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## SEISMIC IMAGE OF THE OUTER CARPATHIANS DEEP STRUCTURE IN VICINITY OF THE MSZANA DOLNA TECTONIC WINDOW

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### Introduction

The Mszana Dolna tectonic window occurs in the central part of the Polish Outer Carpathians. In this window, two tectonic units crop out from beneath the Magura Nappe: the Dukla Unit followed upwards by the Grybów Unit. For many years this area has been a target of many cartographic studies as well as lithostratigraphic and tectonic analyzes. The deep geological structure of this area is not so well recognized. In the southern part of the Mszana Dolna tectonic window, there are boreholes: Poręba Wielka-1, Poręba Wielka-IG1 and Niedźwiedz-1. Only the Niedźwiedz-1 borehole reached the tectonic unit of Obidowa-Słopnice below the Dukla Unit base at the depth of 2790 m. This unit was also drilled in the vicinity of the Mszana window by Obidowa IG-1, Chabówka-1 and Słopnice area boreholes. It belongs to the Foremagura group of nappes or to the Skole Nappe. This article is based on the results of the Blue Gas II program. The structural interpretation of new 2D seismic profiles in the area of the Mszana Dolna tectonic window, with particular emphasis on tectonic units containing in the litho-stratigraphic profile mature rocks (e.g., Menilite Formation) was one of the objectives of this project.

### Samples and methods

The seismic data used in the study were measured and processed in 2010 and 2011 by Geofizyka Kraków S.A. commissioned by Aurelian Co. The pre-stack time migration version of these data as well as boreholes and cartographic data were integrated and interpreted in the Petrel (Schlumberger Ltd) system.

### Results

As a result of a comprehensive interpretation of the data, the following main tectonic units and lithostratigraphic complexes were identified within the Outer Carpathian overthrust (Fig. 1):

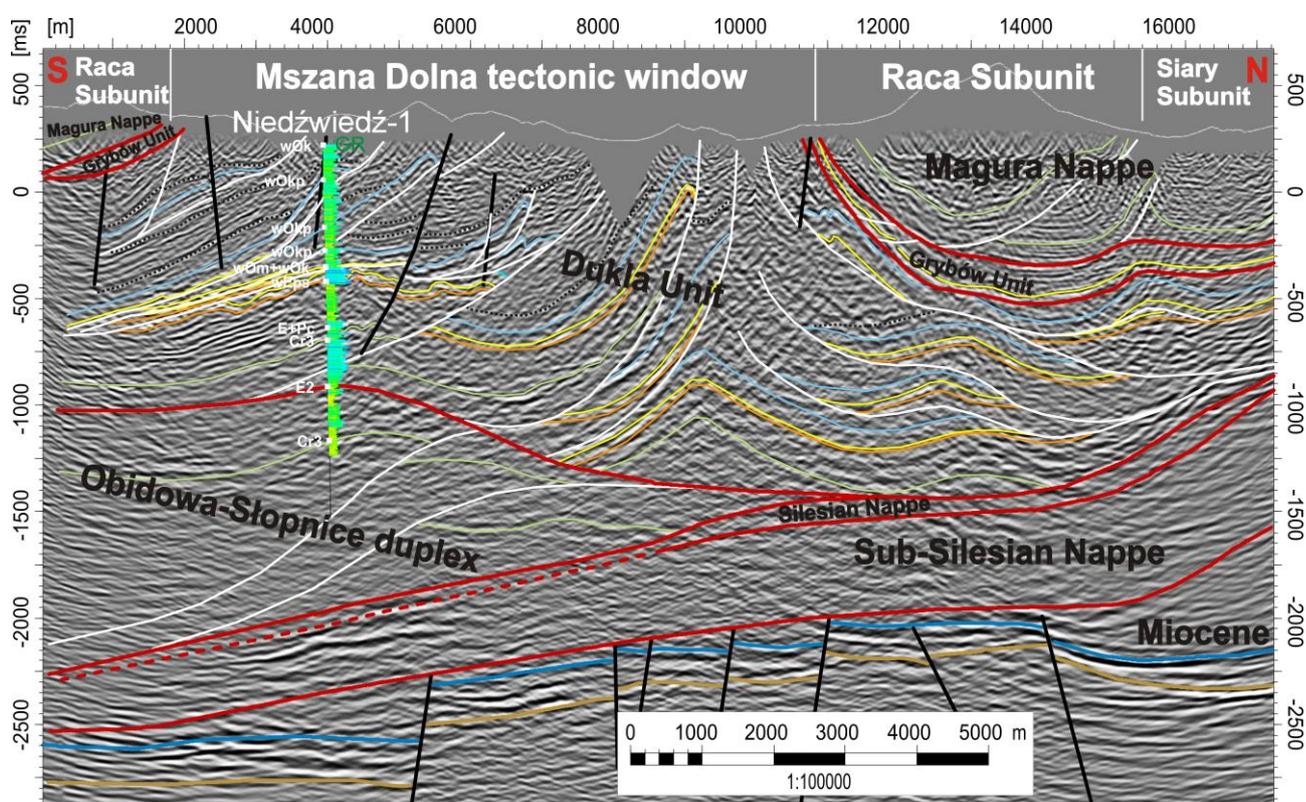
1. Magura Nappe, The thrust surfaces of the Raca and Siary tectonic sub-units, subordinate overthrust faults and the top of the Palaeocene–Cretaceous deposits were identified within this nappe.
2. Grybów Unit. Subordinate overthrust faults (if the unit is thick enough to see its internal structure in seismic data) and top of the Menilite Formation (Oligocene) were interpreted within this unit.
3. Dukla Unit. The lower order thrust faults and slices were interpreted within this unit. They form a triangular zone in the northern part of the tectonic window. The tops of the Palaeocene–Cretaceous deposits as well as of the Oligocene Menilite and Krosno formations were identified within this unit. The Krosno Formation was divided into pre- and syn-tectonic parts. This was possible due to the good quality of the seismic record.
4. Obidowa-Słopnice Duplex (Unit). It is a proposal to name a tectonic unit drilled in the bottom of the Niedźwiedz-1 well as well as in the boreholes: Obidowa-1, Chabówka-1, Słopnice-1 based on a characteristic seismic record observed on all seismic lines crossing the unit. Whereas the upper boundary (roof thrust) of this tectonic unit is tied to wells and easy to interpret, the lower boundary (sole thrust) is ambiguous in interpretation due to the specific almost non-reflective seismic record which is observed below boundary between the Eocene and the Palaeocene-Cretaceous strata. The three-dimensional image of this unit indicates the presence of a thrust duplex composed of several thrust slices. At least two of them, were penetrated by wells Obidowa IG-1 and Chabówka-1. The duplex displays out-of-sequence structure and may represent northern part of the Dukla unit, a



