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# Could Permian felsic volcanic rocks and granites in the Tisza Mega-unit (Pannonian Basin) be in a plutonic–volcanic connection? Implications from zircon U-Pb geochronology and whole-rock geochemistry

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Permian felsic ignimbrites and lavas occur in several parts of the Tisza Mega-unit (Pannonian Basin) including outcrops in the Apuseni Mts (Romania) and the Mecsek Mts (Southern Transdanubia, Hungary) as well as drillings in Southern Transdanubia and the eastern Pannonian Basin (Hungary). Permian plutonic rocks occur in the Apuseni Mts, only in the Highiş–Drocea Unit, part of the Biharia Nappe System and their relationship with the felsic volcanic rocks have not been studied yet.

Based on petrographic and whole-rock geochemical observations Permian volcanic rocks of the Tisza Mega-unit are the products of the same volcanic system. Ignimbrites are similar in all the studied areas, they are rich in flattened, devitrified pumices and have 30–40% resorbed quartz, feldspar and hematitized biotite phenocrysts. In some pyroclastic samples strongly altered pyroxene and rarely garnet crystals are present. Lavas are porphyric with the same main mineral assemblage and have various recrystallized textures. Based on the immobile element ratios ($Zr/TiO_2$ vs. Nb/Y) the volcanic rocks show rhyolitic–dacitic composition. All of them are enriched in Rb, Th and U and depleted in Ba, Nb, Sr and Ti. The chondrite-normalized REE patterns show higher enrichment in LREEs, slighter enrichment in HREEs and strong negative Eu anomaly. Zircon U-Pb ages of the volcanic rocks range between 270.8±2.2 and 259.5±2.8 Ma.

These ages suggest a ca. 10 Myr long lasting magmatic system in the Guadalupian with rhyolitic–dacitic composition that might have been rejuvenated several times causing dominant ignimbritic eruptions and lava flows/domes. Rejuvenation could be associated with mantle-derived mafic-intermediate magmas providing heat to partial melting in the crust that are present as lavas (basalts and subordinate andesites) in the Apuseni Mts. Similar U-Pb ID-TIMS zircon ages (266.7±3.8 Ma and 264.2±2.3 Ma) were published by Pană et al. (2002) from the Permian anorogenic granites and diorites of the Highiş massif. This massif is situated within the Biharia Nappe System that also contains Permian ultramafic–mafic-intermediate and felsic A-type rocks assemblage crosscut by a late basalt–granite porphyry–rhyolite dike suite (Bonin & Tatu 2016).

The immobile element geochemistry indicates relationship, both rock types showing similar 'seagull' REE pattern with deep negative Eu anomaly (characteristic of hot-dry-reduced magmas) and their LaN vs. LaN/YbN ratios plot on the same trendline. Thus, it is possible to interpret Highiş granite as the 'frozen' (non-rejuvenated) part of the crystal mush system, that might generated volcanic rocks on the surface. Similar relationship were put forward in case of other Permian rhyolitic and granodioritic rocks from the Atesina-Cima d'Asta volcano-plutonic complex, Southern Alps, Italy (Barth et al. 1993) and from the Western Carpathians (Silicic Unit; Ondrejka et al. 2018).

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