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GEOCHRONOLOGY OF CRYSTALLINE BASEMENT OF THE WESTERN OUTER CARPATHIANS' SEDIMENT SOURCE AREAS – PRELIMINARY DATA

Abstract: For the Western Outer Carpathians' (WOC) sediment source areas three separate metamorphic events were identified: (1) the Neoproterozoic to Cambrian one in the northern domain, related to the Brunovistulicum and/or Malopolska Massifs, (2) the Late Carboniferous to Permian one, related to Silesian ridge and southern Magura ridge, and (3) the Albian one, related to Marmarosh Massif. The WOC developed on the basement, being the southern prolongation of the Trans-European Suture Zone (TESZ). Palaeoboundary between Variscan and "Cadomian" orogens in the WOC's basement is related here to contact zone of the Silesian basin and Silesian ridge. Silesian ridge and southern Magura ridge are regarded here as fold-and-thrust belts, active during the late Cretaceous-Paleocene and Eocene respectively. Their intense elevation and exposition for erosion is explained by syn-collisional compression and convergence. Presence of the Albian metamorphic blocks in the eastern Silesian basin, contrasting with Albian facies development of the basin, proofs also significant Late Cretaceous-Paleogene convergence between Silesian basin and Marmarosh Massif.

Keywords: Western Outer Carpathians, sediment source are, K/Ar isotopic age, tectonics, palaeogeography

INTRODUCTION

The WOC are composed of several major tectonic units (Fig. 1), characterised by, to some extend, individual facies development. The units are composed of sedimentary fill of, at least partly, individual basins/subbasins. The basin-fill was detached from the original basement, deformed and thrusted over the European plate. Little is know about original basement of the Outer Carpathian basins, however it is often presumed, that the basins developed on the southern limb of

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European plate, substantially thinned due to extension related to the Mesozoic rifting.

The Outer Carpathian sedimentary basins were supplied with sediments from still poorly known external and internal source areas, often regarded to as "cordilleras" (e.g. Książkiewicz 1965, Wieser 1985). All of the source areas avoided the Miocene detachment and thrusting over a distance of a few hundred of kilometres towards foreland. As a result no units related to source area are recognised in the WOC orogen. Knowledge about the "cordillera's" geological setting comes therefore from indirect analysis, particularly from studies of pebble/block fraction of detrital sediments, so called "exotics" (e.g. Wieser 1985).

In the present contribution we present preliminary results of K/Ar isotopic dating of crystalline "exotic" pebbles (on muscovite and biotite) and detrital muscovite from the WOC flysch sediments (Fig. 1). We also relate obtained results to previous K/Ar isotopic age determination (Lis 1980, Ślączka 1999) and chemical U-Th-Pb dating of monazite (Hanžl et al. 2000) for WOC's "exotic" pebbles. The main objective of the research is to obtain new constrains on tectonic evolution and palaeogeography of the WOC.

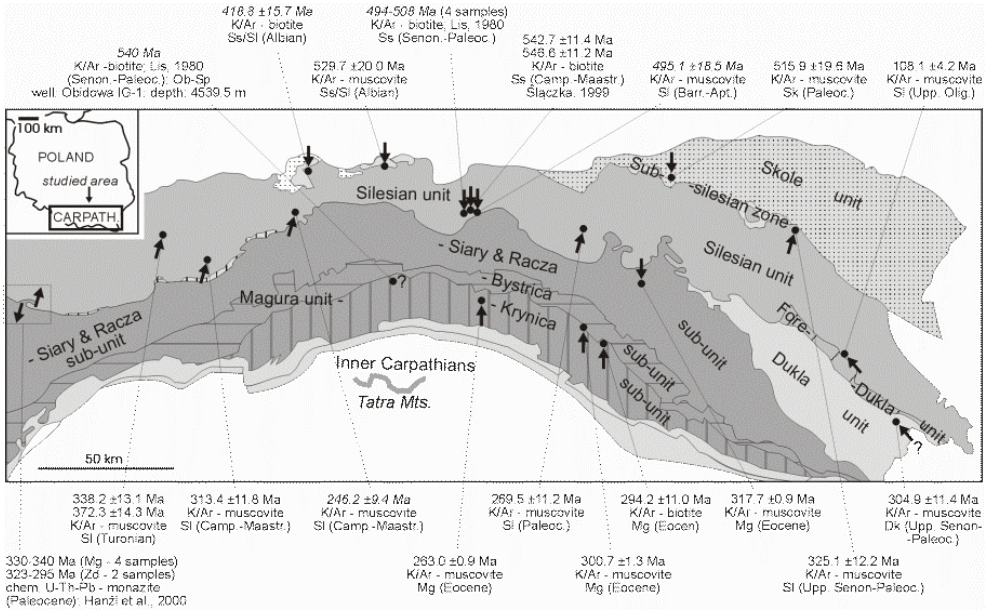

Fig. 1. Location of sampled outcrops and relevant, obtained K/Ar isotopic dates, at a background of simplified tectonic map of the WOC. Presumed deposition direction for each sampled formation are given with the black arrows. Stratigraphic age of each sampled formation is given in brackets. K/Ar ages of a lesser reliability are given with italics. Sk – Skole unit; Sl – Silesian unit; SS – Subsilesian unit; Mg – Magura unit; Zd – Ždánice unit; Ob-Sl – Obidowa-Słopnice unit.

