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Letter

High-pressure aragonite phenocrysts in carbonatite and carbonated syenite xenoliths within an alkali basalt

Vratislav Hurai,[1,*] Monika Huraiová,[2] Rastislav Milovský,[3] Jarmila Luptáková,[3] and Patrik Konečný[4]

[1]Geological Institute, Slovak Academy of Sciences, Dúbravská cesta 9, 840 05 Bratislava, Slovakia
[2]Department of Mineralogy and Petrology, Comenius University, Mlynská dolina, 842 15 Bratislava, Slovakia
[3]Geological Institute, Slovak Academy of Sciences, Ďumbierska 1, 974 01 Banská Bystrica, Slovakia
[4]State Geological Institute of D. Štúr, Mlynská dolina 1, 817 04 Bratislava, Slovakia

Abstract

We describe the first observation of primary magmatic aragonite in carbonatite and carbonated syenite, occurring as xenoliths in a Pliocene basaltic diatreme located near the Hungary–Slovakia border. The aragonite-hosting matrix consists of disordered P-rich calcite, occasionally associated with trachyte glass. We interpret the aragonite growth as evidence of supra-lithostatic overpressure in the magmatic plumbing system that connected the crustal basaltic reservoir with the partial melting zone of the lithospheric mantle, and the disordered calcite ± trachyte as quenched residual, immiscible melts, generated close to the solidus of the carbonated alkali basalt differentiated in the crustal reservoir. The quenching event was a phreato-magmatic eruption within the stability field of the low-pressure calcite; this was triggered by advective overpressure, caused by expanding gas bubbles in a quasi-incompressible silicate melt system. The high-pressure, pre-eruption origin of aragonite is indicated by enrichment in ^{13}C compared to the associated calcite interpreted as a record of CO_2 degassing at $T > 500$ °C. The oxygen ($\delta^{18}O$ ranges of 22.1–24.5‰ V-SMOW in aragonite, 21.6–22.7‰ in calcite) and carbon ($\delta^{13}C$ ranges of –4.4 to –5.9‰ V-PDB in aragonite, –11.9 to –12.7‰ in calcite) isotope signatures are consistent with a degassed carbonatite melt primarily derived from a subduction zone.

Keywords: Aragonite, carbonatite, syenite, xenolith, alkali basalt, Slovakia