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The Hunga-Tonga-Hunga-Ha'apai Jan 15, 2022 eruption: Mineral and melt evidence for heterogeneous magma sources.

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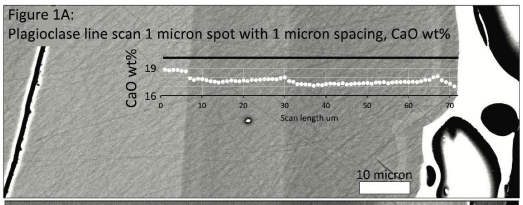

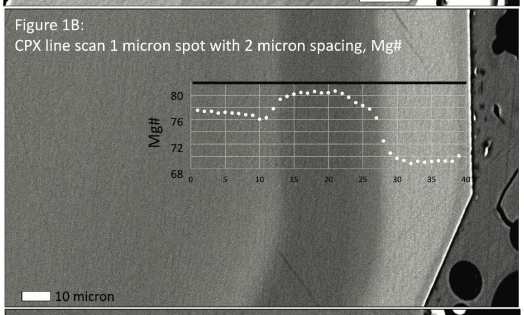

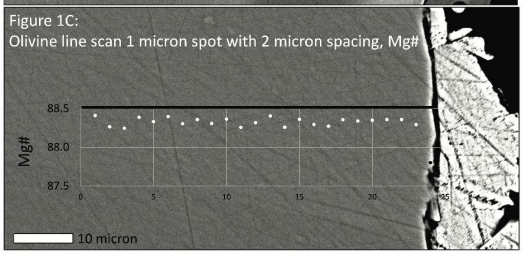

On 15 Jan 2022, Hunga-Tonga-Hunga-Ha'apai volcano in the Tonga-Kermadec oceanic arc generated the most explosive eruption of the 21st century. The predominantly andesitic magma (avg. SiO_2 58 wt %) is dominated by blocky, poorly vesicular glassy ash with subordinate vesicular pumiceous ash and fine lapilli, and contains ~10% crystals of plagioclase, orthopyroxene, clinopyroxene, and very rare olivine. Crystals are commonly euhedral or fractured and are most abundant in the 500-1000 μm size fraction. Preliminary micro-analysis data indicate that many plagioclase phenocrysts have high-anorthite cores with a sharp boundary to more sodic mantles (Fig. 1A). The most common clinopyroxene phenocryst cores have Mg# values of 76.5 (range = 68.0 to 87.5), and orthopyroxene cores have a mode at Mg# 73.7 (range = 63.4 to 82.7). Overgrowth mantles on pyroxene range from 100 to 300 microns and may be more or less mafic than the cores, but rims are normally zoned, and the outermost edges are similar to groundmass pyroxenes (Fig. 1B). Preliminary thermobarometry estimates from equilibrium opx-cpx pairs indicate temperatures of ~1060 °C (range = 1040 to 1090) and pressures of ~400 MPa (range = 310 to 420), which are higher than pressures observed in previous Hunga eruptions of ~150 MPa ± 70 from CPX-melt thermobarometry [1]. Olivine crystals are euhedral with homogenous cores up to Fo_{93} and thin, normally zoned rims (Fig. 1C). Chondrite-normalized Rare Earth Element and primitive mantle-normalized trace elements in tephra glass are in excellent agreement with whole-rock values from the 2014/2015 Hunga eruption [1], with slightly lower incompatible element concentrations. The 2022 Hunga eruption reflects assembly from heterogeneous magma sources tapping deeper parts of the magma system than seen in previous events, likely due to the extreme energy of this eruption, with no apparent evidence for magma recharge immediately preceding eruption.

[1] Brenna, M., SJ Cronin, IEM Smith, A Pontesilli, M Tost, S Barker, S Tonga'onevai, T Kula, R Vaiomounga (2022). Post-caldera volcanism reveals shallow priming of an intra-ocean arc andesitic caldera: Hunga volcano, Tonga, SW Pacific. *Lithos*, 412-413, 106614.