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**K/Ar DATING OF CRYSTALLINE PEBBLES FROM THE OTRYT
SANDSTONE (EASTERN SILESIA UNIT, OUTER CARPATHIANS)**

Abstract: For two pebbles of mica schist from the Otryt sandstone (Oligocene, eastern Silesian unit) the Middle Cretaceous ⁴⁰K/⁴⁰Ar isotopic cooling age was obtained (108.1 ±4.2 and 95.3 ±3.6 Ma). Metamorphism in the source area is in contrast with the coeval development of the Silesian basin, indicating significant palaeogeographic distance between the two domains in “Middle” Cretaceous time. In the Late Oligocene the source was in a proximal position with respect to the Silesian basin. This is suggestive for the (Late Cretaceous?-) Paleogene collisional convergence.

Keywords: Outer Carpathians, Otryt sandstone, Oligocene, provenance, metamorphic schist, K/Ar age, palaeogeography

INTRODUCTION

The Outer Carpathians is the Late Oligocene to Middle Miocene fold-and-thrust belt, composed of several tectonic units with, at least partly, individual facies development. Among these, one of the main is the Silesian unit, build of the Late Jurassic to Early Miocene deep marine, mostly flysch sediments, deposited in the basin referred to as the Silesian one. The basin was supplied with detritus by enigmatic source areas, which avoided detachment and tectonic transport in the thrust belt, thus are not represented in the recent structure of the orogen. Most of the knowledge about the provenance areas comes from analysis of coarse fraction of detrital sediments, like pebbles or blocks.

Analysis of sediment transport directions indicate, the during the Late Cretaceous to Early Eocene time the eastern Silesian basin was supplied with sediments from the southern source, referred to as Silesian ridge (Książkiewicz 1962). According to the study of Poprawa *et al.* (2004) this source is characterized by Carboniferous to Permian K/Ar cooling age determinations for mica from both metamorphic and magmatic rocks (Fig. 1). In the Oligocene time detritus was coming to the Silesian basin was from two different sources, supplying from the N-NE and the S-SE the Krosno beds of the Lesko and Otryt development, respectively (Dżułyński, Ślącza 1959). The latter contains a spectacular submarine slumps with blocks of mica schist of low grade metamorphism, eroded from so called “Marmarosh Cordillera” (Ślącza, Wieser 1962; Bąk *et al.* 2001). This contribution presents preliminary results of K/Ar dating of the mica schist and aims to discuss paleogeographic and tectonic consequences of the obtained results.

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METHOD AND DATA

Two outcrops of the Otryt sandstone in the inner part of the eastern Silesian unit (Bieszczady Mts) were studied: one in Roztoki Dolne village and other in the Zakopaniec stream south of the Ustrzyki Górne (location: Fig. 1). Standard petrographic study of thin section was performed on collected “exotic” crystalline pebbles. For two samples of metamorphic rock $^{40}\text{K}/^{40}\text{Ar}$ isotopic dating of muscovite was performed. Potassium was determined by flame photometry with Na buffer and Li internal standard. The purified Ar was measured in a static mode in the mass spectrometer. Due to here used technique of K/Ar age calculation the analytical errors are likely to be overestimated.

