



Origin and ascent history of unusually crystal-rich alkaline basaltic magmas from the western Pannonian Basin

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The last eruptions of the monogenetic Bakony-Balaton Highland Volcanic Field (western Pannonian Basin, Hungary) produced unusually crystal- and xenolith-rich alkaline basalts which are unique among the alkaline basalts of the Carpathian-Pannonian Region. Similar alkaline basalts are only rarely known in other volcanic fields of the world. These special basaltic magmas fed the eruptions of two closely located volcanic centres: the Bondoró-hegy and the Füzes-tó scoria cone. Their uncommon enrichment in diverse crystals produced unique rock textures and modified original magma compositions (13.1-14.2 wt.% MgO, 459-657 ppm Cr, 455-564 ppm Ni contents). Detailed mineral-scale textural and chemical analyses revealed that the Bondoró-hegy and Füzes-tó alkaline basaltic magmas have a complex ascent history, and that most of their minerals (~30 vol.% of the rocks) represent foreign crystals derived from different levels of the underlying lithosphere. The most abundant xenocrysts, olivine, orthopyroxene, clinopyroxene and spinel, were incorporated from different regions and rock types of the subcontinental lithospheric mantle. Megacrysts of clinopyroxene and spinel could have originated from pegmatitic veins / sills which probably represent magmas crystallized near the crust-mantle boundary. Green clinopyroxene xenocrysts could have been derived from lower crustal mafic granulites. Minerals that crystallized in situ from the alkaline basaltic melts (olivine with Cr-spinel inclusions, clinopyroxene, plagioclase, Fe-Ti oxides) are only represented by microphenocrysts and overgrowths on the foreign crystals. The vast amount of peridotitic (most common) and mafic granulitic materials indicates a highly effective interaction between the ascending magmas and wall rocks at lithospheric mantle and lower crustal levels. However, fragments from the middle and upper crust are absent from the studied basalts, suggesting a change in the style (and possibly rate) of magma ascent in the crust. These xenocryst- and xenolith-rich basalts yield diverse tools for estimating magma ascent rate that is important for hazard forecasting in monogenetic volcanic fields. According to the estimated ascent rates, the Bondoró-hegy and Füzes-tó alkaline basaltic magmas could have reached the surface within hours to few days, similarly to the estimates for other eruptive centres in the Pannonian Basin which were fed by "normal" (crystal- and xenolith-poor) alkaline basalts.