5.4.P04

Magma mixing in a compositionally layered silicic magma chamber: Inferences from silicate melt inclusions

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The Bükkalja Volcanic Field (Northern Hungary) comprises Miocene rhyodacitic to rhyolitic ignimbrites, which contain phenocrysts with fresh glassy silicate melt inclusions. In this study, we demonstrate how composition of these glass inclusions can be used to constrain magma chamber processes.

The studied volcanic suite comprises a lower welded, fiamme-bearing subunit, overlain by a mixed pyroclastic deposit containing andesitic scoriae and rhyolitic pumices. These subunits consist of similar mineral assemblage showing overlapping compositional variation and thus they can be considered as a cogenetic series, i.e. they derived from repeated downward migrating withdrawal of the same magma chamber. One of the most remarkable features of these deposits is the large compositional variation of the plagioclases, orthopyroxenes and the juvenile glasses even in single samples. It suggests pervasive mixing of different magma batches and crystals formed at different stages of magma evolution. Geochemical composition of the melt inclusions is strikingly similar with that of the rhyolitic glasses of fiamme and pumices and this compositional variation can be explained by fractional crystallization involving plagioclase, orthopyroxene and biotite. This could have resulted in the formation of residual rhyodacitic to rhyolitic liquids, which were separated buoyantly at the top of the magma chamber. Scoria clasts also contain phenocrysts (mainly orthopyroxene) with silicate melt inclusions, but these glass inclusions are more silicic than the glass of the matrix of the scoria and are compositionally similar with the glass shards and the melt inclusions found in the loose crystals of the host pyroclastic deposit. This suggests that the phenocrysts of the scoria clasts are in fact xenocrystic and could have been picked up when the fresh andesitic melt intruded into the layered silicic magma chamber. The insufficient residence time could prevent hybridisation and crystallization of the intruding fresh andesitic melt. Instead, syn-eruptive mixing and mingling occurred between the different magma batches as shown also by the occurrence of composite juvenile clasts (scoria core and pumiceous margin) and banded pumices.

5.4.P05

Evidence for internal mixing in the Variscan Hospitais tonalite (Ossa-Morena Zone, Portugal)

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The tonalitic Hospitais massif (THM) belongs to a voluminous association of igneous rocks, ranging from gabbro-diorites, through tonalites and granodiorites, to granites, within a gneissic-migmatitic complex located at the westernmost part of the Ossa-Morena Zone (Iberian Variscan Chain; SW Portugal). The country rocks are generally considered of Neoproterozoic and Lower Palaeozoic ages [1]. The THM corresponds to an elliptical-shaped plutonic body, with a 15 km long axis in the WNW-ESE direction, following the main Hercynian structures in the studied area. The dominant lithology in this massif is a medium to coarse-grained tonalite, with a hypidiomorphic granular texture, composed mainly by plagioclase, quartz, hornblende, cummingtonite and biotite. Dark-coloured enclaves, displaying well-rounded outlines and ovoid forms, occur sparingly. These enclaves have a medium to fine-grained texture and, despite their mafic character, they show the same mineral assemblage of the tonalites. In the neighbourhood of the THM, some small gabbro-dioritic bodies occur. Gabbros and diorites are medium to coarse-grained and contain dominantly plagioclase, hornblende (often poikilitic) and pyroxene.

Variation diagrams suggest that the gabbros, diorites and tonalites belong to a magma suite derived by fractional crystallization. All these lithologies have similar trace element patterns, with slight LREE-enrichment and strong negative anomalies for Nb-Ta and Ti, typical of magmas from volcanic arc environment. On the other hand, the amphibole-rich mafic enclaves, hosted by the tonalites, have slightly concave downward REE patterns with pronounced negative Eu anomalies. The presence of microgranular mafic enclaves suggests a mechanism of mixing/mingling for the THM evolution, in addition to the fractional crystallization processes. According to their geochemical features, the mafic enclaves can be interpreted as an intermediate differentiation product internally mixed with the tonalite melt. Their amphibole cumulate composition could have resulted from a latter filter pressing process [2] that expelled the interstitial melt from the enclaves.

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