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A RECORD OF MULTI-PHASE PROTEROZOIC AND PALAEOZOIC MAGMATISM IN THE CENTRAL SUDETES, N BOHEMIAN MASSIF, REVEALED BY SHRIMP ZIRCON DATING

Abstract: Results of SHRIMP U-Pb zircon dating for selected samples of (meta)igneous rocks from the Kłodzko Metamorphic Complex are presented. Zircons extracted from a metavolcaniclastic rock (TKT) yielded two groups of $^{238}U/^{206}Pb$ ages, clustering at 528.4 ±5.2 and 543.3 ±5 Ma. Two orthogneiss samples (SCI and K-163) provided $^{238}U/^{206}Pb$ ages of 495.3 ±2.8 and 491.5 ±3.2 Ma, respectively. The emplacement age of a non-metamorphic rhyolite (Ścinawica) was dated at $^{238}U/^{206}Pb$ 339 ±9.6 Ma, but the zircon population of this sample also comprises a broad range of inherited components.

Keywords: Bohemian Massif, Neoproterozoic crust, Pre-Variscan basement, Variscan belt, Zircon, Geochronology, U/Pb, SHRIMP

The Kłodzko Metamorphic Complex (KMC) in the Central Sudetes comprises a nappe sequence, built up by several crustal components of Palaeozoic and Neoproterozoic age (Mazur 2003; Mazur *et al.* 2004). The KMC records evidence for a prolonged magmatic history occurring in changing tectonic settings (Kryza *et al.* 2003) and can be considered to represent a reference area for the entire Central Sudetes. In order to better constrain the timing of successive magmatic events, we have applied ionprobe (SHRIMP) U-Pb zircon dating to meta-igneous rocks from the study area. The new data provide valuable insight into the magmatic evolution of distinct crustal domains which eventually have been accreted into the Variscan belt.

Previous ID-TIMS U-Pb zircon dating of multigrain separates suggested an age of 590.1 ±7.2 Ma for metagabbros and associated felsic rocks and provided a rather imprecise age estimate of c. 590-600 Ma for a metatuffite collected from a volcano-sedimentary succession (Mazur *et al.* 2004). To verify the latter provisional age, we dated zircons from a similar metavolcaniclastic layer interbedded with clastic metasediments (sample TKT03). The analysed zircons yielded two groups of $^{238}U/^{206}Pb$ ages (Fig. 1a), interpreted to indicate the time of protolith formation (528.4 ±5.2 Ma) and the age of an inherited component (543.3 ±5 Ma). Ages around 540 Ma are widely known throughout the Variscan belt and generally are correlated with a phase of post-orogenic magmatism following the Cadomian orogeny. The Early Cambrian age (c. 528 Ma) is similar to that obtained by Kröner *et al.* (1997) for a metarhyolite from the varied volcano-sedimentary series of the neighbouring Śnieżnik Massif. The new results indicate that the volcano-sedimentary succession of the KMC either represents an age interval of c. 528-590 Ma or that the previously reported multigrain age of c. 590-600 Ma (Mazur *et al.* 2004) is geologically meaningless, due to mixing of grains with different internal structures and ages.

