100th Anniversary of the Carpathian-Balkan Geological Association

XXII International Congress of the Carpathian-Balkan Geological Association (CBGA)

ABSTRACTS

Geologica Balcanica

Irena Peytcheva, Anna Lazarova, Georgi Granchovski,
Rositsa Ivanova, Iskra Lakova, Lubomir Metodiev
(Editors)

7–11 September 2022
Plovdiv, Bulgaria

Bulgarian Academy of Sciences

ISBN 978-619-91305-4-4
e-ISBN 978-619-91305-5-1

Sharp changes in magma evolution during the Quaternary volcanism of South Harghita, eastern-central Europe: constraints from bulk rock and zircon geochemistry and U-Pb dating

Ioan Seghedi[1], Réka Lukács[2,3], Ildikó Soós[3], Marcel Guillong[4], Olivier Bachmann[4], Barbara Cserép[3,5], Szabolcs Harangi[3,5]

[1] Institute of Geodynamics 'Sabba S. Ştefanescu' Bucharest, Romania; e-mail: seghedi@geodin.ro
[2] Institute for Geological and Geochemical Research, Research Center for Astronomy and Earth Sciences, ELKH, Budaörsi út 45, H-1112, Hungary, Hungary, e-mail: lukacs.reka@csfk.org
[3] MTA-ELTE Volcanology Research Group, Eötvös Loránd Research Network, ELKH, Pázmány Péter sétány 1/C, 1117 Budapest, Hungary, e-mails: reka.harangi@gmail.com; ildiko.soos14@gmail.com; cserep.barbara@gmail.com
[4] Department of Earth Sciences, ETH Zürich, Clausiusstrasse 25, 8092 Zürich, Switzerland; e-mails: olivier.bachmann@erdw.ethz.ch; marcel.guillong@ erdw.ethz.ch
[5] Eötvös Loránd University, Institute of Geography and Earth Sciences, Department of Petrology and Geochemistry, Pázmány Péter sétány 1/C, 1117 Budapest, Hungary, e-mail: harangi.szabolcs@ttk.elte.hu

The southernmost-end segment of the Călimani-Gurghiu-Harghita (CGH) chain (Eastern Carpathians, Romania) is represented by a succession of four aligned volcanoes (Luci-Lazu, Cucu, Pilişca and Ciomadul) formed by a postcollisional volcanism. The last three show distinct magma source characteristics and different petrogenetic evolution compared to the volcanic systems at the northern segment of the CGH.

The increasing Sr and Ba values in the bulk rocks, along with the changing Eu/Eu*, Hf content of zircon crystal with the calculated fO_2 from the Cucu volcano toward south is interpreted as distinct magma source regions with increasing metasomatized nature of the lithospheric mantle followed by fractional crystallization and mixing processes at crustal level. Two major sharp changes in the erupted magma composition are recognized at 2 Ma and 1 Ma, respectively, as revealed by zircon U-Pb ages. The last one occurred after an eruption gap between ~1.4–1 Ma when the activity of the Pilişca volcano terminated and the Ciomadul volcano dome field (CVDF) started to develop.

The Pilişca volcano with basaltic andesite evolved to dacite shows already a transition toward adakitic type magma composition. The CVDF volcanic activity started with a primitive shoshonitic magma derived by a low-degree partial melting of strongly metasomatized lithospheric mantle, whereas the more typical dacites were formed via multistage fractional crystallization and magma mixing. The adakitic character could be a result of various potential processes, from slab melting, interaction with peridotite mantle wedge, partial melting of mafic lower crust as well as magma mixing and fractional crystallization of garnet and/or amphibole. Trace element signatures of the magmas from Luci-Lazu to Ciomadul show a changing mantle source trend with various parental magma types and distinct fractional crystallization paths. Accumulation of mafic magmas beneath CVDF occurred at the base of the continental crust, where amphibole-dominated crystallization led to more evolved magmas. These differentiated magma batches built up a shallow crustal long standing felsic magma reservoir, where intermittent magma recharge events caused mixing in addition to a low pressure crystal fractionation, involving amphibole, biotite and plagioclase. Over time, the growing felsic magma reservoir below CVDF acted as a density filter and prevented the ascent of mafic mantle-derived magmas to the surface.

The sharp changes in the erupted magma composition can be related to changes in the geodynamic situation at the Southeast Carpathians during the Quaternary such as the distinct thermomechanical properties of the crustal blocks affecting the style of the collision as well as the geometry and asthenospheric mantle flow around the descending lithospheric slab. The associated geodynamic model could be a delamination process supporting magmatism generated in a highly hydrated lithospheric mantle below the Moesian Platform during the slab delamination rollback, although the alternative model of a near vertical slab as remnant of a former subduction cannot be unambiguously excluded as the source of adakitic and the ultrahydrous character of magmas via slab melting.

Acknowledgements Work supported by the Ministry of Research and Innovation, CNCS–UEFISCDI funding projects PN-III-P4-ID-PCCF-2016-0014 and by the National Research, Development and Innovation Office in Hungary and part of the project No. K135179.