

## Early stages of the Polish Carpathian foredeep development

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**Abstract:** The flysch olistoplaque from the W part of Polish Carpathian Foredeep could be correlated with the Old Styrian overthrust of the Moravo-Silesian Carpathians. This nappe load caused the development of the Karpatian flexural depression which was filled with coarse clastic sediments. This subsidence was followed by the intra-Karpatian uplift and erosion of the Cieszyn-Slavkov Ridge. The new Late Karpatian/ Early Badenian subsidence was connected with development of extensional grabens at the front of the Old Styrian thrust, and accompanied by the Early Badenian regional transgression

**Key words:** Mioceneflysch olistoplaque, Old Styrian nappe front, Karpatian foredeep, of the Western Carpathians

### Introduction

The Early to Middle Miocene Polish Carpathian Foredeep (PCF) developed as a peripheral foreland basin in front of the moving Carpathians (Oszczypko, 1998). The outer foredeep is filled with Badenian and Sarmatian marine deposits which are up to 3500 m thick. The inner foredeep is located beneath the Carpathian nappes and composed of Lower to Middle Miocene autochthonous deposits. The Lower Miocene strata are mainly terrestrial in origin, whereas the Badenian and Sarmatian ones are marine.

### Results

In the inner part of PCF (Fig. 1) the flysch derived olistoplaque (Sucha Fm., Ślącza, 1977) has been documented in a few deep boreholes (Moryc, 1989, Oszczypko, 1998). This formation overlaps both a few dozen metres of the Lower Miocene polymictic conglomerates as well as the Paleozoic basement. The olistoplaque, which is 79-267 m thick, is composed of Lower Cretaceous to Paleocene flysch and is connected with the Subsilesian/Silesian successions (Laskowicz, 1997, Gedl, 1997). The olistoplaque is covered by the Stryżawa Fm. which, itself, reaches a thickness of 360-566 m (Oszczypko, 1998). The Lower portion of the formation is represented by polymictic conglomerates of the Stachorówka Mb. (Ślącza, 1977, Moryc, 1989) up to 650 m thick (Ślemień 1, SL1). In the Zawoja-1 borehole, the Stachorówka Mb., 180 m thick, is composed of conglomerates and coarse to fine-grained arenites. This matrix of conglomerates changes from clay minerals to a sandstone type, with a dominance of quartz (medium to coarse-grained, poorly rounded and poorly sorted), whereas the cement is composed of changing proportions of carbonate, gypsum and anhydrite. The conglomerate clasts are dominated by: sandstones, mudstones, carbonates,

quartzites, fragments of metamorphic rocks and granites which derived from both the Carpathian flysch as well as from the Paleozoic basement. These conglomerates pass into the upper part of the Stryżawa Fm. This part of the formation is composed of variegated, conglomerate-sandy-mudstone strata. The Stryżawa Fm. contains a relatively frequent microfauna from the Lower Cretaceous – Early Miocene age recycled from the Carpathian flysch (Oszczypko, 1998). From this formation, Karpatian calcareous nannoplankton (NN 4) has also been reported (Garecka et al., 1996). The upper part of the Stryżawa Fm. resembles features of the alluvial fan deposits. In the Sucha IG-1 (SIG1) borehole (Fig. 1) this formation passes upwards into Lower Badenian Skawina Fm.

In the Cieszyn area the flysch olistoplaque (Zamarski Mb.) has been preserved in the central part of paleo-valley beneath the frontal part of the Carpathian overthrust (Fig. 1, Buła & Jura, 1983). The Zamarski olistoplaque, which overlapped both the Upper Carboniferous basement as well as the Lower Miocene Zebrzydowice Fm. (Buła & Jura, 1983), is 25-150 m thick, reaches at least 50 sq. km and is composed of elements of the Subsilesian Unit. The Zebrzydowice Fm. (Fig. 1) is composed of pelitic grey-greenish deposits of the Early Burdigalian (N5/N6) age (Garecka et al., 1996). Early Burdigalian (NN2-NN3) marine deposits were also discovered in NE Moravia (Jurkova et al., 1983). In the Bielowicko IG-1 (BIG1) borehole, polymictic pebbly mudstones, 23 m thick, have been found (Jaworska, 1998) at the base of the flysch olistoplaque (Fig. 1). The olistoplaque is covered by a 10-110 m thick layer of variegated conglomerates composed of flysch-derived clasts. These conglomerates resemble the Stryżawa Fm. from the Sucha-Zawoja area. In the Cieszyn area the upper part of the sub-thrust molasse sequence is represented by a 40-90 m thick complex of transgressive Dębowiec conglomerates, which are composed of Upper Carboniferous clasts. These conglomerates pass upwards into the Skawina Fm.