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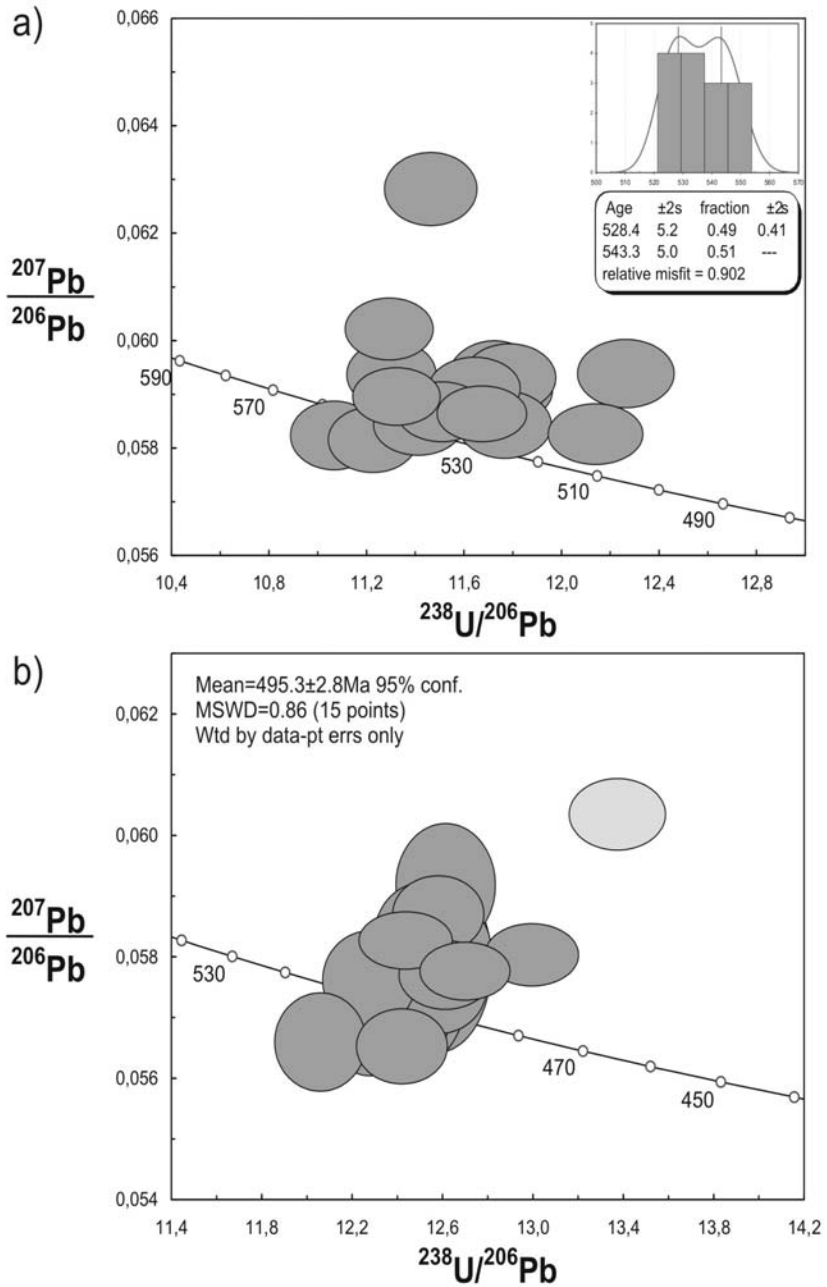

Fig. 1. Tera-Wasserburg diagrams showing U-Pb data for (a) TKT03and (b) SCI samples. Data-point error ellipses are of 68.3% confidence.

