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A new conceptual model for the genesis of Plio-Pleistocene alkaline basalts in the Pannonian Basin

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A new model for the formation of Plio-Pleistocene alkaline basalts in the Pannonian Basin is presented. It is demonstrated, based on the water content of basalt hosted clinopyroxene phenocryst, that the water content of their host basalts was (2.0 – 2.5 wt.%) similar to that of island arc basalts. Likewise, the source region of the host basalts is water rich (550 – 700 ppm) similar to the source of ocean island basalts. The reason for the high water content could be the Mesozoic and later subductions (e.g. Penninic, Vardar, Magura) having transported considerable amount of water back to the upper mantle or hydrous plumes originating from the subduction graveyard beneath the Pannonian Basin.

The asthenosphere with such high water content beneath the Pannonian Basin may have been above the pargasite dehydration (<90 km) or the nominally anhydrous (>90 km) solidus during and after the extension in the Miocene. The basaltic melt from the asthenosphere, however, was extracted mainly not at the peak of extension, but only at the onset of the following tectonic inversion stage at 5 Ma. The extraction could have been facilitated by evolving vertical foliation in the asthenosphere as a response to the compression between the Adriatic indenter and the stable European platform. The vertical foliation and the prevailing compression were more favourable for squeezing the partial basaltic melt out from the asthenosphere. The overlying lithosphere may have suffered buckling as a response to compression which was probably accompanying by the formation of deep faults/deformation zones. These zones paved the way towards the surface for melts squeezed out from the asthenosphere.

The global application is that basaltic partial melts could be present in the asthenosphere where the bulk water content is high. This melt could be extracted even under a compressional tectonic regime where the combined effect of vertical foliation in the asthenosphere and deep fractures/deformation zones in the buckling lithosphere provides pathways towards the surface. The model also applies to deep seated transpressional or transtensional fault zones in the lithosphere.