V31F-0157 Melt distribution and Vp/Vs for the Mid Crust at the Santorini-Kolumbo Volcanic System

Wednesday, 13 December 2023

08:30 - 12:50

Poster Hall A-C - South (Exhibition Level, South, MC)

Abstract

The Santorini arc volcano in the Hellenic subduction zone has a history of caldera-forming Plinian eruptions, most recently in the Late Bronze Age 3.4 kya, and it remains volcanically active. To inform volcanic hazard assessments, it is crucial to understand where melt is distributed. The PROTEUS experiment in 2015 recorded >14,000 controlled marine sound sources on 165 land and seafloor seismic stations. Tomographic inversion of this data revealed low P-wave velocities in the upper 4 kilometers beneath the caldera and nearby Kolumbo seamount interpreted as the magma system (McVey et al., 2020; Chrapkewiecz et al., 2022). However, structure of the magma system was only determined in the upper (<4-6km) crust and melt content is only weakly constrained. In this study we improve constraints on the deeper magma system and subsurface melt content with a tomographic P and S wave velocity structure. To do so, we add to the inverse problem arrival times from ~1500 local earthquakes with magnitudes from 0.5 to 3.0 that occurred between 5 and 20 km depth. The events were recorded on 142 3-component ocean bottom and island seismic stations that span the seafloor ~60 km west and east of the island and the nearby islands. Results beneath Santorini and Kolumbo suggest that the upper crustal magma reservoirs extend deeper than previously found, and we image

a high Vp layer (~5-8 km) under the magma reservoir at Kolumbo. We identify this layer as strong, cooled, intruded magma and correlate it to the location of earthquakes, within which, swarms of rapidly upward propagating seismicity support prior inferences of melt conduits traversing a rheologically strong layer (Schmid et al, 2022). We give values for melt content of the upper crustal reservoirs using a scaled Vp/Vs model. Since the number of arrivals, apriori assigned uncertainty, and differences in ray geometry can result in P and S waves with different resolving power, we use measured resolution to scale the Vs perturbations and create a more realistic Vp/Vs model. The addition of earthquake arrivals allows us to map the magma reservoirs beneath the Santorini-Kolumbo magma system to 8 km depth and identify regions of elevated melt content.

First Author

H

Rebeckah S Hufstetler
University of Oregon

Authors

H

Emilie E E Hooft
University of Oregon

C

Nikos Chatzis
Aristotle University of Thessaloniki

T

Douglas R Toomey
University of Oregon

P

Costas B Papazachos
Univ Thessaloniki