



## Early Devonian Carpathian-Balkan ophiolite formation: U–Pb zircon dating of Cherni Vrah gabbro, Western Balkan, Bulgaria

### Формиране на раннодевонските Карпато-Балкански офиолити: U–Pb цирконови възрасти на Чернивръшкото габро, Западен Балкан, България

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The Carpathian-Balkan pre-Alpine ophiolites comprise four massifs/segments: Tisovitsa Iuti (Romania), Deli Jovan and Zaglavak (Serbia), and Cherni Vrah (Bulgaria). Almost twenty years, the only one convincing geochronological data (U-Pb zircon) of these ophiolites was Late Neoproterozoic – 563±5 Ma (Quadt et al., 1998) for the Cherni Vrah metagabbro. Recently were published consistent Early Devonian ages for the ophiolites: Deli Jovan massif (406±24 Ma by Sm-Nd mineral isochron, 405±3 Ma by U-Pb SHRIMP zircon, by Zakariadze et al., 2012); Zaglavak ophiolitic massif (388.1±5.1 Ma gabbro and 383.9±4.2 Ma plagiogranite, by Balica et al., 2014); Tisovitsa Iuti and Deli Jovan massifs (Sm-Nd isochrone 380±34 Ma, 390±52 Ma, 382±46 Ma and 386±25 Ma, by Plissart et al., 2017). These data let us reconsider the Late Neoproterozoic age of the Cherni Vrah gabbro as based on only one zircon that may represent recycled material. We re-sampled the pegmatoid coarse-grained gabbro from the Cherni Vrah ophiolite massif (Bulgaria) in a search of a magma batch with sufficient zircons and present here the newly obtained in-situ LA-ICP-MS U–Pb zircon age.

The Cherni Vrah ophiolite massif was introduced by Haydoutov (1989, and reference therein) under the name „Cherni vruch Group”. It includes three superpositional units which were named toponymically as follows: „unit of the layered cumulates (Kopilovtsi), unit of the parallel dykes (Monastir), and unit of the pillow lavas (Rupski)”. As these are actually non-bedded lithostratigraphic units, the unit names were later revised without changing the geographic names, the authorship and date of introduction. The revision was made by Angelov et al. (2008), whereas the whole unit was designated as “Cherni vruch Metabasite Complex”. It is exposed as a strip with length exceeding 18 km,

width from 0.3 to about 4 km and total thickness of about 3 km, while the thickness of gabbro and ultrabasites in the Cherni Vrah massif varies from 0.6 km to up to 1.5–2 km. The cumulate unit is represented by a rhythmic alternation of gabbro and ultramafites. The latter are exposed in the lower part and locally in higher levels of the unit section. Pyroxene gabbro with typical lenses of labradorites and pegmatoid gabbro predominate in the middle and upper parts of the unit.

Our recent field work was carried out in the Western Forebalkan and Western Balkan regions. In an outcrop 2 km southern from Gorni Lom village (coordinates – 43° 27' 38.42"; 22° 43' 52.78") we collected 5 kg sample of the pegmatoid gabbro and succeeded to separate enough zircon grains for the LA-ICP-MS dating (Fig. 1).

Cathodoluminescence (CL) and back-scattered (BSE) images acquired prior to zircon analyses to identify internal zoning, cracks and inclusions. U-Pb isotope analyses of particular zircon zones were carried out using a New Wave Research (NWR) Excimer 193 nm laser-ablation system attached to a Perkin-Elmer ELAN DRC-e inductively coupled plasma mass spectrometer (LA-ICP-MS) at the Geological institute of the Bulgarian Academy of Science. Spatial resolution was 35 µm and frequency of 8 Hz. Measurement procedure involved calibration against an external zircon standard (GEMOC GJ-1) at the beginning, middle and at the end of the analytical block. We analyzed 28 spots of 24 zircon grains. The zircons are predominantly middle prismatic with oscillatory zoning. The ages of the both cores and rims are consistent and yield a Concordia age of 391.2 ± 1.3 Ma (Fig. 1).

The newly obtained geochronological data of the Cherni Vrah gabbro supports the idea that the four Carpathian-Balkan pre-Alpine ophiolitic mas-

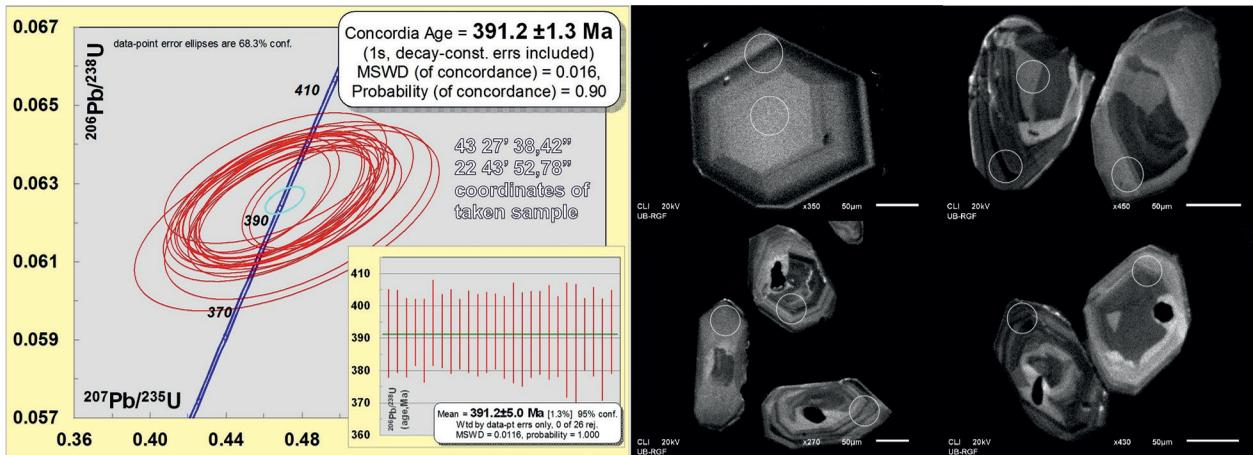


Fig. 1. U-Pb Concordia age of zircons of the Cherni Vrah coarse grained gabbro (left); CL zircon images (coordinates of taken sample – 43 27' 38.42"; 22 43' 52.78") (right)

sifs/segments represent a complete ophiolitic pile (Haydoutov, 1989; Plissart et al., 2017, and reference therein) and the age of these ophiolites is consistently Early Devonian. Plissart et al. (2017) interpret them as formed in back-arc in the northern part of the East Rheic probably within a dextral transtensive setting. Further Hf-isotope studies of the dated zircons from Cherni Vrah gabbro will provide additional constraints on the tectonic setting of the ophiolite complex.

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