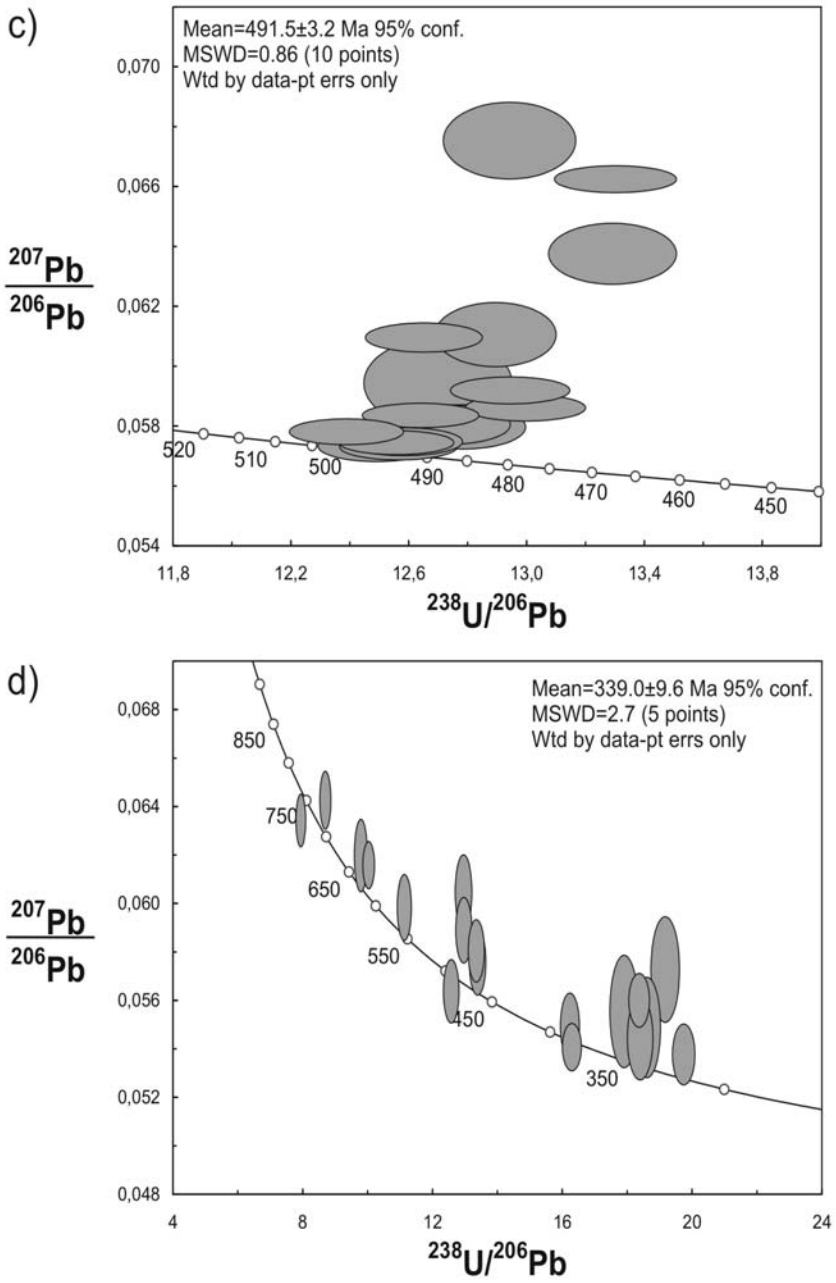

Fig. 1. (continued) Tera-Wasserburg diagrams showing U-Pb data for (c) K-163and (d) SNW samples. Data-point error ellipses are of 68.3% confidence.

Two samples (SCI and K-163) represent the so-called Ścinawka orthogneiss previously dated at c. 500 Ma (Mazur *et al.* 2004). However, some uncertainty was associated, with this age, because several zircons revealed features of intense recrystallization. Nevertheless, the newly dated orthogneiss samples yielded ages of 495.3 ±2.8 Ma (SCI) and 491.5 ±3.2 Ma (K-163), largely confirming previous age estimates (Fig. 1b,c) and further supporting the existence of Lower Ordovician granitic protoliths in the KMC. Orthogneisses of this age are widespread throughout the Variscan belt.

Sample SNW was collected from an unmetamorphosed, subvolcanic rhyolite, emplaced directly at the boundary of the KMC with the cover rocks and represents the group of rhyolites that intruded into the sediments of the Bardo Basin. SHRIMP U-Pb zircon dating yielded a broad spectrum of $^{238}U/^{206}Pb$ ages. The largest and youngest age group with a mean age of 339 ±9.6 Ma is interpreted to indicate the time of magmatic emplacement. Older ages (c. 380-390 Ma, c. 460-500 Ma, c. 550 Ma, c. 610-630 Ma and c. 700-760 Ma; Fig. 1d) most likely represent inheritance. Some of these ages correspond to magmatic events well known from the Sudetes and/or the whole Variscides, e.g. the syn- and post-orogenic Cadomian magmatism (610-630 Ma and 550 Ma, respectively), the voluminous Ordovician granite plutonism (460-500 Ma) and the decompression-related migmatization within the adjacent Góry Sowie Massif (380-390 Ma). Rather unique in the light of previous studies are pre-Cadomian ages in the range of 700-760 Ma. Similar ages have been rarely reported from the Variscan belt (see *e.g.* Friedl *et al.* 2004), although a comparable inherited zircon age was recently described from granulites of the neighbouring Śnieżnik Massif (Anczkiewicz *et al.* 2005).

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REFERENCES

ANCZKIEWICZ R., MAZUR S., SZCZEPAŃSKI J, STOREY C., CROWLEY Q., VILLA I.M., THIRLWALL M.F., JEFFRIES T.E 2005: Lu-Hf geochronology and trace element distribution in garnet as evidence for the multiphase uplift and exhumation of ultra-high temperature and ultra-high pressure granulites in the Sudetes, SW Poland, Central European Variscides. *Earth Planet. Sci. Lett.– in press.*

FRIEDL G., GINGER F, PAQUETTE J.-L., VON QUADT A., MCNAUGHTON N.J,. FLECHTER I.R. 2004: Pre-Variscan geological events in the Austrian part of the Bohemian Massif deduced from U-Pb zircon ages. *Int. J. Earth Sci.*, 93: 802-823.

KRÖNER A., HEGNER E. & JAECKEL P. 1997: Cambrian to Ordovician granitoid orthogneisses in the Polish and Czech West Sudetes Mts. and their geodynamic significance. *Terra Nostra*, 97(11): 67-68.

KRYZA R., MAZUR S., PIN C. 2003: Subduction- and non-subduction-related igneous rocks in the Central-European Variscides: geochemical and Nd isotope evidence for a composite origin of the Kłodzko Metamorphic Complex, Polish Sudetes. *Geodinam. Acta*, 16(1): 39-57.

MAZUR S. 2003: Structural evolution of the Kłodzko Metamorphic Complex and the implications for the Variscan tectonics of the Sudetes. *Acta Universitatis Wratislaviensis no 2581, Pr. Geol.-Mineral.*, 74: 1-199.

MAZUR S., TURNIAK K., BRÖCKER M. 2004: Neoproterozoic and Cambro-Ordovician magmatism in the Variscan Kłodzko Metamorphic Complex (West Sudetes, Poland): new insights from U/Pb zircon dating. *Int. J. Earth Sci.*, 93: 758-772.