Compression to extension: The geological signature for rapid tectonic reversal from Naxos, Greece

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Naxos Island, Greece, is traditionally considered a Cordilleran-style metamorphic core complex, formed during regional extension of the Aegean Sea. Although lithospheric extension undoubtedly occurred throughout the Aegean during the last 10 Ma, the cause of regional kyanite/sillimanite-grade metamorphism within the core of the Naxos dome remains controversial. Specifically, little is known about the pre-extensional, prograde evolution of the core complex and the relative timing of peak metamorphism in relation to the onset of extension. Here, we present new structural mapping, combined with petrographic analysis, phase equilibria modelling of anatectic sillimanite migmatites, kyanite gneisses and blueschists with in-situ laser-ablation ICPMS U–Th–Pb monazite, zircon, allanite, and rutile geochronology. We find that metamorphism gets younger and higher grade with increasing structural depth over a timeframe of ca. 50-13 Ma. At the top of the pile, Cycladic Blueschists attained ca. 14.3 kbars, 470ºC at 49-46 Ma during NE subduction of the continental margin. This was followed by nappe stacking and crustal thickening leading to regional metamorphism from 40-17 Ma, and kyanite grade conditions of ca. 10 kbars, 670 ºC at 22-18 Ma. At the deepest structural levels, hydrous melting occurred within the kyanite field at ca. 8-10 kbars at 18-17 Ma. This was followed by decompression through the muscovite dehydration melting reaction to sillimanite-grade conditions of ca. 5 kbars, 730 °C at 16-15 Ma, indicating that the migmatite dome formed in < 2.5 Ma, a timescale much shorter than previously thought. Our data suggest that crustal shortening continued in the central Aegean until the mid Miocene (17 Ma), followed by a rapid switch to regional extension at ~15 Ma that drove cooling at rates of up to 90°C/Myr and was contemporaneous with a 2-fold decrease in the convergence rate between Nubia and Eurasia. The Naxos metamorphic core complex formed due to crustal shortening resulting in metamorphism and partial melting, and was exhumed due to the switch from compression to extension at 17-13 Ma.