separate unit within the Foremagura group of nappes, the Skole nappe. The duplex fragments may also belong to the Silesian Nappe.

5. Silesian Nappe. Thick nappe is observed on the surface in front of the Magura Nappe and the Skrzydlina sheet. The nappe dips steeply towards the Mszana Dolna tectonic window. Depending on the interpretation, the nappe pinches-out or is partially incorporated into Obidowa-Słopnice Duplex.
6. Sub-Silesian Nappe. It is interpreted as the lowest part of Outer Carpathian overthrust, below the higher units. North of the Mszana Dolna tectonic window, it crops out at the front of the Magura Nappe, in a series of tectonic windows (Lanckorona-Żegocina tectonic zone). Diapiric extrusions of the nappe are interpreted as the out-of-sequence duplexes.

Miocene deposits and Meso-Paleozoic basement were identified below the Outer Carpathian overthrust. His interpretation is based on extrapolation of data from the area north of the Mszana Dolna tectonic window.



- Paleozoic top
- Mesozoic top
- Paleocene/Cretaceous top
- Eocene top
- Menilite beds top
- top of the pre-tectonic Krosno Formation
- syn-tectonic Krosno Formation
- faults
- major thrusts
- White lines - minor thrusts

**Figure 1.** Structural interpretation of the seismic profile crossing the Mszana Dolna tectonic window. GR-gamma ray log. Well markers: wOk – Krosno Formation (Oligocene), wOkp – pre-tectonic/syn-tectonic boundary inside Krosno Formation, wOm – Menilite Formation (Oligocene), wEps – variegated shales (Eocene), E+Pc – Eocene and Paleocene undivided deposits, E2 – upper Eocene deposits (probably variegated shales or hieroglyphic beds), Cr3 – Upper Cretaceous (probably Ropianka Formation).

### Conclusions

New seismic data, processed using advanced PSTM algorithms, allow a more unambiguous structural interpretation. The result is a new tectonic units observed in the area of the Mszana Dolna tectonic window.

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