



## Geochemical models of melting and magma storage conditions for basalt lava from Santorini Volcano, Greece

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Santorini volcano sits ~150 km above the Wadati-Benioff zone of the Aegean arc, where the African plate subducts northward beneath the Eurasian continent (Papazachos et al. 2000). Santorini volcano has a long history: activity started ca. 650 ka (mainly rhyolites and rhyodacites), with active pulses following ca. 550 ka (basalt to rhyodacite) and ca. 360 ka (large explosive eruptions of andesite to rhyodacite and minor basalt), culminating in the caldera-forming Bronze-age Minoan event (Druitt et al. 1999). As in many arc volcanoes, scenarios of fractional crystallization with or without mixing between felsic and mafic magmas have been proposed to explain the compositions, textures, and eruptive styles of Santorini products (e.g., Huijsmans & Barton 1989; Montazavi & Sparks 2004; Andújar et al. 2015). Here we focus on a basalt lava from the southern part of Santorini volcano (Balos cove, 36°21.7'N, 25°23.8'E), one of the few basaltic localities in the Aegean arc. The goals are to infer constraints on the magma chamber conditions which lead to mafic eruption at Santorini Volcano and to evaluate the slab and mantle wedge conditions via geochemical and petrological mass balance modelling.

We collected and characterised 20 samples for texture (SEM), mineral chemistry (FE-EPMA) and whole-rock chemistry (XRF). The basalts contain phenocrystic olivine (Ol) and clinopyroxene (Cpx) (<600  $\mu\text{m}$  diameter) in a fine groundmass (<100  $\mu\text{m}$  diameter) of Ol, Cpx, plagioclase (Pl) and magnetite (Mt) with minor glass and rare xenocrystic quartz. Santorini basalts exhibit a pilotaxitic to trachytic texture defined by randomly to flow-oriented tabular Pl, respectively. The predominant minerals are calcic Pl (core  $\text{An}_{78-85}$  and rim  $\text{An}_{60-76}$ ; 45-50 vol.%), Cpx ( $\text{En}_{36-48}\text{Wo}_{41-44}\text{Fs}_{11-21}$ ; 10-15 vol.%) and Ol ( $\text{Fo}_{74-88}$ ; 10-12 vol.%). Idiomorphic to subidiomorphic Mt (<10  $\mu\text{m}$  diameter) with variable  $\text{TiO}_2$  contents (1.9-16.5 wt%) is a minor constituent (~1-2 vol.%) in the less mafic samples.

Observed mineralogy and major element chemistry suggest fractionation in a shallow magma chamber. Using the major element chemistry and PRIMACALC2 (Kimura & Ariskin 2014) back-calculator, inferred crystallization conditions are  $P=0.02$  GPa, oxidized ( $f\text{O}_2=\text{QFM}+2$ ), and ~1 wt%  $\text{H}_2\text{O}$  in the primary basalt. The source mantle conditions are estimated at  $P=2.1$  GPa,  $T=1350^\circ\text{C}$ , and degree of melting  $F=8\%$ . We also used trace elements to estimate the incompatible element budget of the primary basalt using the forward trace-element mass-balance model of ARC BASALT SIMULATOR ver.4 (Kimura et al. 2014). Preliminary results suggest that the slab flux was derived from ~150 km depth, and fluxed mantle melting occurred at  $P=2.3$  GPa,  $T=1380^\circ\text{C}$ ,  $F=8\%$ . The estimated slab depth is consistent with the seismic observations and mantle conditions are consistent with the PRIMACALC2 major element modelling. Our intent is to extend our analytical data with precise trace element and isotope analyses in order to reveal more detailed source conditions and richer information about processes from the slab through the mantle and up to the shallow magma chamber.

### References

- Andújar, J. et al. (2015). JPET, 56 (4), 765–794.  
Druitt, et al. (1999). Geological Society Memoir, 19.  
Huijsmans, J. P., & Barton, M. (1989). JPET, 30(3), 583-625.  
Kimura, J. I., & Ariskin, A. A. (2014). G<sup>3</sup>, 15, 1494-1514.  
Kimura, J. I. et al. (2014). G<sup>3</sup>, 15, 691–739.

Mortazavi, M., & Sparks, R. S. J. (2004). *Con Min Pet*, 146(4), 397-413.

Papazachos, et al. (2000). *Tectonophysics*, 319(4), 275-300.