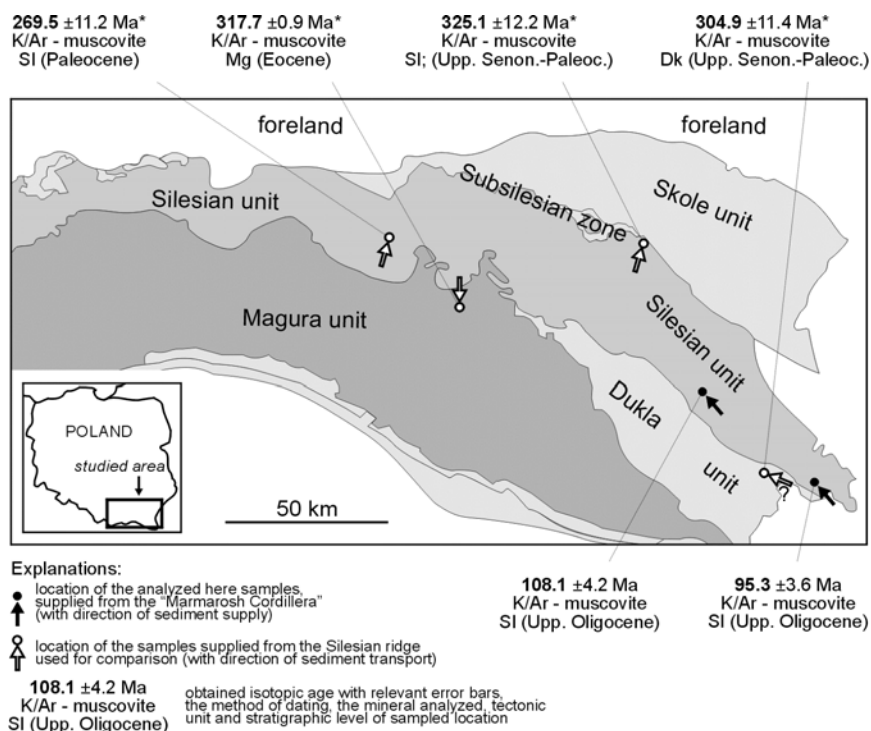


Fig. 1. Simplified tectonic map of the Western Outer Carpathians with location of the sampled outcrops and obtained K/Ar isotopic age on mica. Data for pebbles eroded from the Silesian ridge, marked with *, after Poprawa *et al.* (2004). SI – Silesian unit; Dk – Dukla unit; Mg – Magura unit.

RESULTS AND DISCUSSION

Muscovite from two pebbles, the chlorite-rich fyllite and the chlorite-muscovite schist, collected from the Oligocene Otryt sandstone were dated with $^{40}\text{K}/^{40}\text{Ar}$ method. The obtained ages are 108.1 ± 4.2 Ma and 95.3 ± 3.6 Ma (Fig. 1). Samples are rich with muscovite which is not affected by alteration. Potassium contents, measured with flame photometry technique, is relatively high ($K = 5.02\%$ and $K = 6.24\%$, respectively) and error bars are narrow. Results obtained for both the samples are coherent, and rational if considering the other geological constraints. Therefore the data are regarded reliable.

