



Long-living crystal mush system beneath the Ciomadul volcanic dome field (Eastern-Central Europe) based on zircon crystallization age distribution

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The Ciomadul volcanic dome field is the southeasternmost manifestation of the volcanic activity along the Călimani-Gurghiu-Harghita volcanic chain and represents the youngest volcanism in eastern-central Europe. The first eruptive period of Ciomadul volcanic activity (“Old Ciomadul eruptive period”) lasted from 1 Ma to ca. 350 ka and sporadically produced lava domes (collectively 2-3 km³) in a tectonically controlled alignment in a 5x7 km² area. During this period, three eruptive epochs can be distinguished based on recently published zircon (U-Th)/He dating results (Molnár et al. 2018). The active eruptive phases were separated by episodes of quiescence of 100-200 kyr. After a 150 kyr long repose interval, the “Young Ciomadul eruptive period” started at 160 ka during which an additional ~7.5 km³ of volcanic material erupted. The first eruptive epoch of Young Ciomadul was characterized by extrusion and amalgamation of dacitic lava domes and after ca. 40 kyr quiescence, the volcanic activity became more explosive between 56 ka and 30 ka (Molnár et al. 2019). The last eruption phases created the spectacular St. Anna crater lake at ca. 30 ka. Since these last eruptions, the volcano is quiescent, but gas emanations and mofettes at the surface suggest that the volcanic complex it is still active (Kis et al. 2017). The eruptive products of Ciomadul are uniform in terms of textures, mineralogy, and bulk-rock (major and trace element) chemistry, suggesting a common petrogenesis.

We use high spatial resolution zircon geochronology and chemistry to reveal the lifetime and chemical evolution of the mid-upper crustal magma reservoir beneath Ciomadul. We analysed 24 samples covering both eruptive episodes and used SIMS and LA-ICP-MS measurements on separated zircon crystals. Zircon saturation temperature and Ti-in-zircon shows that zircon crystallised mainly between 720 and 670 °C. Zircon crystallization occurred nearly continuously for 1.5 Ma, including the quiescence periods. The age distribution for analysis spots placed in crystal interiors and on outer surfaces of zircon crystals from the Young Ciomadul eruptive period suggests the existence of an upper crustal crystal mush reservoir beneath the Ciomadul volcanic dome field with a 500-1000 km³ volume that has evolved along with a 10-2.5 km³/y magma flux. This result is consistent with an intermittently rejuvenated, growing silicic pluton that fed sporadic eruptions with relatively low volume magma batches. Thus, the Ciomadul magmatic system is characterized by a long-lived and presumably still active magma reservoir and a remarkable 1:100 erupted volume/magma mush ratio.

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References:

- Molnár et al. (2018): JVGR, 354, pp. 39-56.
Molnár et al. (2019): JVGR, accepted paper
Kis et al. (2017): JVGR, 341, pp. 119-130.