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THE ENERGY POTENTIAL OF AUTOCHTHONOUS MIOCENE RESERVOIR IN THE EASTERN PART OF THE CARPATHIAN FOREDEEP - GEOTHERMAL RESEARCH IN THE PETROLEUM PROVINCE

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Abstract

The Carpathian Foredeep, genetically associated with the youngest geological unit of Poland – The Flysch Carpathians, is an asymmetrical structure filled with Miocene molasses with a thickness from several hundred to about 3,000 meters, in the form of shale, siltstone and sandstone sequences. This complex is referred as so-called autochthonous Miocene and its sediments originate mainly from the erosion of folded deposits of Carpathian Flysch (Ney i in., 1974). The Carpathian Foredeep is one of the four hydrogeothermal provinces in Poland. Geothermal waters within this region are associated with both the Miocene reservoir and its Paleozoic-Mesozoic substratum, although, their current development is at a low level.

The potential reservoirs of the Miocene geothermal waters within the Carpathian Foredeep are situated above the Paleozoic-Mesozoic reservoirs of the platform substratum. To the north of the Carpathians, Miocene reservoirs are opened and in a limited way hydraulically linked to quaternary groundwater reservoirs, while in the south, shielded by the Carpathian Overthrust (Oszczypko, 2011). The autochthonous Miocene submerges under the Carpathian Mountains and continues under the allochthonous folded Miocene units: Zgłobice Unit and Stebnik Unit (Ney, 1974). The autochthonous Miocene of the Carpathian Foredeep is characterized by high variability of reservoir parameters resulting, inter alia, from the depth of its deposition. The deepest Miocene deposits are located in the eastern part of the Carpathian Foredeep, reaching the maximum values of over 4,000 meters below sea level, under the Carpathian Overthrust. Also, under the Carpathian Overthrust, the Miocene is characterized by smaller thickness (maximum of several hundred meters) than in the zone extending towards north. The largest thickness of the Miocene is marked north-east of Przemyśl, where it locally exceeds 3,000 meters. The Miocene of a considerable thickness occurs also in the area of large cities in the eastern part of the Carpathian Foredeep – i.e. Rzeszów, Dębica and Ropczyce – which are considered as potential heat consumers. The deep location of Miocene deposits has a positive effect on the temperatures prevailing in the reservoir. In the eastern part of the analyzed area, temperatures of around 80-100°C are to be expected at a depth of approximately 3,000 meters. But the low capacity of boreholes constitutes the essential problem in the area of the Carpathian Foredeep, in almost all hydrogeothermal reservoirs including the Miocene one, where zones with increased potential of wells' capacities occur only locally (Górecki (ed.), Sowizdżał et al., 2012; Sowizdżał, 2015). The water-bearing horizons of the Miocene in the eastern part of the Carpathian Foredeep are generally discontinuous. Below the freshwater water, there are saline, sulfate or hydrogen sulfide waters (Chowaniec, 2004). What is more, Miocene sandstones as reservoir rocks often have the form of lenses and pinching out layers, variable thicknesses, which may be important for maintaining stable operating parameters in a long-term perspective (Górecki (ed.), Sowizdżał et al., 2012). For this reason, analyzes of local reservoir parameters of Miocene deposits are of particular importance. Simultaneously, the region of the eastern part of the Carpathian Foredeep is one of the most important petroleum provinces in Poland. So far, over 100 natural gas deposits have been discovered within the Miocene deposits of the Carpathian Foredeep. This number includes both large fields with multi-billion resources, sometimes exploited with even several hundred wells, as well as small, never used accumulation. In the area of the Carpathian Foredeep, there is mainly high-methane natural gas, operated for several decades. Most of dry gas accumulations occur in the clastic deposits of Baden and Sarmat, while oil and natural gas deposits were also found in the substratum of the Miocene basin - in the Mesozoic and Paleozoic reservoir rocks (Karnkowski, 1993, 1994). Hydrocarbon deposits often occur in

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areas that are prospective in terms of potential geothermal energy resources availability, and the accompanying water can become an energy carrier. In connection with the lasting many years exploration of hydrocarbon fields, the region of the eastern part of the Carpathian Foredeep is relatively well-known from drilling, and hydrocarbon deposits discovered and exploited within this area provide an excellent source of information for a geothermal research.

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