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A 'brief' history of Aegean subduction: *P–T–t* evolution of the Cycladic Blueschist Unit, Sifnos, Greece

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Garnet geochronology, combined with garnet trace element zonation and thermodynamic analysis, permits construction of the pressure–temperature (*P–T)* history of Aegean subducted lithologies. Sifnos is comprised of the Cycladic Blueschist Unit (CBU), which represents part of a subduction-related accretionary complex in the Aegean Sea [1]. The CBU on Sifnos is well preserved, lithologically heterogeneous, and is regarded as a structurally coherent sequence that essentially experienced the same metamorphic evolution.

High precision Sm-Nd garnet geochronology was performed on several of these lithologies, generating multi-point isochron ages on both bulk garnet separates and distinct, microsampled growth zones of larger porphyroblasts. This chronology revealed a metamorphic history involving slow initiation of garnet growth at 53.4 ± 2.6 Ma [2], followed by a period of rapid growth between 46.95 ± 0.61Ma and 44.96 ± 0.53 Ma. Individual samples from this growth pulse exhibit entire porphyroblast growth durations spanning just *hundreds of thousands of years*. Lastly, microdrilled garnet rims from some samples, along with bulk ages from garnets in which Sm is heavily concentrated in crystal rims, provided younger ages between 42.5 ± 3.0 Ma and 42.9 ± 1.7 Ma.

This chronology is coupled with both trace element zonation in garnet and phase equilibria modeling of several lithologies, constraining 1) a minimum heating rate during garnet growth close to peak *P*, and 2) a detailed *P–T* history during burial and exhumation. The pulse of growth described above coincides with a period of *close to isobaric* heating, at a rate of >75°C/Myr, terminating at the peak *P* and *T* estimated for Sifnos (~2.2 GPa and 560°C [3]). The late stage of garnet growth described above, is predicted to have occurred at lower pressures (1.0–1.3 GPa), following *close to isothermal* decompression, possibly recording garnet growth during the early stages of exhumation.

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Figure 1: Photo of Vroulidia Bay, Eocene

We infer that peak metamorphism on Sifnos may have occurred along a transition in thermal regime, possibly from subduction under a colder fore-arc to that under a warmer regime dominated by viscous flow of the mantle wedge, with the resultant pulsed metamorphism stemming from these elevated heating rates. Alternately, rapid heating may have occurred during the early stages of exhumation, possibly during underthrusting or entrainment of the unit into the subduction channel.

Utilizing this large isotopic dataset, in combination with characterization of parent element (i.e. Sm) zonation and phase equilibria modelling, can provide a detailed *P–T–t* evolution of the CBU and help elucidate the potential mechanisms for such rapid heating at high pressure.

References:

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[2] Dragovic B et al. (2015) EPSL 413: 111-122
[3] Dragovic B et al. (2012) Chem Geol 314-317: 9-22