



U-Pb zircon dating of granites and orthogneisses from the Madan unit in the Arda river valley, Central Rhodopes, Bulgaria

U-Pb цирконово датиране на гранити и ортогнайси от Маданската единица по долината на р. Арда, Централни Родопи, България

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Key words: Central Rhodopes, Madan unit, orthogneisses, U-Pb zircon dating.

Geological setting

The Central Rhodope metamorphic core complex is composed of several orthogneisses dominated tectonic units. The higher-grade migmatitic units: Arda (dome core), Startsevo and Madan, have their continuation on the territory of Greece and correspond in general to the so-called Sidironero unit (Krohe, Mposkos, 2002). We present new geochronological data that are supposed to help for better understanding of the Madan unit origin/evolution and for relevant correlation with the units in Greece.

The Madan unit is situated in the southwestern part of the complex, composed of biotite orthogneisses and subordinate paragneisses, marbles, and amphibolites (Raeva et al., 2008; and references therein). Syn- to post-kinematic granite bodies intruded the metamorphic rocks controlled by a ductile strike-slip shear zone (Naydenov et al., 2006; and references therein).

The samples selected for U-Pb zircon dating include a host orthogneiss (E165 – N41°29'38; E24°35'40) and a small syn-kinematic granite body (E159B – N41°27'33; E24°51'24).

Geochronological data available

The Late Hercynian (300–310 Ma) Arda unit orthogneiss protoliths are affected by late-Alpine migmatization 37–38 Ma (Peytcheva et al., 2004; and references therein). The overlying Startsevo unit (eastern periphery of the complex) consists of abundant ~150 Ma old metagranites and older metabasic rocks (450 Ma) both hosting 43 to 53 Ma old syn- to post-kinematic granites (Ovtcharova, 2004). The only age

determination in the Madan unit regards to the post-kinematic Smilyan granite body specified at 41.92 ± 0.22 Ma (Kaiser-Rohrmeier, 2005). The host Madan unit orthogneiss is of unknown age. The Sidironero unit orthogneisses in Northern Greece also consists of two groups of protoliths – Mesozoic 135–165 Ma, and Paleozoic 294 Ma (Turpaud, 2006; Liati, 2005) intruded by ~56 Ma old granite complex – the Barutin-Buynovo-Elatia-Skaloti-Paranesti pluton (Soldatos et al., 2008).

U-Pb zircon dating

Single zircon grains were dated by precise isotope-dilution U-Pb (TIMS) technique, using the double uranium spike of the Earth-Time project (ET535). In order to minimize the effects of secondary lead loss, zircons were pretreated by "chemical abrasion" techniques.

The zircons from both samples are colorless to pink, transparent and prismatic. The analyzed zircons from the orthogneiss sample E165 show both inheritance and Pb loss effects. Two of the grains are concordant at different ages in the range of 157.4 ± 1.9 Ma to 160 ± 2.3 Ma (Fig. 1a). When all the analyzed zircons are anchored to 43 Ma (inferred from the age of the late granite intrusion) the upper intercept is calculated at 160.6 ± 2.3 Ma. This age is in agreement with the near sited Late Jurassic Startsevo and Sidironero units orthogneiss protoliths.

The zircons from the small granite body (sample E159B) show a slight effect of inheritance of old lead component; three concordant zircons scatter along the concordia in the range of 43.5 ± 0.36 Ma to 43.8 ± 0.49 Ma (Fig. 1b). Therefore, the lower in-

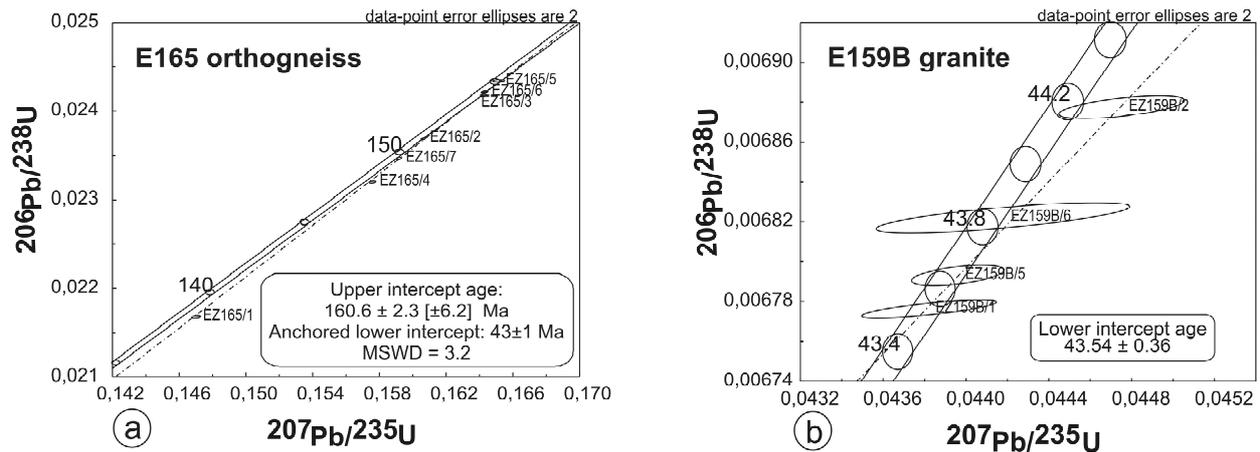


Fig. 1. Concordia diagrams for zircons of samples E165 (orthogneiss) and E159B (granite) with the calculated U-Pb ages

tercept age of 43.54 ± 0.36 Ma, calculated from all analyzed zircons is considered to be the best estimate for the age of zircon crystallization. The age of the analyzed syn-kinematic granite body corresponds well with the field observation of its emplacement, prior to that of the largest post-kinematic Smilyan granite body (41.92 ± 0.22 Ma).

Discussion and conclusions

The new geochronological U-Pb zircon data define a Late Jurassic (160 ± 2.3 Ma) protoliths age of the orthogneisses in the Madan unit similarly to the orthogneisses of the Startsevo and parts of the Sidiron-

ero unit. The Madan unit metamorphic rocks are intruded by syn- and post-kinematic granite bodies of very similar age of 43.5 ± 0.36 Ma to 41.92 ± 0.22 Ma. The results confirm an earlier syn-kinematic granite emplacement (controlled by a ductile strike-slip shear zone) and later Smilyan granite post-kinematic emplacement. The similar granite ages (42–56 Ma) of the tectonic units mentioned above, represent the time span of granite melt generation and emplacement that predated the final exhumation of the Central Rhodopian Dome core. The geochronological data corroborate an idea of similar tectonic evolution and exhumation of the Madan, Startsevo, and parts of the Sidironero unit.

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