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# Magmatic evolution patterns of the Miocene silicic explosive volcanism in the Pannonian basin, eastern-central Europe

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The formation of the Pannonian basin by major lithospheric extension during the early to mid-Miocene was accompanied by intensive volcanic activity. Among it, explosive volcanism fed by silicic (dacite to rhyolite) magmas is considered to have been the largest (accumulated tephra volume exceeded 4000 $km^3$) in Europe in the last 20 Myr. Zircon U-Pb geochronology indicates that this occurred between 18.2 and 14.4 Ma (Bükkalja volcanic field; BVF) and involved at least four major eruption episodes. Distal ash materials related to these volcanic eruptions are recognized around the Pannonian basin and even farther, over thousand kilometre away, based on zircon and glass shard data. Another major silicic volcanic activity developed eastward (Tokaj Mts., TM) from 13.2 to 11.5 Ma. In this case, explosive and effusive volcanic products were equally preserved. Explosive events in the TM are also clearly distinguished by zircon geochronology as well as zircon and glass shard trace element compositions.

The diverse zircon and glass geochemical data from these two areas suggest that reservoirs with distinct silicic magmas developed in the shallow continental crust for about 7 Myr. The epsilon-Hf values of zircon crystals are in a similar range from -10 to +2 and show a temporal increase, implying increasing role of mantle-derived magmas. In the BVF, an abrupt change in the epsilon-Hf values occurred after 16.2 Ma, suggesting that by this time the crust, and the lithospheric mantle was considerably thinned, while in the TM, this occurred later and in two smaller steps. MELTS modelling results, zircon and glass trace element data suggest different magma evolution in the BVF and TM as shown particularly by the Eu and Ce anomalies. In the TM, silicic magmas evolved under more reduced and drier magmatic environments. In contrast, wetter, and more oxidised conditions, with the presence of amphibole in the mineral assemblage, dominated in some of the BVF silicic magmas. The silicic magmatism had a major influence on the state of the continental crust due to the contemporaneous presence of large volume silicic magma reservoirs in the crust, and could have contributed to the crustal stretching beneath the Pannonian basin.