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Sequence of construction of Ciomadul (Csomád) dacitic lava domes, East Carpathians, by unspiked K-Ar Cassignol-Gillot technique in comparison with other radiometric methods

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Located at the southern tip of the Intra-Carpathian Volcanic Range in Romania, the Ciomadul (Csomád) volcanic complex (CVC) is the youngest eruptive center of the Carpatho-Pannonian Region (CPR). It consists of a dozen of dacitic lava domes that encompass two youngest explosive craters (those of the older Mohos peat bog and the younger St. Ana lake). Whereas, in the last decade, the Ciomadul explosive history for the last 50 ka was well constrained by numerous studies, the chronology of the dome sequence still lacks robust chronological constraints, since it is based on biased K-Ar ages.

Here, we provide a detailed K-Ar dating approach to refine the chronology of the domes, using the unspiked K-Ar Cassignol-Gillot technics for the first time. New eruption ages were performed especially on groundmass (separated from 3-4 kg unaltered sample rocks), the only material the cooling of which is doubtlessly contemporaneous with the eruption. Every age obtained is found to be younger than those proposed on previous whole rock K-Ar datings. Our analysis shows that most of the K-Ar ages in the previous studies suffer from the unsuitability of the material used to obtain eruptive ages, since dating whole rock gives a mixed age due to various mineral fractions with different individual ages. Our new results show that Ciomadul's volcanic activity began by the construction of the south-easternmost, peripheral domes from ca. 700 ka to 450 ka. Next, after a ca. 200 kyr long quiescence period, activity occurred in the north at 250 ka, and subsequent domes were emplaced from 200 - 150 ka forming roughly north-south aligned domes at the western and central part of the complex. Next, after another 50 kyr long quiescence period, activity resumed around 100 ka to form the eastern-central domes.

In addition to this chronological history of lava dome volcanism, we also investigated the sequence of crystallisation of phenocrysts present in the lavas, with respect to the modification of the eruptive ages. We separated and dated different phases containing potassium, i.e. feldspar, amphibole, biotite, plagioclase microlite, and groundmass. Ages obtained on feldspar, amphibole, biotite are systematically older than those obtained on the groundmass illustrating that these phenocrysts were formed before (or well before) the eruption, and brought up by the magma during the eruption. On the other hand, plagioclase microlite displays a complex range of ages, from the age of groundmass to the age of plagioclase phenocrysts. Finally the influence of the groundmass size fraction used (ideally, from 63 to 250 micrometres) was also tested. The applied methodology allows us to propose an appropriate procedure to separate the adequate material in order to obtain the K-Ar age of the eruption, i.e. the groundmass, in which there is no risk of presence of older, inherited phenocrysts.