Mafic and salic igneous xenoliths in Late Tertiary alkaline basalts: Fluid inclusion and mineralogical evidence for a deep-crustal magmatic reservoir in the Western Carpathians

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Abstract: Explosive Late Tertiary alkaline basalts have ejected pyroxenite, hornblendite, anorthoclaseite and quartz-bearing tonalite-trondhjemite xenoliths in the northern margin of the Pannonian Basin. One tonalite sample contains primary CO₂-H₂O inclusions with up to 20 vol. % of aqueous phase. Remaining tonalites, anorthoclaseites and mafic rocks trapped CO₂ inclusions without detectable water. Except for hornblendites, the CO₂ inclusions coexist with silicate melts. Additional, not yet detected volatiles are responsible for depression of the CO₂ final melting temperature, which clustered mostly around -58°C in all rock-types. Maximum densities of the CO₂ inclusions tend to decrease from pyroxenites (0.92 g/cm³), through anorthoclaseites (0.89 g/cm³), to tonalites (0.85 g/cm³) and hornblendites (0.75-0.87 g/cm³), thus reflecting decreasing depth of formation. Equilibration PT conditions for clinopyroxenes ranged between 1220°C at 10 kbar and 1068°C at 4.3 kbar, with the 50 % of estimates projecting between 6.5-7.5 kbar. Postcumulus hornblende, coexisting with An₅₃-₆₄ plagioclase, crystallized at 928-1074°C. Most of the PT data for pyroxenites indicate depths between 23-26 km, close to recent Moho discontinuity (27-29 km), while those for tonalites and hornblendites reflect their middle crustal emplacement (15-20 km). Cumulate textures, varying modal composition and essentially CO₂-dominated primary inclusions suggest formation of the xenoliths by fractional crystallization in a large reservoir of mantle-derived basaltic magmas. The cumulate origin of tonalites and anorthoclaseites is corroborated by nearly identical whole-rock REE distribution, showing pronounced positive Eu anomaly and enrichment in LREE. Contrasting calc-alkaline and alkaline affinities of clinopyroxenes and hornblendes in selected mafic xenoliths might result from heterogeneity of the parental basaltic magma generated either in metasomatised lithospheric mantle or in upwelled asthenosphere.

Key-words: alkaline basalts, cumulate xenoliths, fluid inclusions, thermobarometry, Pannonian Basin, Western Carpathians.

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