Subduction dynamics and exhumation of eclogites and blueschists: The Cycladic Blueschist Unit (Cyclades, Greece)

Valentin Laurent (1,2,3), Laurent Jolivet (1,2,2), Stéphane Scaillet (1,2,3), Pierre Lanari (4), Romain Augier (1,2,3)
(1) Université d’Orléans, ISTO, UMR 7327, 45071, Orléans, France, (2) CNRS/INSU, ISTO, UMR 7327, 45071 Orléans, France, (3) BRGM, ISTO, UMR 7327, BP 36009, 45060 Orléans, France, (4) Institute of Geological Sciences, University of Bern, Baltzerstrasse 3, Bern CH-3012, Switzerland

Located in eastern Mediterranean, the Hellenic subduction zone results from the convergence between Apulia and Eurasia plates since the late Cretaceous. The Cycladic Blueschist Unit (CBU) is a HP-LT metamorphic unit that was buried and exhumed in the Hellenic subduction zone. Famous for its excellent preservation of HP-LT metamorphic rocks and tectonic structures, the CBU is considered as a natural laboratory to study subduction dynamics. Our study, mainly conducted on Syros Island, combines field structural observations, P-T thermodynamic modelling and 40Ar/39Ar dating that provide a detailed P-T-t-d path of the CBU. Our results show that the CBU was exhumed by an overall top-to-the east shearing during exhumation from eclogite- to greenschist-facies depths, localized along several retrograde shallow-dipping shear zones. Thermobarometry shows that three events of garnet growth have been recorded in the CBU. A first prograde event is recorded in garnets from eclogites at 17 ± 2 kbar and 450 ± 50 °C and a second one at peak P-T conditions around 22 ± 2 kbar and 550 ± 50 °C. A last garnet growth event is recorded only in retrograded samples between 10-12 kbar and 500-570 °C. We interpret this retrograde garnet growth event as the result of an almost isobaric heating previously highlighted on Tinos and Andros islands. Finally, 40Ar/39Ar ages constrain the timing of peak pressure conditions at 52-49 Ma, which is consistent with previous U/Pb, Sm/Nd, Lu/Hf and Rb/Sr ages. Our 40Ar/39Ar ages then constrain exhumation through blueschist-facies P-T conditions between 47 and 35 Ma and the final ductile exhumation in the greenschist-facies at 18-20 Ma. Syn-orogenic exhumation of the CBU, from eclogite- to blueschist-facies P-T conditions, was accommodated in ca. 15 Ma within the subduction channel between a top-to-the E detachment above (Vari Detachment) and a thrust below. Then, a change of subduction dynamics and the settling of a faster slab retreat, coeval with the migration of the subduction front southward within the more external zones (Phyllite-Quartzite Nappe in Crete and Peloponnese), resulted in a break of exhumation of the CBU accompanied by isobaric heating during ca. 5 Ma. Retreat then induced large-scale back-arc extension leading to thermal re-equilibration of the lithosphere from a cold syn-orogenic regime in the subduction zone to a warmer post-orogenic regime in the back-arc domain. Post-orogenic exhumation in greenschist-facies P-T conditions was finally accommodated in a LP-HT environment by several detachments systems (e.g. NCDS, WCDS, NPEFS) acting during 10-12 Ma. During this 30 Ma long evolution, deformation progressively localized until the brittle detachments observed today.