



U-Pb zircon and $^{40}\text{Ar}/^{39}\text{Ar}$ ages of Mesta volcanic rocks and Central Pirin pluton

U-Pb цирконови и $^{40}\text{Ar}/^{39}\text{Ar}$ възрасти на вулканските скали от Места и Централнопиринския плутон

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Introduction

Mesta volcanic complex and the Central Pirin pluton have been interpreted by many authors as a volcanic-plutonic association (Arnaudova, Arnaudov, 1982; Amov et al., 1982; Zagorchev et al., 1987; Harkovska et al., 1998). This conclusion is based on detailed mineralogical, geochemical and isotopic studies. The pluton has recently been dated precisely using U-Pb zircon geochronology at 34 Ma (in Georgiev et al., 2010) but its age relationship with the Mesta volcanic is not clear because the volcanic rocks have been dated by the less precise K-Ar method (Harkovska, Pecskey, 2000). In order to constrain the ages and time span of volcanic and plutonic igneous activity and clarify their genetic relationship, we completed high-precision U-Pb zircon dating of 6 samples from the Mesta volcanics and 2 samples from the Central Pirin pluton, complemented by two $^{40}\text{Ar}/^{39}\text{Ar}$ measurements of sanidine from the volcanic rocks.

Geological setting

The Mesta volcanic complex crops out within an elongated SSE–NNW-oriented graben structure, situated between the western Rhodope block to the

east and the Pirin horst to the west. It is part of the Macedonian–Rhodope–North Aegean Magmatic zone (Harkovska et al., 1998). Two polygonal calderas (Kremen and Banichan) and two linear volcano-tectonic zones are distinguished within the volcanic complex (Harkovska et al., 1998). The subvolcanic and volcanic rocks are represented by stocks, domes, dome-flows, cryptodomes, dykes and pyroclastic flows. The volcanic rocks have exclusively felsic compositions, represented by rhyodacites (oldest phase from field relations), dacites and rhyolitic ignimbrites. The Central Pirin pluton consists of porphyritic granites and equigranular granodiorites (as two separate bodies) geochemically similar to the Mesta volcanic rocks.

Analytical methods and results

Cathode-luminescence images of zircon samples were carried out in Belgrade University and ETH–Zurich. Zircon LA-ICP-MS U-Pb dating was performed at the Geological Institute of BAS using a New Wave UP193FX laser ablation coupled to an ELAN DRC-e quadrupole ICP-MS. Sanidine samples were dated by $^{40}\text{Ar}/^{39}\text{Ar}$ method at the University of Geneva. Results are summarized in Table 1.

Table 1. U-Pb zircon and $^{40}\text{Ar}/^{39}\text{Ar}$ sanidine ages of Mesta volcanic rocks and Central Pirin pluton

Sample location	Rock type	U-Pb age	$^{40}\text{Ar}/^{39}\text{Ar}$ age
2 km north of Mesta village	rhyodacite	35.26±0.37 Ma	
Dobrinishte dyke	rhyodacite	33.79±0.38 Ma	
Kremen village	rhyodacite	33.90±0.88 Ma	
Kremen village	rhyodacite	33.2±1.0 Ma	
Dyke near Boukovo bridge	dacite	34.99±0.66 Ma	33.62±0.17 Ma
Momina Koula	dacite	33.10±0.45 Ma	33.25±0.17 Ma
Bezbog chalet	porphyritic granite	33.10±0.88 Ma	
Vihren chalet	equigranular granodiorite	32.70±1.0 Ma	

Discussion

U-Pb zircons ages and more precise $^{40}\text{Ar}/^{39}\text{Ar}$ sanidine ages from the two magmatic bodies are in good agreement. Results for the rhyodacites can be divided into two groups: (1) two zircon samples from the Kremen body are 33.2 ± 1.0 and 33.9 ± 0.8 Ma old (mean $^{206}\text{Pb}/^{238}\text{U}$ age – 33.55 Ma); (2) a dyke from the village of Dobrinishte gave a $^{206}\text{Pb}/^{238}\text{U}$ age of 35.26 ± 0.37 Ma. The age of the Kremen body fits well with the $^{40}\text{Ar}/^{39}\text{Ar}$ age of sanidine from Gostoun bridge (33.58 ± 0.17 Ma) and the zircon age of the coarse porphyritic Bezbog granites (33.10 ± 0.88 Ma). Relatively younger dacites from Momina Koula and Boukovo bridge exhibit U–Pb and $^{40}\text{Ar}/^{39}\text{Ar}$ ages of 33.10 ± 0.45 Ma and 33.25 ± 0.17 Ma, respectively. However, the zircon age of the Bukovo dacite is substantially older (34.99 ± 0.66 Ma) which may represent (1) a slightly earlier zircon population or

(2) mixed ages of inherited cores and younger rims. The equigranular granodiorites near Vihren chalet yielded the youngest U-Pb age of 32.7 ± 1.0 Ma, which is within the error of the dacite ages.

Conclusions

Our new U-Pb and $^{40}\text{Ar}/^{39}\text{Ar}$ radiometric ages of the Mesta volcanics and the Central Pirin plutonic rocks are very similar, overlapping within analytical errors. $^{40}\text{Ar}/^{39}\text{Ar}$ ages confirm our field observations for the relative ages of the magmatic bodies. The time span of the magmatic activity seems to be within 1 Ma, supporting their cogenetic origin.

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References

- Amov, B., V. Arnaudov, M. Pavlova. 1982. Lead isotope data and age of granitoids and metamorphic rocks from Sredna Gora and Pirin. – *C. R. Acad. bulg. Sci.*, 35, 1535–1537.
- Arnaudova, R., V. Arnaudov. 1982. Comparative geochemistry and conditions of formation of the “South Bulgarian granites”. – *Geologica Balc.*, 12, 4, 21–36 (in Russian with an English abstract).
- Georgiev, N., J. Pleuger, N. Froitzheim, S. Sarov, S. Jahn-Awe, T. J. Nagel. 2010. Separate Eocene-Early Oligocene and Miocene stages of extension and core complex formation in the western Rhodopes, Mesta Basin, and Pirin mountains (Bulgaria). – *Tectonophys.*, 487, 59–84.
- Harkovska, A., P. Marchev, Ph. Machev, Z. Pecskey. 1998. Paleogene magmatism in the Central Rhodope area, Bulgaria – a review and new data. – In: Christofides, G., P. Marchev, G. Serri, (Eds.). *Tertiary Magmatism of the Rhodopian Region. Acta Vulcanol.*, 10, 2, 199–216.
- Zagorchev, I., S. Moorbath, P. Lilov. 1987. Radiogeochronological data about the Alpine magmatism in the western part of the Rhodope massif. – *Geologica Balc.*, 17, 2, 59–71 (in Russian with an English abstract).