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Eruption chronology of Ciomadul, a long dormant dacitic volcanic system in the Eastern Carpathians

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During the last decade, the zircon (U-Th)/He geochronology has become a promising method for dating eruption histories even in case of very young (Quaternary) volcanic products. It is proved to be particularly applicable when other dating methods such as radiocarbon, K/Ar, and 40Ar/39Ar techniques encounter analytical or interpretational difficulties often caused by a lack of appropriate materials for dating. Zircon (U-Th)/He method can be used to infer the date of the rapid cooling of the erupted magma, i.e. the eruption age. However, when the crystals formed less than ∼350 ka, correction for U-series disequilibrium is necessary. The effect of the secular disequilibrium can be corrected by the U-Th zircon dates, which provides additional information also about the timescale of the magma storage.

Here, we provide a detailed zircon (U-Th)/He dating approach to refine the eruption chronology of the Ciomadul dacite volcanic complex, found at the East Carpathians, eastern-central Europe. It is characterized by an intermittent precursor lava dome activity with extrusion of 0.1-0.6 km3 dacitic magma, followed by the build-up of a massive lava dome complex with two explosion craters. The erupted products are fairly homogeneous dacite with similar mineral cargo. During the field campaigns we focused on the volcanic products of the Ciomadul lava dome complex and sampled all the known localities to cover the whole volcanic period and avoid sampling bias. According to the new (U-Th)/He results the precursor lava domes were formed between ∼1000 and 300 ka, during several intermittent eruption events which were separated by long repose times: Bába Laposa: 950±50 ka, Delaul Mare: 840±12 ka, Puturosul: 710±50 ka, Bálványos: 580±20 ka and Turnul Apor: 330±40 ka. After another long quiescence, volcanic activity renewed at about 200 ka and became more productive. Numerous lava domes were developed between ca. 160 and 100 ka, which form the 10-12 km3 central lava dome edifice. Following a ca. 40 ka lull of volcanism, a more explosive phases with minor dome building activity occurred between ∼56 and 32 ka. Since 32 ka, the volcano has been again in a dormant state. However, geophysical data still suggest melt-bearing magma body beneath the volcano. The zircon U-Th crystallization ages imply that a silicic crystal mush could have been present for several 100's ka before the eruptions and this was rapidly remobilized by uprising hot basaltic magmas.

This new geochronological data set yields an unique insight into the temporal evolution of a dacitic volcanic complex and provides clear evidences for long (several 10's and even 100's kyr) repose times between the eruption periods that have to be considered in the volcanic hazard assessments of long dormant volcanic systems.

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