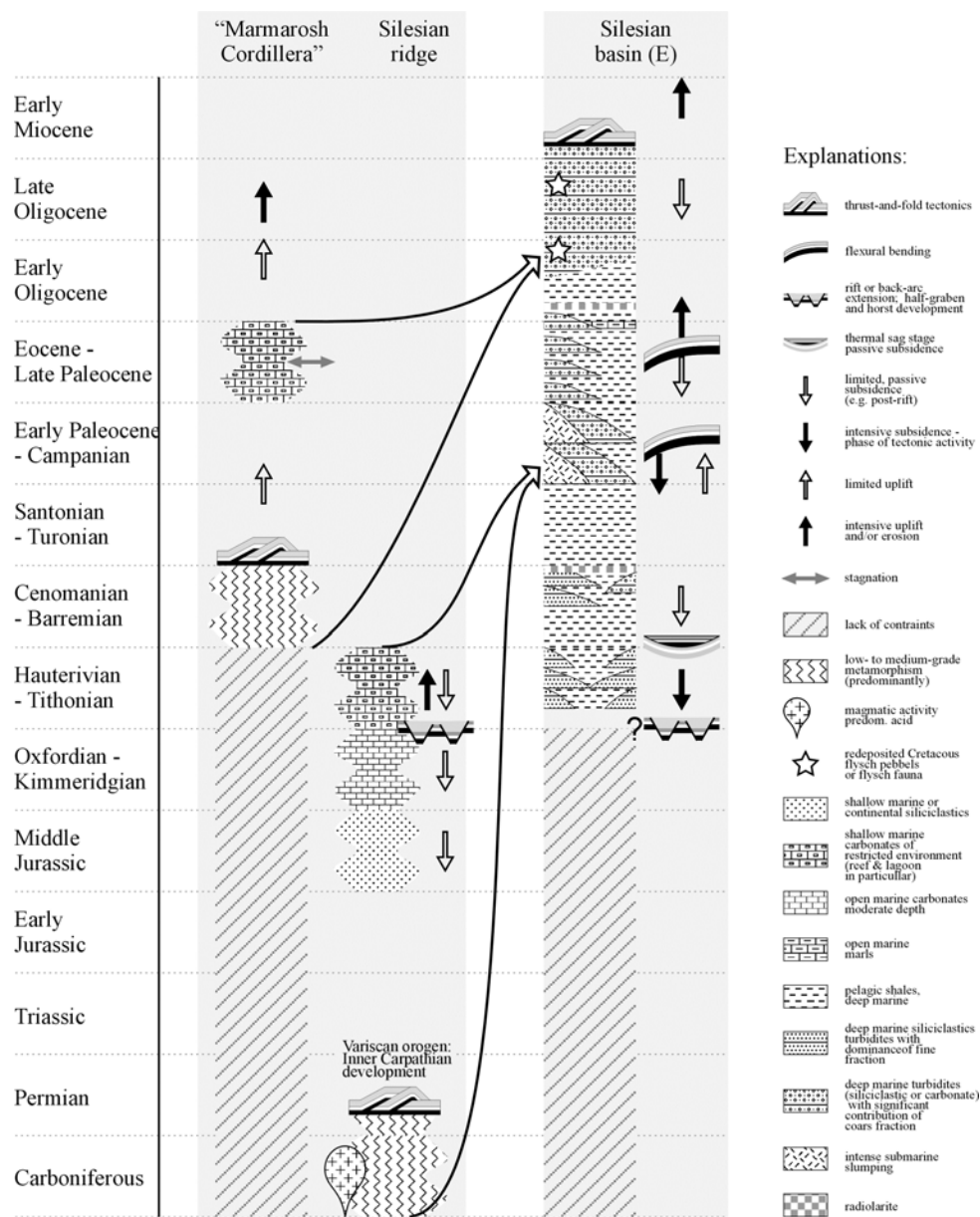


Fig. 2. Simplified geological sections of the eastern part of the Silesian basin and its southern and eastern sediment source areas. Note significant reconstruction of the provenance area between the Late Cretaceous-Paleocene and the Oligocene time. Note also contrasting development of the “Middle” Cretaceous” in the Silesian basin (deep marine shales and thin-bedded turbidites) and in its proximal Oligocene source, *i.e.* the “Marmarosh” ridge (metamorphism).

The Middle Cretaceous cooling after metamorphism in the “Marmarosh Cordillera” (comp. Poprawa *et al.* 2004) is coeval with deep marine sedimentation of thin-bedded flysch and shales of limited thickness in the eastern Silesian basin (Fig. 2). Such

development indicates lack of significant tectonic activity in the later one, coherent with the model of postrift thermal sag (comp. Poprawa *et al.* 2002). This stands for significant palaeogeographic distance between the basin and the “Marmarosh Cordillera” during the Middle Cretaceous. However during the Oligocene, *i.e.* the time of the Otryt sandstone deposition (Fig. 2), the Marmarosh provenance area was located very close to the southern limit of the Silesian basin, justified by proximal facies and presence of large, poorly rounded blocks (Ślączka, Wieser 1962; Bąk *et al.* 2001). This clearly indicates significant convergence and/or strike slip movements between the domain of Silesian basin and the “Marmarosh Cordillera” in the (Late Cretaceous?-) Paleogene time. This might be limited to the middle Eocene-early Oligocene time, if to assume similar characteristic of the Ciężkowice sandstone in the Fore-Dukla unite as further to the west (Poprawa *et al.* 2002).

Such interpretation is confirmed by comparison of development of the Oligocene and the Late Cretaceous-Paleocene southern provenance areas for the eastern Silesian basin (Fig. 2). Available K/Ar ages for pebbles eroded from the later one, *i.e.* Silesian ridge (Fig. 1) are coherent with the model of the late Variscan orogenic metamorphism (Poprawa *et al.* 2004). In the analysed area this is also confirmed by CHIME dating of detrital monazite from the Upper Cretaceous-Paleocene sediments, which apart of the young ages (140-250 Ma) shows also the Variscan cluster of the monazite ages (Kusiak *et al.* 2004). The replacement of the source of the Variscan consolidation by the one of Mid Cretaceous metamorphism evidences a significant reconstruction of the domain to the south of the Silesian basin in the (Late Cretaceous?-) Paleogene time. The reconstruction is attributed here to collisional convergence and/or strike slip tectonics of that age, acting to the south of the Silesian basin.

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