New thermal constraints for the Anatolian lithosphere from Curie depth point and Pn tomography

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Continental deformation can be described in two end-member approaches: block (or microplate) and continuum models. The first considers a strong lithosphere with deformation localized in fault zones. For the latter, however, the lithosphere is weak and deforms as a thin viscous sheet. The Anatolia – Aegean domain represents both continuum and plate-like deformation. Furthermore, recent modeling studies suggest a dynamic support mechanism of the Anatolian plateaus, with dynamic topography estimates ranging from 1 to 3 km for various crustal models and geodynamic scenarios, although the gravity and crustal thickness data support predominant Airy isostasy. The solution to both intricacies relies on the thermal structure of the crust and the lithosphere. Available thermal considerations stem from either the uppermost mantle velocity structure or thermal modeling with assumptions on radiogenic heat production and boundary conditions. Yet, homogeneous and independent constraints on the lithospheric structure are scarce. We aim to contribute to this knowledge gap by providing Curie Point Depths (CPDs), which corresponds to the depth at which rock-forming minerals lose their magnetization at the Curie temperature, ~580 °C.

Resolution of deep magnetic sources requires spectral methods with large windows, which reduce the CPD resolution. Moving & overlapping smaller windows have been used in order to increase the resolution, but these introduce spectral leakage and bias. In previous studies, subjective wavenumber ranges of the magnetic anomaly spectra were used, often combined with wrong scaling factors between map units and the equations. This resulted in generally erroneous CPD estimates. Furthermore, CPD uncertainties have often been unquantified for the study area. We use a wavelet transform method, which overcomes the artifacts due to segmentation of magnetic signal to finite windows, results in higher spatial resolution as well as enabling uncertainty estimation. We used as large an area as possible for constraining the edge effects away from the study area. The resultant CPD map spatially correlates well with low Pn velocity areas, locations of volcanoes, and thermal springs.