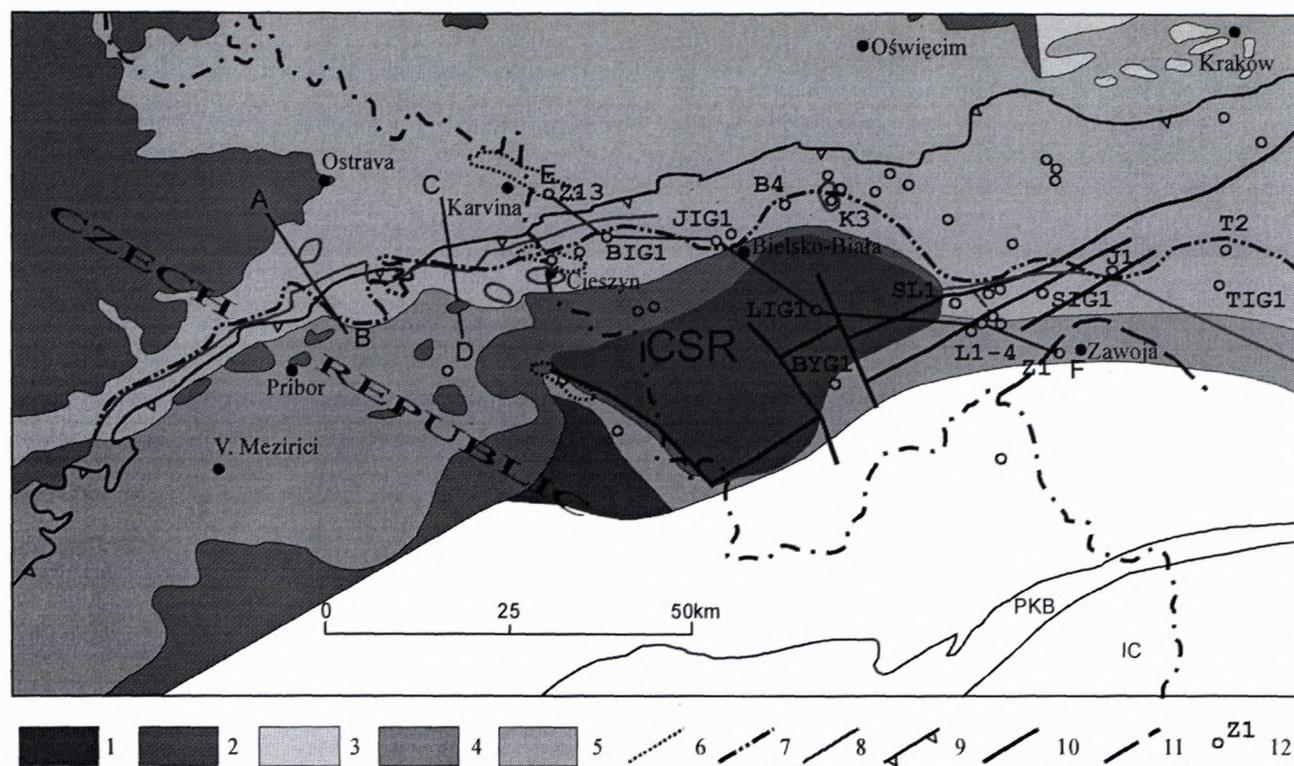


Fig. 1. Distribution of the Miocene autochthonous deposits in the Valašské Meziříčí-Ostrava and Cieszyn-Bielsko Biała-Zawoja areas (after Jurkova, 1971, Jurkova et al., 1983, Oszczypko et al., 1989, Palensky et al., 1995 and new boreholes).

