Geophysical Research Abstracts
Vol. 19, EGU2017-7851, 2017
EGU General Assembly 2017

Intraplate volcanism in the Danube basin: 3D geophysical model of the Late Miocene Pásztori volcano

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The Little Hungarian Plain Volcanic Field is located in the Hungarian part of the Danube basin, which is one of the deepest depocenters of the Pannonian basin system of Central Europe. We are aiming to understand the crustal architecture and evolution of the basin, characterized by up to 8 kilometres of Miocene sediments. The crystalline pre-Cenozoic basement is built up by Paleozoic to Mesozoic metamorphic rocks. At such great depths an integrated potential field modelling can provide valuable key information from depths where other geophysical methods with high resolution failed due to poor seismic imaging and sparse well data.

The Pásztori volcano buried beneath a 2 km thick Late Miocene to Quaternary sedimentary sequence was drilled by several exploration wells. Based on petrological analysis, the volcanic rocks consist of a series of pyroclastics and lava flows. The measured magnetic susceptibilities of these samples are generally very low, ca. 0.00005-0.0005 SI. Texture and petrography of the pyroclastic deposits imply subaqueous eruptions resulting in mixing of volcanic material with semi-consolidated sediments. The 3D gravity and magnetic modelling software IGMAS+ was used to construct a geophysical model of the volcano and adjacent area. We have used gridded gravity and magnetic data, interpreted 2D reflection seismic sections and borehole data combined with re-evaluated geological constraints. Our suggested simplified model includes geobodies with different geophysical parameters (i.e. effective induced magnetization and density): uppermost volcanoclastics, trachytic igneous rocks, and a deeper magmatic pluton in the depth range of 5-14 km. The 3D model of the Danube basin is consistent with observed high dZ magnetic anomalies, up to 400 nT above the volcano, while the observed Bouguer gravity anomalies correlate better with the crystalline basement depth.

The findings infer that intraplate alkaline volcanism in the Danube basin commenced at earliest Late Miocene times (ca. 11-10 Ma) resulting in a trachyandesite-trachyte volcano at the surface associated with a magmatic pluton located in the upper crust. After a period of quiescence (a few million years) alkaline basaltic volcanism took place. The erosional remnants of this latter phreatomagmatic event are preserved on the surface, while stalled intrusions and the older trachyandesite volcano are mapped on seismic profiles and confirmed by our integrated modelling. Late Miocene alkaline volcanism in the Danube basin is genetically controlled by the Miocene extension associated anomalously ascended asthenosphere and the Raba Fault Zone.