



Depths of magma chambers at three volcanic provinces in the Karlıova region of Eastern Turkey

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The size of a volcanic eruption, and thus the associated potential hazards, depends partly on the depth, geometry, and size of the source magma chamber. To estimate magma chamber depths and sizes, we apply a newly developed analytical method, based on the aspect ratio (length/thickness) of dikes, to three volcanoes in the Karlıova region of Eastern Turkey, namely Turnadağ, Varto, and Özenç. The results indicate that the depths of the source chambers are between 2 and 4 km at Turnadağ, 2 to 5 km at Varto, both of which are located in transtensional tectonic regimes, but from 22 to 27 km at Özenç, which is located in a convergent tectonic regime. A similar reservoir depth at Özenç is indicated by seismic tomography, and this data also suggests that the reservoir is laterally continuous for more than 40 km. The large volume of ignimbrites (> 40 km³) associated with Varto, a collapse caldera, indicates that caldera subsidence may have maintained the excess magmatic pressure (through tectonic forcing) in the chamber over a longer time than during normal pyroclastic eruptions. The dike aspect ratios further indicate magmatic overpressures of 13–21 MPa for Varto, 13–17 MPa for Turnadağ, and 26–31 MPa for Özenç. The combined results from seismic tomography, analytical models and magma compositions indicate that both Turnadağ and Varto volcanoes, which are typical stratovolcanoes composed of mostly intermediate, and more rarely, acidic magmas, were fed by two very shallow and comparatively small magma chambers (2–5 km depth). Whereas less evolved magmas were erupted from Özenç, which hosts predominantly basaltic and intermediate lavas and dikes that were fed by a deep reservoir at 22–27 km depth. Our tomographic models show that none of the volcanoes are located directly over the center of a deep magma reservoir. Our data also indicates that the magma in the reservoir has migrated between 34 and 40 km in a right lateral motion (to the east) below Varto and Turnadağ, respectively, and 23 km in a left lateral motion (to the west) at Özenç over the past 3 Ma. This lateral propagation of magma can be explained by tectonic escape of the Anatolian block to the west through the Northern Anatolian Fault and the Varto Fault Zone over the last 6 Ma.