

A rapid pulse of garnet growth and deformation in the Betic Cordillera, Spain revealed from zoned Sm-Nd geochronology of spiral garnets

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Garnet is a well-known recorder of P-T-d-t conditions during orogenesis. Multiple zoned geochronology studies have used garnet to place temporal constraints on the rates and durations of metamorphism and deformation [1, 2]. Here, we report new Sm-Nd isochron ages on individual growth zones from structurally-characterized garnets from the Nevado-Filabride Complex, the lowest unit in the Betic Cordillera. Four 1 cm garnets hosting spectacular spiral inclusions were micro-drilled to isolate three distinct growth zones based upon Mn concentration contours and inclusion trail truncations. Cores were found to have nucleated at 13.60 ± 0.31 Ma, the medians at 13.37 ± 0.36 Ma, and the rims at 13.28 ± 0.48 Ma. The age of these garnets is consistent with Lu-Hf garnet ages from the same complex [3]. The core to rim duration of growth was constrained using a Monte Carlo style analysis to $0.45 + 0.51 / - 0.32$ Ma. While other zoned garnet studies have shown similar rapid growth [4]; this is the first such documentation of such rapid growth from a garnet hosting spiral inclusions during regional metamorphism. The spiral inclusion trails developed either through garnet rotation due to localized shear, or by episodic overgrowth of suborthogonal crenulation cleavages due to changes in regional-scale tectonics. In either case, the rapid formation of these spiral garnets has implication for the rates and dynamics of metamorphism and deformation during orogenesis.

[1] Christensen et al. (1989) *Science* **244**, 1465-1469. [2] Pollington & Baxter (2011) *Earth and Planetary Science Letters* **293**, 63–71. [3] Platt et al. (2006) *Geology* **34**(11), 981–984. [4] Dragovic et al. (2012) *Chemical Geology* **314-317**, 9-22.