6] DeWolfe et al., (1996), *GCA* 60, 212-134; [7] Amato et al., (1999), *EPSL* 171, 425-438.