Platform basement: 1 – Proterozoic-Lower Paleozoic, 2 – Upper Paleozoic, 3 – Mesozoic; Carpathian Foredeep: 4 – Karpatian, 5 – Lower-Middle Badenian, 6 – boundary of the Zebrzydowice Fm. (Early Burdigalian), 7 – northern boundary of the Karpatian deposits, 8 – northern boundary of the Old Stryrian overthrusts, 9 – present-day front of the Outer Carpathians, 10 – fault, 11 – northern boundary of the Paleogene autochthonous deposits, 12 – borehole. Abbreviations: CSR-Cieszyn- Slavkov (Příbor) Ridge, PKB-Pieniny Klippen Belt, IC- Inner Carpathians.

According to Garecka et al. (1996) both the Debowiec congl. as well as the lowermost portion of the Skawina Fm. belong to the Late Karpatian. An isolated fragment of the Subsilesian Unit has also been found in a sub-thrust position in borehole K-3 near Bielsko-Biała (Fig. 1). This 112 m thick olistoplaque was discovered in conglomerates of a Dębowiec type. In our opinion the Subsilesian fragments (Zamarski Fm.) found at the base of the Badenian subthrust sequence in the Cieszyn - Bielsko-Biała area could belong to the same flysch olistoplaque in the Sucha-Zawoja area (Sucha Fm.). In the area between Bielsko-Biała and Zawoja this olistoplaque was removed by erosion. In the more uplifted part of the Cieszyn Slavkov Ridge (CSR), both the flysch olistoplaque as well as Miocene deposits are absent (Fig. 1, Oszczypko et al., 1989). The westernmost fragment of the CSR is covered by Karpatian deposits, which are a few dozen metres thick (Palensky et al., 1995). In the South-West of Valašské Meziříčí, the thickness of these strata are more than 300 m (Palensky et al., 1995). In NE Morava, the Karpatian foredeep was at least 40 km wide (Fig. 1). This foredeep extended to the East - Zawoja-Sucha area (Poland) and also towards the Sambor-Rozniatov basin (Ukraine). Beneath the Polish Carpathians, the axes of the Karpatian foredeep is manifested by the magnetotelluric depression and a gravimetric low (Oszczypko, 1998).

The flysch olistoplaque (Sucha and Zamarski fms.) from the W part of PCF could be correlated with the Old Styrian overthrust in marginal part of the Moravo-Silesian Carpathians. In the Příbor area, the front of the Old Styrian nappe, composed of the Sub-Silesian sequence, is located 1-3 km north of the present-day margin of the Carpathians (Fig. 1). In a few places the erosional outliers of this nappe are even preserved in the Badenian paleodepression 10 km north of the Carpathian margin. Close to the Polish-Czech border, the Old Styrian nappe is presently overlapped by a margin of the Carpathians. Meanwhile East of Cieszyn this nappe has been described above as the Zamarski and Sucha Fms.

### Interpretation

In our opinion, all buried fragments of the Sub-Silesian unit are erosional remnants of the Old Styrian nappe, which was at least 25 km wide. According to Jurkova (1971), the Old Styrian overthrust was formed after the Karpatian age and before the deposition of „basal Badenian clastics“, which are synonymous with the Debowiec congl. in Poland. However, if we accept the new biostratigraphic data (Garecka et al., 1996), then the age of Old Styrian thrusting should be regarded as intra-Karpatian.

On this basis, we are able to propose the following scenario for the Early/Middle Miocene evolution of the inner western part of PCF: After the Ottangian compressive event, the front of the Outer Carpathians overrode the platform and the thin-skinned Sub-Silesian nappe (NE Moravia and S Silesia) reached more or less the present-day position of the Carpathians. The load of this nappe caused the development of the Karpatian flexural depression (foredeep), which was filled with coarse clastic, terrestrial sediments from both the Carpathians as well as the emerged platform. This event was further followed by an intra-Karpatian uplift and an erosion of the CSR (Eliaš & Palensky, 1997), which could be correlated with the discordance below the terminal Karpatian strata in Southern Moravia (Jiricek, 1997). The new period of the Late Karpatian/ Early Badenian subsidence was characterised by the development of SW-NE and NW-SE trending grabens at the front of the Old Styrian thrust (Fig. 1). This subsidence was accompanied by the Early Badenian regional transgression (Oszczypko, 1998).

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