Constraining magmatic evolution and residence timescales at the Nola Seamount, Cape Verde

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The dynamics of magma storage beneath volcanoes is fundamental for understanding their behaviour during volcanic eruptions. Detailed petrography and mineral chemistry of the Nola Seamount, northwest of the Cape Verde archipelago is presented with the aim to unravel the pre-eruptive processes and thus contribute to our understanding of magma ascent and evolution at Ocean Islands.

The volcanics from Nola Seamount are basanites and ankaramites with glassy to microcrystalline groundmass that host phenocrysts of clinopyroxene, olivine and ilmenite. Clinopyroxene is the dominant phenocryst phase and classifies as diopside to salite. Clinopyroxene shows increasing FeO, TiO_2 and Al_2O_3 and decreasing MgO content from core to rim. Three geochemically different groups of clinopyroxene zonation can be distinguish; 1) primitive zones have high MgO (12.5 to 15 wt%) and low Al_2O_3 (3.5 to 7.5 wt%), 2) zones with intermediate MgO (9.5 to 13.8 wt%) and Al_2O_3 (5.0 to 12.0 wt%), and 3) evolved zones with low MgO (8.3 to 13.0 wt%) and high Al_2O_3 (6.5 to 12.9 wt%).

Diffusion chronometry has been employed to model the pre-eruption residence times of clinopyroxene. We obtain three timescales: 1 to 3 months; 0.5 to 2.5 weeks; and 2.5 to 4 days, which correlate with the groups of zonation. Additionally, the growth of the groups of zonation can be traced by thermobarometry to 0.6 to 1.0 GPa, 0.2 to 0.5 GPa and 0.1 to 0.5 GPa, respectively.

Integrating the compositional, timescale and pressure information, we trace the formation of the primitive zones to the oceanic lithospheric mantle with residence times of a few months. The intermediate composition zones formed near the Moho and have residence times of up to a few weeks, whereas the evolved zones formed in the crust and were subsequently erupted only days later. This pattern of ascent and eruption is likely common at Ocean Islands, as these timescales are remarkably consistent with observations of seismicity during the 2011 eruption El Hierro, Canary islands.