

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

Stéphane Dibacto, Pierre Lahitte, Dávid Karátson, Daniel Veres, Ralf

Gertisser

▶ To cite this version:

Stéphane Dibacto, Pierre Lahitte, Dávid Karátson, Daniel Veres, Ralf Gertisser. Sequence of construction of Ciomadul (Csomád) dacitic lava domes, East Carpathians, by unspiked K-Ar Cassignol-Gillot technique in comparison with other radiometric methods. EGU General Assembly 2017, 2017, Vienna, Austria. hal-03662433

HAL Id: hal-03662433 https://hal.science/hal-03662433

Submitted on 12 May 2022

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers. L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Sequence of construction of Ciomadùl dacitic lava domes, East Carpaathians, by unspiked K-Ar Cassignol-Gillot technique in comparison with other radiometric methods GEOP

S PARIS



Stéphane Dibacto ^{1,2}, Pierre Lahitte ^{1,2}, David Karatson ³, Daniel Veres ⁴ and Ralf Gertisser ⁵ ⁽¹⁾ Laboratoire GEOPS, UMR 8148, Univ. Paris-Sud, Orsay, France, ⁽²⁾ CNRS, Orsay F-91405, France, ⁽³⁾ Department of Physical Geography, Eötvös University, Budapest, Hungary, ⁽⁴⁾ Institute of Speleogy, Romanian Academy, Cluj-Napoca Romania, ⁽⁵⁾ School of Physical and Geographical Sciences, Keele University, Keele, UK

Abstract

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. 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 techniques for the first time in Carpathian Range. New eruption ages were performed on groundmass, the only material the cooling of which is doubtlessly contemporaneous with the eruption. Each age obtained is found to be younger than those proposed on previous whole rock K-Ar datings. Our analysis shows that 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. A correlation between excess argon from these whole-rock measurements and the abundance of glomerocrysts is established. we also investigated the sequence of crystallisation of phenocrysts present in the lavas, with respect to the modification of the eruptive ages. We dated different phases containing potassium, i.e. feldspar, amphibole, biotite, plagioclase microlites, 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 microlites display a complex range of ages, from the age of groundmass to the age of plagioclase phenocrysts. The newly applied methodology, mainly consisting in a double full preparation first at larger grain size and next at < 100 micrometres, 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.



- 1) Potassium content
- > Measured by flame absorption spectrometry
- Compared with extrapolated curve from different standard

Methods

2) Argon

- Measured by mass spectrometry
- > Based on the double comparison of 36 and 40 isotopes of an atmospheric and a sample aliquot



sample aliquot Atmospheric aliquot





sity measurement

Why this geochronometer?

- Recent volcanic activity
- Nature of Ciomadùl rock: Cal-akaline to alkalin rock
- Very stable analytic condition reached by our mass spectrometer

Principle of atmospheric correction and signal call	bration
---	---------

- Groundmass age = last phase to crystallize during eruption

Main issue is to separate by using heavy liquid in association with magnetic separator the groundmass from the important presence of inherited phenocrysts such as: biotite, amphibole, feldspars (plagioclase).

Density range of groundmass in this study is between **2.40-2.51**; felspar (**2.55-2.65**); Biotite/amphibole (**2.8-3.17**).

Observations

> Presence of mixed grains i.e. grains composed with groundmass/plagioclase and/or groundmass biotite, amphibole

> Groundmass density is to close to density of plagioclase: this could **biaised** our results For example grain with 2.50 of density could be composed of 2/3 of a 2.45 dense groundmass and a 1/3 of 2.60 dense plagioclase.

To avoid such problems, we proceeded to a double full steps separation

Double full steps separation

Goals: separate from the groundmass any fraction of inherited mineral having an age not contemporaneous to the dome eruption. It also allows to minimize the potential risk to keep grain affected by fluid circulation.



Whole rock: crushed and sieved at 250-500µm 200 g of this is cleaned and separated using heavy liquid in association with magnetic separator in order to isolate with typical narrow density range of density for the dacitic domes of **2.46-2.51** of groundmass but not only.



crushed and sieved again at: 63-125µm

Grains are then separated by heavy liquid a second time in order to separate the pure **G.M.** fraction (**C**), typically (2.46-2.50 of density) from the remaining plagioclasic prains (**D**).

D



phenocrysts remain

some



G.M.= groundmass **Amp**=Amphibole **Bte**= Biotite **Plg**= Plagioclase

Age obtained on pure separated minerals					
Sample code	Dated phase	Fraction size (µm)	K%	Mean age ±1σ	
15CIO01	Amp	125-250	0.931	1386±37	
5CIO01	Plag.Gl	125-250	0.822	1132±22	
5CIO01	Biot.	125-250	6.532	569±9	



125-250





Dealul Cetătii (15ClO01)

CINIS

After purification of G.M. (+ magnetic separation), samples are hand-picked to check its 100 percent purity.



±1σ

202±6



Discussion

Age previously obtained on traditional K/Ar whole rock on the same lava dome (Dealul Cetății): 400±160 ka



References:



Age: 1132±22 Ma

Proportion: **11%;** K% (K_i): **0.82%**

Mixed grains

Proportion (P_i): **29%**



Whole-rock age simulation from Image analysis of thin section **Known parameters** In order to test the whole rock incidence and show ,that, ages 'Pure' groundmass obtained on whole rock are biased. An image simulation of grain Age (a_i): **184±5ka** composition have been done from the thin section of 15CIO01 Proportion (P_i): **60%**; K% (K_i): **3.72 Pure Plagiolase** sample coming from **Dealul Cetatii** (A) in different steps:

> Thin section image (A) is binarized on gray scale range (B1) and pixelated (B2) to simulate a 200 µm size grains

Determination of each grain composition from their color (C): Blue (pure G.M. grain), Yellow (pure plagioclase grain), Range of red (Mixed grain)

Estimation of age of whole rock and for each grains (D):

Age = $\sum_{i} *p_{i} *K_{i} / \sum_{i} *K_{i}$ Where a p and K are the age, the proportion and K content of each phase present in each grain i obtained age:

320 ka \longrightarrow 74% elder than groundmass age

Senerally, fractionation occurs during rock crushing with a larger proportion of groundmass than phenocrysts being crushed at lower size than 200 μm. For instance if a third of G.M. is removed during crushing and no Plg is lose, the resulting proportion between **G.M.** and **Plg** would induce an age of **405 ka**



Single step

15CIO01

Quantification of the abundance of glomerocrysts on whole-rock age

Glomerocrysts are aggregates of phenocrysts (> 1 mm and up to 5 mm in size,), with cumulate texture containing mainly plagioclases and amphibole and secondarily Fe-Ti oxides, apatite, biotite and zircon.

Mineralogical analyses

3.612

Evaluation of percentage of glomerocrysts in each rock (thin section) dated on both whole-rock (previous studies) and pure separated groundmass (this work)

Assuming that the principal reason of difference of our age with traditional K/Ar dating is due to inherited argon. Example of Glomerocryts



Karatson D. et al. / Journal of Volcanology and Geothermal Research 319 (2016) 29–51

Harangi et al, 2010: "Radiocarbon Dating of the Last Volcanic Eruptions of Ciomadul, Southeast Carpathians, Eastern-Central Europe"

Szakacs A. et al., 1995. The Calimani–Gurghiu–Harghita volcanic chain, East Carpathians, Romania: volcanological features. Acta Volcanol 7, 145–153