Experimental constraints on the magma evolution of the basanite-phonolite series from Cumbre Vieja volcano (La Palma, Canary Islands)

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Eruptive products of the recent Cumbre Vieja volcano (CV) cover a large spectrum of alkali-rich rocks ranging from basanites to phonolites. A model of the magma plumbing system is largely based on barometric studies of phenocrysts and xenoliths and includes three major intervals of magma stagnation and fractionation at mantle and crustal depths [1]. However, the relative influence of different thermodynamic parameters on phase equilibria is still unknown. We present results of an experimental study aimed for evaluating p-T-aH$_2$O-fO$_2$ conditions in the genesis of a basanite-tephrite-phonolite system. High pressure and temperature experiments (700 and 400 MPa; 1000-1175°C) in the presence of H_2O-CO_2 fluid (X_{H2O} varied between 0-1, keeping fO_2 between ~FMQ and FMQ+3.3) were conducted in an internally heated pressure vessel using two natural basanites with 13.7 wt.% and 9 wt.% of MgO, respectively, representing two differentiation stages in the evolution of CV magmas.

The natural phase assemblage (Ol+Cpx+Spl) was reproduced at 700 and 400 MPa, 1150-1100°C and 0.7-2.9 wt.% H_2O in the melt (H_2O^m) for the primitive basanite and at 400 MPa, 1150-1125°C and 2.2-2.7 wt.% H_2O^m for the evolved basanite. Tephritic residual melts were produced by Ol+Cpx+Spl crystallization at 400 and 700 MPa and low H_2O^m (1.4-2.9 wt.%). Phonotephritic melts were generated by Cpx+Ol+Krs+Mt crystallization at 400 MPa, 1075-1100°C and 0.7-3.1 wt.% H_2O^m. Tephriphonolitic melts were produced by Cpx+Pl+Krs-Mt+Ap crystallization at 400 MPa, 1050°C, 0.7-1.1 wt.% H_2O^m.

Our results indicate that differentiation from basanites to tephrites is possible in a pressure range of 400 to 700 MPa at least. Pl crystallization in basanites at 700 MPa is suppressed indicating that tephriphonolitic or phonolitic melts can only be generated at lower pressures or from a parent more evolved than basanite. Krs is an amphibole that can be stable even in melts with <1 wt.% H_2O^m (>0.1 X_{H2O}), suggesting that CV melts are CO_2 rich and H_2O-poor even in evolved magmas. It also requires low fO_2 (~FMQ): higher fO_2 results in extensive Mt crystallization leading to qz-normative residual liquids instead of Ne-normative.

[1] Klügel *et al* (2005) *EPSL* **236**, *211-226*.

Dunefield chronology in the Simpson Desert, central Australia, revealed by cosmogenic nuclide and luminescence dating

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Dune fields are among major features in arid–semiarid Australia, but our knowledge of their origin, formation mechanism and development history are incomplete. Chronology is essential for comprehensive understanding of the evolutionary history of dunefield, but conventional dating has been limited by its age range, e.g., up to ~50 ka for radiocarbon and ~300 ka for luminescence dating. In this study, we employ cosmogenic nuclide burial dating, based on ^{10}Be and ^{26}Al measurements, to determine the dune ages within the Simpson Desert, central Australia. Total 14 sand core samples, collected from three dune ridges and associated swales, have been measured for cosmogenic ^{10}Be and ^{26}Al. All samples show depressed ^{26}Al/^{10}Be ratios of 2.2–4.3; with distinctive contrast to the expected ratio of 6.7 for a simple exposure sample, the measured ratios indicate the model burial ages from 0.6 to 2 Ma. Near surface samples (<5 m depth) exhibit consistent ^{10}Be or ^{26}Al concentrations between drill holes, with a uniform burial signal of ~0.8 Ma. This observation suggests that i) sand at the site is well mixed and ii) sand particles inherit burial signals from either previous episode(s) of dune formation and/or storage in river floodplain during sediment transport. The nuclide inventory can be changed from this 'regional average' near-surface concentration only when sand particles are isolated from surface mixing (i.e., by burial under a stable sediment column within dunes). Assuming that sand now buried under dunes had nuclide concentrations similar to the current surface sand, 'inheritance corrected' burial ages can be calculated, which represent the time since the sand has been isolated from surface mixing. The corrected burial ages range 0.24–1.21 Ma. The Simpson Desert dunefield, while still active, appears to have developed over at least the last 1 Ma.

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