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Tectonic and thermal evolution of a Metamorphic Core Complex: the Menderes Massif (Western Turkey)

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Understanding the origin of lithospheric- and crustal-scale thermal anomalies requires the study of the long-term thermo-tectonic evolution at large spatial-temporal scales. For instance, cold plate-converging settings (i.e. involving subduction) may exhume first colder units still preserving HP-LT assemblages from the earlier nappe stack, and then HT-LP parageneses in the post-orogenic setting. In both cases, the thermal evolution of such assemblages depends primarily on whether the basement is involved in the wedge (radioactive heat production), the coupling between crust and mantle, the depth of the lithosphere-asthenosphere boundary and the basal input from the mantle, the proximity of the cold subducting slab, the velocity of subduction/exhumation of crustal units and, lastly, the intensity of shear heating. Considered as one of the world's largest MCC, the Menderes Massif has recorded a succession of tectonic stages with different P/T gradients from ∼60 Ma to the Present above the Hellenic subduction zone. It is thus a good candidate to better understand relationships between slab dynamics and associated thermal anomalies. Using high-resolution laser 40Ar/39Ar dating of white mica and biotite and U-Pb dating of monazite combined with detailed regional-scale kinematic-structural data, this study bring new constraints on the Eocene-Miocene thermal evolution of a MCC (Metamorphic Core Complex). The first HT-LP metamorphism event associated with nappe stacking started in Eocene times and lasted until Oligocene times, affecting mainly the central and the southern part of the Menderes massif. This crustal thickening was mainly exhumed along a syn-orogenic extensional shear zone (SMSZ) in Eocene time, outcropping in the southern part of the massif. The presence of HP-LT rocks within the Menderes cover in the same area suggests that the northern part (or the entire massif ?) has undergone HP-LT conditions before the Eocene Barrovian metamorphism overprint. In the central part of the MCC, HT-LP metamorphism and associated deformation fabrics developed mainly during Miocene. Extension is thus localized into different shear zones such as the Bozdag shear zone (ductile deformation), the Gediz and the Büyük detachments (ductile-brittle deformation) accommodating exhumation of the MCC. During the history of the MCC, high-temperature metamorphism migrates southward from ∼30 Ma in the north to ∼20 Ma in the central part (19 to 26 Ma) as a consequence of slab retreat and tearing. Our multi-disciplinary kinematic, paleothermal, and thermochronological approach is integrated into a lithospheric-scale geodynamic model exploring the interactions between the crust and mantle to explain the thermal anomaly associated with the MCC formation. We discuss the origin of the large-scale thermal anomaly encompassing the Menderes Massif and the eastern and central Aegean Sea in relation with the slab tear shown by seismic tomography.