First findings of Late Cretaceous magmatic rocks in the Pirin Mts

Първа находка на къснокредни магматични скали в Пирин планина

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Introduction

Late Cretaceous extrusive and intrusive rocks from the Srednogorie zone represent the easternmost part of the Apuseni-Banat-Timok-Srednogorie magmatic belt in SE Europe (Popov, 2002). Most rocks are located in the Srednogorie zone but a number of outcrops are described also in the Balkan zone and the Northern Rhodope massif (Kamenov et al., 1999; von Quadt, Peytcheva, 2005; Marchev et al., 2006). Magmatic activity shows a general younging from north to south from 95 Ma in the Balkan zone to 68 Ma in the Rhodopes which has been explained by the retreat and rollback of the subducted Vardar-Izmir Ocean (von Quadt et al., 2005; Georgiev et al., 2009, 2012). The magmatic rocks are predominantly extrusive to the north and exceptionally plutonic to the south.

Here we report Late Cretaceous ages for magmatic rocks from Pirin Mts. This is the first documented occurrence of Upper Cretaceous igneous rocks south of Srednogorie zone and outside of the Rhodope massif, which enlarges the areal distribution of the Late Cretaceous magmas.

Location and geology of the area

The studied rocks are located SW of Kremen village, 24 km SE of Dobrinishte. Basement rocks consist of gneisses of probable Jurassic magmatic protolith age, which are intruded by stocks and dykes of Oligocene rhyodacites. The Late Cretaceous lithologies are represented by: 1) a plutonic body of dark green coarse grained diorites and 2) two finer-grained dykes, intruded into the diorites. The dykes are 1 and 4 m tick, respectively, both trending SE-NW (120°).

Petrography

The coarse-grained diorite (samples PF29 and PF30) is very slightly foliated with well preserved magmatic features. It is composed of hornblende, plagioclase, biotite, magnetite and accessory apatite, zircon and alanite. The rock is variably affected by hydrothermal alteration. The biotite is entirely replaced by chlorite, whereas plagioclase is partly replaced by sericite and epidote. Sample PF30 is more altered, replaced by secondary quartz and cut by thin veinlets of quartz, epidote and feldspar. Dykes (sample PF27 and PF28) are porphyritic, with phenocrysts of plagioclase, amphibole, biotite and magnetite set in groundmass of plagioclase, quartz and biotite. The two samples suffered different degree of alteration, comparatively weak in sample PF27 and much more intensive in PF 28. In the latter, amphibole is replaced almost entirely by epidote and chlorite, biotite is entirely chloritised and plagioclase is sericitised.

Analytical data

U-Pb zircon age data were obtained by LA-ICPMS measurements of zircons separated from diorite samples PF29 and diorite porphyritic dyke PF27. Analyses were performed at the Geological Institute of BAS on a New Wave UP193FX laser ablation system coupled to an ELAN DRC-e quadrupole ICP-MS. U-Pb measurements were calibrated using GJ-1 zircon standard. Laser crater was set to diameter of 35 microns and ablation frequency of 8 Hz. Analytical 1σ error ranges from 1% to 3%. Statistical uncertainty was estimated using MS Excel add-in Isoplot and reduced to a range of 1.1% to 1.7%. Cathode luminescence (CL) and backscattered photographs of zircon grains were taken at the University of Belgrade on a microprobe JEOL JSM-6610 LV SEM-EDS.

Results and discussion

Zircons of diorite sample PF29 are long to short prismatic, transparent. Although numerous CL-images reveal corroded cores, inherited zircons of older ages have not been established. Nine analyzed spots yielded ages between 86.3 and 84 Ma with concordia age of 85.27 ± 0.92 Ma which we consider to reflect the timing of pluton emplacement.

Zircons found in the dyke PF27 are mostly short prismatic and transparent. From 18 analyzed zircons, only one lacks inherited core. As a rule, the inherited grains reveal magmatic oscillatory zoning with thin white rim and a net of fractures cutting the whole grain which are enveloped by variably thick oscillatory magmatic rim. Twelve analyses of the inherited grains vary from 155.4 to 131.1 Ma with the oldest ages probably reflecting the age of the contaminating rocks. The younger ages of the inherited zircons can be interpreted as reflecting mixed values between older cores and metamorphic rims and fractures. One zircon grain was dated at ~81 Ma, similar to the host diorite pluton. One measurements of zircon without inherited cores and 2 large rims yielded a concordia age of 71.2 ± 1.06 Ma, which is interpreted as the time of emplacement of the mafic dykes.

Conclusion

Finding of Late Cretaceous igneous rocks in the Pirin Mts shows that this magmatism is distributed to the south and beyond the so far known Balkan zone, Srednogorie zone and the Rhodopes.

Space proximity and petrographic similarity of the rocks implies close emplacement ages. Surprisingly, they exhibit large age difference of ~12 Ma which may suggest two different magmatic phases.

Zircons from the large intrusive diorite do not show inherited zircons suggesting negligible crustal contamination from the local basement rocks. Diorite porphyry dyke contains large amount of inherited zircons of older ages, possibly reflecting more pronounced effects of crustal input. The contaminant seems to have been predominantly from the neighbouring Jurassic gneisses and in lesser amount from the host diorite.

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