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Rapid (~1 My) heating associated with intraoceanic thrusting beneath the Samail Ophiolite (Oman/UAE): major- and trace-element diffusion speedometry of the metamorphic sole

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Metamorphic soles of ophiolites are thought to record the initiation of intraoceanic thrusting that may eventually lead to self-sustained subduction. Differences between the timing of sole-related metamorphism and ophiolite crystallization have thus been used to study the occurrence and mechanics of induced *vs.* spontaneous subduction initiation (SI). In the Samail Ophiolite, the timescales of metamorphism in the highest-grade sole rocks are controversial, because different dating methods yield divergent results. For example, zircon U-Pb TIMS dates suggest peak, granulite-facies sole metamorphism beneath the Samail Ophiolite occurred over <1 My [1] and was roughly synchronous with ophiolite crystallization, indicative of spontaneous or rapid forced SI. In contrast, garnet Lu-Hf isochron dates suggest that sole metamorphism was lengthier (~8–10 My) and initiated well-prior to the ophiolite [2], favoring induced SI. To discriminate between these order-of-magnitude differences in the duration of metamorphism in the Samail sole, we performed high-resolution optical, EPMA, and LA-ICPMS characterization of garnet, coupled to major- and trace-element thermobarometry and diffusion speedometry. Preliminary garnet mapping data from the southernmost Samail massifs shows the retention of prograde major and trace-element zoning, with subsolidus, concentric REE growth zoning in garnet cores transitioning to oscillatory-zoned, melt-related rims and new grains. Strikingly, there are several examples of retained step-function zoning in both major and trace elements, including both growth and partial garnet resorption features. Considering published experimental diffusion parameters for various elements in garnet [3,4], such sharp elemental discontinuities suggest that the duration of >700°C metamorphic conditions was short (~1–2 My). The preliminary data thus indicate rapid heating to and cooling from granulite-facies conditions in the Samail sole, which is consistent with zircon U-Pb TIMS data from the same rocks [1]. Ongoing analyses are aimed at characterizing chemical, thermal, and textural variations in high-grade sole rocks along the length of the ophiolite.

[1] Rioux et al., this volume

[2] Guilmette et al. (2018), *Nat. Geosci.* 11, 688–695.

[3] Carlson (2006), *Am. Min.* 91, 1-11.

[4] Bloch et al. (2020), *J. Pet.* 61, 1-29.