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U-Pb detrital zircons geochronology from metasedimentary rocks of the Sakar Unit, Sakar-Strandzha zone, SE Bulgaria

U-Pb геохронология на детритни цирконии от метаседиментни скали на Сакарската единица, Сакар-Странджанска зона, ЮИ България

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The investigated pre-Triassic basement and Triassic metasedimentary rocks are part of the Sakar Unit in the Sakar-Strandzha zone (Ivanov, 2017). The basement is considered Volcanic-Terrigenous Complex (VTC; Gerdjikov, 2005), while the covering metasedimentary succession is assigned to the Topolovgrad Group (Sakar Type Triassic, STT) (Chatalov, 1990). Our study deals with metasedimentary rocks metamorphosed to amphibolite facies (Tzankova, Pristavova, 2007; Chavdarova, Machev, 2017) and containing detrital zircon crystals. The VTC samples from the Hlyabovo village area (N42°04'21.56, E26°18'7.85) are metasandstone, chlorite-muscovite and chlorite schists. The STT samples belong to the Ustrem Formation (muscovite and calcite-biotite schists) and Paleocastro Formation (metabreccia-conglomerate) in the Srem village area (N42°01'43.30, E26°29'37.60). We used detrital zircon U-Pb geochronology for interpreting the sedimentary provenance and maximum depositional age.

Methodology and results

The selected zircon grains (200–63 μm) of six samples were arranged in epoxy resin and dated by LA-ICP-MS at the Laboratoire Magmas & Volcans in Clermont-Ferrand, France. The ages at a 10% level of discordance ($^{206}Pb/^{238}UMa:^{207}Pb/^{235}UMa*100$) were used in the study.

The zircon populations from both complexes display similar morphology and internal textures. The variety of zircon morphology includes almost completely unrounded prismatic crystals and fragments to well-rounded grains. Among the smaller grains (63–100 μm) dominate unrounded long prismatic crystals. CL images show different internal textures, namely: dominant proportion of typical igneous oscillatory-zoned grains; homogeneous or weak convolute zoning; patchy, sector or mosaic zoning; grains with xenocrystic cores and unzoned rims.

The VTC yielded dates from 536 Ma to 2 673 Ma. Both the concordia diagram and probability density distribution plot (Fig. 1a) reveal the presence of a major cluster from 536 Ma to 690 Ma and a relatively small proportion of grains with ages between 813 Ma and 2 637 Ma. The cluster of Neoproterozoic–Early Cambrian ages refer to igneous and metamorphic grains within two subgroups: 536–607 Ma (mean Th/U 0.29) with the highest frequency of 570–580 Ma and concordia age of 572.8±9.4 Ma (2 σ level) calculated for one of the sample; 612–706 Ma (mean Th/U 0.52) with the highest frequency of 630–650 Ma and weighted average age of 649.8±4.9 Ma. The Archean–Paleoproterozoic ages recorded by the xenocryst grains exhibit variable Th/U ratio values (0.02–1.40).

The specified STT ages vary between 286 Ma to 622 Ma, with two populations of detrital zircons (Fig. 1b). The Early Permian–Early Carboniferous cluster of data ranges from 286 Ma to 346 Ma (mean Th/U 0.49) and concordant age of 301.3±3.8 Ma (2 σ level) calculated for one sample. The younger ages of the same population (286–304 Ma) were recorded in the finer grains zircon fraction. The older age population of Late Neoproterozoic to Early Silurian zircons represent several concordant to subconcordant results from 438 Ma to 622 Ma with variable Th/U from 0.07 to 0.80.

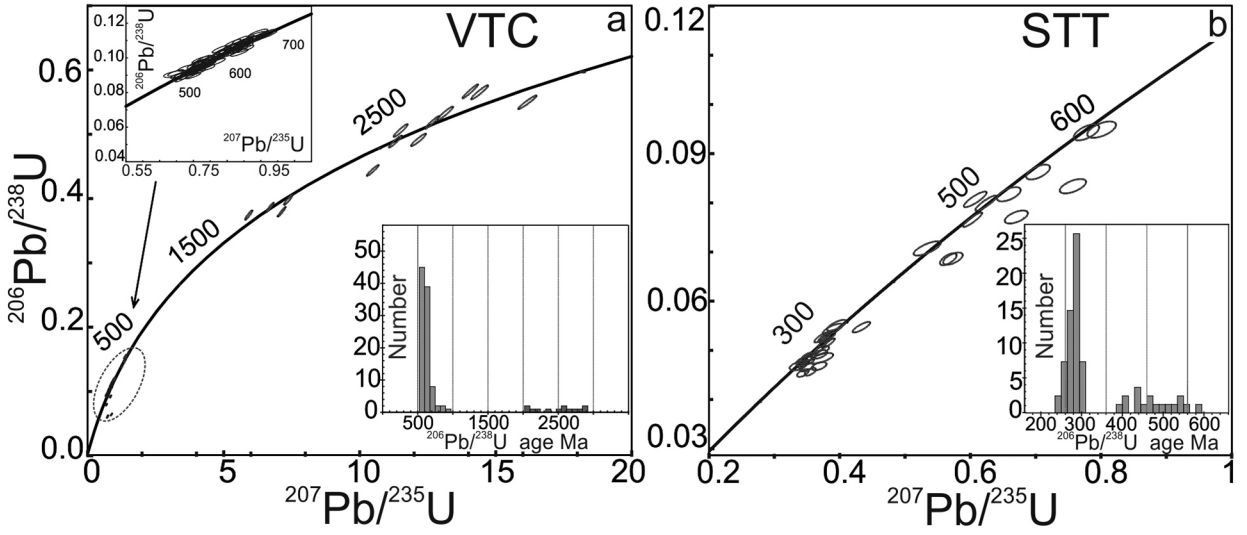

Fig. 1. U-Pb isotope data of detrital zircons: *a*, VTC U-Pb concordia diagram with insets of a fragment for 536 Ma to 691 Ma and a histogram plot of all results; *b*, STT U-Pb concordia diagram with an inset histogram plot of all results

Conclusions

The data of the detrital zircons allow identifying dominant magmatic provenance sources for both complexes. The VTC detrital zircons suggest Precambrian–Early Cambrian provenance and post-Cambrian depositional age. Analogous Early Cambrian ages were reported for the orthometamorphic rocks of the Strandzha basement (Çatalca, İhsaniye, Binkiliç metagranites) in Turkey (discussion in Okay, Topuz, 2017). The STT provenance area was dominated by Early Carboniferous–Early Permian rocks, similar to the Sakar batholith, Melnitsa and Lesovo orthometamorphic complexes studied by Bonev et al. (2017). The youngest detrital zircon age is Early Permian suggesting later deposition while Filipov et al. (2018) gives Late Permian maximum depositional age for Paleocastro metasandstone. The variety of zircons age populations of the Triassic terrigenous-carbonate rocks includes Mesoproterozoic–Early Devonian zircons from the Klokotnitsa village area (Vladinova et al., 2017) suggesting post-Devonian depositional age. The summarized results indicate changes in sedimentary provenance and maximum depositional ages of the Triassic succession.

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