

THE MENILITE FORMATION AS A POTENTIAL UNCONVENTIONAL HYDROCARBON ACCUMULATIONS IN THE POLISH CARPATHIANS

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Introduction

The Polish Carpathians belongs to one of the largest petroleum provinces of Central Europe, constituting one of the oldest petroleum-producing regions in the world. The Carpathian region is one of the territories of the world, where the petroleum industry was born (Golonka and Picha, 2006). Currently is operated 29 oil and 35 gas fields with total recoverable resources of 540 thousand tons of oil and 1.3 trillion m³ of gas. Recent years have brought great progress in the prospect for unconventional hydrocarbons "shale gas" and "tight gas" type.

Outline of geology

The Carpathian Arc is a constituent of the Alpine orogenic belt, and stretches for more than 1300 km from the Vienna Forest to the Iron Gate on the Danube. The Outer Carpathians are bounded on the north and north-east by the Eastern European Platform, on the east by the Moesian Platform, and by the Inner Carpathians on the. The Outer Carpathians consist of a number of tectonic units thrust over one another forming a system of nappes. The Polish part of the Outer Carpathians comprise the following tectonic units (from north-east to south-west): Carpathian Foredeep, Skole Unit, Silesian Unit, Dukla Unit, Magura Unit, and Pieniny Klippen Belt. The stratigraphic extent of these tectonic units of the Carpathian Flysch belt varies and encompasses stratigraphic range from the Jurassic to the early Miocene. This sequence is represented by Late Cretaceous to Miocene clastic deposits, both shelf and deep-water flysch facies, with minor amount of Jurassic and Lower Cretaceous carbonates and clastics.

Results

The best source rocks (s.r.) in the Carpathians are recognized the Menilite Shales. For the petroleum characteristics the results of geochemical analyses of 673 samples of Mn.Sh. from 13 boreholes and 31 outcrops from the three areas of the Outer Carpathians have been gathered (Figure 1A). Most of the results of geochemical research comes from Kosakowski et al. (2009). The studies of the Mn.Sh. shown very good source rock potential in all analysed units (Figure 1B). The measured total organic carbon (TOC) and hydrocarbons (S₁+S₂) content are very high and reaches up to 20 wt% and 167 mg/g rock, respectively.

1-D modelling of hydrocarbon generation process reveal that during the sedimentary stage (40-18 m.y.) of Carpathians development, the Menilite Shales did not reach a level of thermal maturity enough to generate of hydrocarbons (Figure 1C; Kosakowski, 2013). The initial conditions of "oil window" phase were reached in early Miocene, at a depth exceeding 2km. The thrusting stage (18-10 m.y.) differentiated the thermal maturity of kerogen. The uplift of the Carpathians stopped maturation processes of the organic matter.

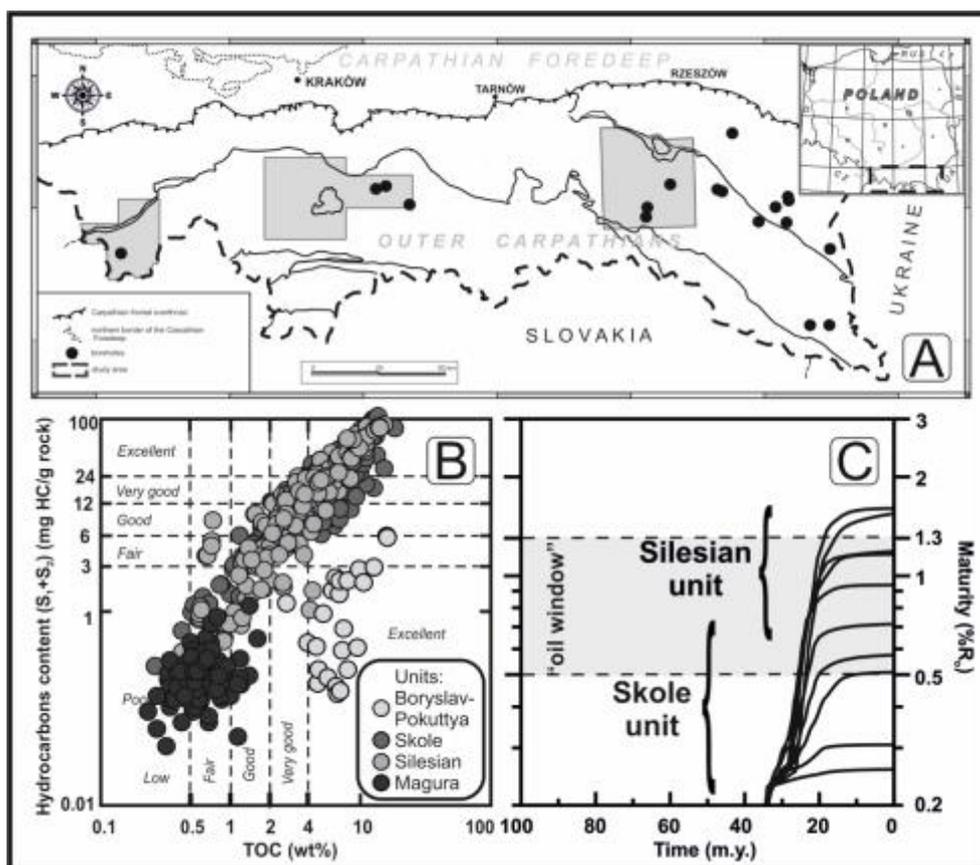


Figure 1 (A) Location map of the study area, (B) petroleum source quality diagram for Menilite Shales and (C) evolution of maturity of the source rocks in modelled boreholes. Classification of source quality after Hunt (1996) and Peters and Cassa (2002).

Conclusions

Preliminary results of such re-examination indicated high potential of occurrence of previously neglected, hydrocarbon unconventional accumulations in the Outer Carpathians. The optimistic premises are documented hydrocarbon shows and inflows from shale formations and from tight sandstone reservoirs. Another premise is well-documented, recent hydrocarbon migration within the rock formations, which proves the presence active hydrocarbon kitchen at depths. Essentially, such kitchen plays a double role: it is, simultaneously, the conventional source rock and the unconventional shale gas and/or shale oil reservoir.

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