THE ORIGIN OF THE LOWER CRUST BENEATH THE PANNONIAN BASIN: EVIDENCE FROM GRANULITE XENOLITHS

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Lower crustal granulite xenoliths have been found in Pliocene basaltic tuffs in the western Pannonian Basin. Most of them are mafic metaigneous rocks containing mainly clinopyroxene, garnet and plagioclase, with minor ilmenite and scapolite. Metasedimentary granulite xenoliths have also been identified. Their mineralogy is characterised by the absence of clinopyroxene, combined with a high proportion of Al-rich phases, especially garnet, plagioclase together with subordinate spinel, sphene, rutile, orthopyroxene, quartz and occasionally graphite; one sample contains biotite.

Thermobarometric results indicate temperatures and pressures of 800° - 950°C and 8-15 kbar for all xenolith types, considerably higher than for most granulite xenoliths from other regions of Phanerozoic Europe. Given that the Pannonian Basin is currently underlain by thin crust (25-30 km thick), the pressure estimates indicate that the crust must have been considerably thicker (40-50 km) prior to the Tertiary collapse in the region.

Mafic granulite xenoliths are dominated by LREE-depleted bulk rock compositions. Many of these have MORB-like $^{143}Nd/^{144}Nd$, but $^{87}Sr/^{86}Sr$ is elevated relative to most MORBs. Their delta^{18}O values cover a wide range from +3.8 to +9.5‰. Nearly one third of the samples have delta^{18}O values less than average mantle (~+5.5‰). A group of LREE-enriched mafic granulites have higher $^{87}Sr/^{86}Sr$ (0.704-0.708) and lower $^{143}Nd/^{144}Nd$ (0.5128-0.5124), with higher delta^{18}O values on average (+7.8 to +10.6‰) than the

LREE-depleted granulites. The LREE-enriched granulites are, however, isotopically similar to newly discovered metasedimentary granulite xenoliths. A sub-linear correlation in epsilonHf-epsilonNd isotope space has a shallower slope than the crust-mantle array, with the metasedimentary rocks forming the low epsilonHf end member; the radiogenic end is restricted to the LREE-depleted granulites and these overlap the field of MORB. Pb isotopes for the LREE-depleted samples are less radiogenic on average than those of the LREE-enriched and metasedimentary xenoliths, and metasedimentary granulites have consistently higher $^{208}Pb/^{204}Pb$.

The wide range in delta^{18}O over a restricted range in Nd and Sr isotope values, in combination with the predominance of LREE-depleted trace element compositions, is consistent with an origin as a package of hydrothermally altered oceanic basalts. The existence of low delta^{18}O values less than average MORB and/or mantle peridotite requires that at least some of these rocks were hydrothermally altered at high temperature, presumably in the oceanic lower crust. The low $^{143}Nd/^{144}Nd$ of the LREE-enriched mafic granulites cannot be explained by simple mixing between a LREE-depleted melt and an enriched component, represented by the recovered metasediments. Instead, we interpret these rocks as the metamorphic equivalent of the shallowest levels of the ocean crust where pillow basalts are intimately intercalated with oceanic sediments. A possible model is accretion of oceanic crustal slices during subduction and convergence followed by high grade metamorphism during the Alpine orogeny.

Key words: garnet granulite, lower crust, isotope geochemistry, oceanic crust, hydrothermal alteration, Pannonian Basin