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## Rapid, paced metamorphism of blueschists from laser-based Lu-Hf garnet-domain geochronology and LA-ICMPS trace element mapping

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Unravelling the timing and rate of subduction-zone metamorphism requires linking the composition of petrogenetic indicator minerals in blueschists and eclogites to time. Garnet is a key mineral in this regard, not in the least because it best records P-T conditions and changes therein and can be dated, using either Lu-Hf or Sm-Nd chronology. Bulk-grain garnet ages are the norm and can provide important and precise time constraints on reactions across both facies. Domain dating, i.e., dating of individual growth zones, moves beyond that. Domain dating by combining mechanical micro-milling and Sm-Nd chronology yielded important constraints on garnet-growth and fluid-release rates for blueschists (e.g., Dragovic et al., 2015). Developing this method for Lu-Hf chronology and, importantly, for "common-sized" garnet ( $\leq 1$  cm) provides an important opportunity to further explore the potential of this approach.

We combined a low-loss micro-sampling technique in laser cutting with a refined Lu-Hf routine to precisely date multiple growth zones of a sub-cm-sized garnet in a blueschist. The targeted grain from a glaucophane-bearing micaschist from Syros Island, Greece, was chemically characterized by major- and trace-element mapping (EPMA, LA-ICPMS) and five zones were extracted using a laser mill. The three core and inner mantle zones are chemically comparable and identical in age within a 0.1 Myr precision ( $2\sigma$ ). The outer two zones are chemically distinct and are resolvably younger (0.2-0.8 Myr). The timing of these two major garnet-growth episodes, together with the variations in trace-element chemistry, constrain important fluid-release reactions, such as chloritoid-breakdown. The data show that the integral history of garnet growth in subduction zones may be extremely short ( $< 1$  Myr), but may, even in that short timeframe, consist of multiple short pulses. Garnet-forming reactions clearly are localized and, thus, associated with focussed high-flux fluid flow. Beyond subduction-zone processes, our new protocol for zoned garnet Lu-Hf geochronology of "common-sized" garnet opens possibilities for constraining the causes and rates of garnet growth and in turn, the pace of tectonic processes in general.

*Dragovic, B., Baxter, E.F. and Caddick, M.J., 2015. Pulsed dehydration and garnet growth during subduction revealed by zoned garnet geochronology and thermodynamic modeling, Sifnos, Greece. Earth and Planetary Science Letters, 413, pp.111-122.*