K/Ar ISOTOPIC DATING

At the present stage of research 13 samples of "exotic" pebbles and 3 muscovite sandstone samples collected from 14 localities were analysed (Fig. 1). Samples were processed to separate muscovite and/or biotite, which was used for K/Ar isotopic dating. The "exotic" pebbles are represented by variety of gneisses of different degree of metamorphism, therefore ages obtained for these correspond to time of post-metamorphic cooling. In a case of sandstone samples the analysed muscovite could be of both of metamorphic and plutonic origin (Wieser 1985), with the first option more probable. Chemical U-Th-Pb dating (CHIME) for the analysed samples is recently conducted, although not results are available at this stage.

Some of obtained isotopic ages are ambiguous because of relatively low potassium content (given with italics on Fig. 1). In most of such cases the ages are regarded as minimum. In a case of biotite obtained age could reflect last tectono-thermal event. The isotopic ages given by Lis (1980) are regarded as less reliable, because laboratory equipment used at that time does not meet recent standards.

CONCLUSIONS FOR THE WOC'S PALAEOGEOGRAPHY AND TECTONCS

Pebbles/blocks deposited to the WOC basins from the external, northern source record the Neoproterozoic to Cambrian cooling after predominantly low grade metamorphism (Fig. 1). This, together with characteristic assemblage of crystalline and sedimentary "exotics", suggest that the source of sediments was related to the Brunovistulicum and/or Małopolska Massifs, representing "Cadomian" orogen (Żelaźniewicz et al. 1997). Similar isotopic age, however of lesser reliability, given by Lis (1980) for Obidowa-Słupnice unit (Fig. 1), as well as facies resemblance, indicate that this unit could be associated with Skole unit and both represent common sedimentary basin, as proposed by Żytko & Malata (2001).

Silesian ridge and southern Magura ridge supplied the WOC basins with pebbles/blocks recording predominantly the Late Carboniferous to Permian metamorphism and, roughly coeval in time, emplacement of granitic bodies (Fig. 1), both related to Variscan orogeny (compare: Hanžl et al. 2000). The same is truth for a source area for the Senonian-Paleocene sediments in the Dukla unit (Fig. 1).

It is concluded, that the WOC developed on the basement, being the southern prolongation of the TESZ, composed of the Variscan and "Cadominan" terrains. The contact zone of the Silesian basin and Silesian ridge coincided with palaeoboundary between basement of Variscan and "Cadomian" orogenic consolidation to the south and north respectively. This boundary represents also a rheological contrast between two terrains, strongly influencing development of the WOC. As it comes from above, subdivision of the Western Carpathians into the Inner and Outer ones, documented by differences in orogenic phases and the Mesozoic facies development, does not corresponds to the basement domains.

During the Late Cretaceous and Paleocene the Silesian ridge was intensively uplifted and eroded, supplying the Silesian basins with coarse-grained sediments, often containing poorly rounded "exotic" blocks and pebbles. Spectrum of the "exotics" includes rocks of different grades of metamorphism and plutonic rocks, as well as not metamorphosed sedimentary rocks, including Lower Cretaceous deep marine flysch sediments. Coeval presence of compressional deformation in the foreland of the Silesian ridge documents tectonic regime at this stage of the WOC development. Based on above observation we conclude that during the Late Cretaceous and Paleocene the Silesian ridge was a zone of orogenic deformation and development of stack of thick-skinned thrust sheets. Similar conclusion is valid for the Eocene development of the area supplying the Magura basins from the south.

During the late Oligocene poorly rounded blocks of anchi-metamorphic rocks, recording the Albian cooling after metamorphism, were deposited in the eastern part of the Krosno Beds basin (Fig. 1). These were derived from a very proximate source, referred to as Marmarosh "cordillera" (Ślączka, Wieser 1962). This clearly contrasts with facies of the Albian sediments in the section of this part of the basin, which are represented by fine-grained, deep marine flysch and shale of a limited thickness. Such sediments can hardy develop in direct proximity of metamorphic domain. This stands for a significant Late Cretaceous-Paleogene, tectonic-driven convergence between Silesian basin and Marmarosh Massif.

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