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High-Mg amphibole and bulk-rock composition from Ciomadul dacitic pumices suggest rapid eruption trigger by strongly hydrous mafic magma recharge

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By investigating fossil eruption products, we can better understand the behaviour of volcanoes and the processes occurring well beneath the volcanic edifice, leading to eruptions. In a felsic, crystal-rich (> 50 volume%), long-dormant mushy system, one of the most critical rejuvenation factors is the addition of hot mafic magma. In the case of Ciomadul volcano (Southeast Carpathians), a dominantly explosive eruption phase occurred at 56-50 ka following a ca. 40 kyr long dormancy. Three eruption units were studied in detail: Băile Tuşnad (Ee5/1tf), the Covasna–Harghita frontier (Ee5/1kh) and Mohoş roadcut (Ee5/1mo). Pumices from these locations have relatively high-Mg values (avg. of 0.56-0.62 mol%) and similar Sr/Y (147-157, but 225 in the Ee5/1tf) and Dy/Yb (1.71-1.73, but 1.89 in Ee5/1tf) ratios akin to the adakite-like rocks. Variation of these bulk pumice as well as the titanite trace element ratios indicates early garnet fractionation or residual garnet in the mantle source region. Trace element signature of the pumices shows strong enrichment of Ba and Sr and a depletion in heavy REE suggesting that the primary magmas originated by partial melting of strongly metasomatized lithospheric mantle.

Mineralogy of the pumices is plagioclase, amphibole and biotite phenocrysts and apatite, titanite, zircon and FeTi oxide accessories. Mafic crystal clots of orthopyroxene, clinopyroxene surrounded by amphibole occur occasionally. Among the phenocrysts, amphibole shows a complex compositional zoning. One of the most particular features is the appearance of high-Mg and low-Al cores, found very rarely, if any, within amphibole, worldwide. Trace element composition of amphiboles shows also considerable variation and suggest crystallization at various magmatic environments. The high-Mg and low-Al amphibole xenocrysts have also peculiar rare earth element patterns: they have relatively low total REE content and a strong depletion in heavy REE. This REE pattern is akin to the amphiboles found in metasomatized spinel harzburgites and xenoliths showing melt-solid reaction. We assume that these amphiboles could have been a near-liquidus phase consistent with an ultrahydrous equilibrium melt. Trace element composition of these early formed amphiboles is thought to reflect the composition of the amphiboles at the

source region, i.e. shows an inherited nature. The strongly hydrous nature of the primary magmas is reflected also by the incongruent transition from pyroxenes to amphiboles as shown by the mafic clot textures.

Petrological features of the pumices suggest that eruption took place by reactivation of a relatively cold (T=700-775 °C), dacitic crystal mush. Rejuvenation was triggered by recharge of hydrous, less viscous mafic magma carrying the early formed crystal assemblage. Reheating and volatile flux initiated rapid remelting, magma ascent and eruption as indicated by thin overgrowth in amphibole and plagioclase and the lack of reaction zone around amphibole. This eruption scenario might have an implication for rapid reactivation after long dormancy in case of apparently inactive volcanoes.

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