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# Origin of hydrocarbon gases accumulated in the Zechstein Main Dolomite reservoir in Wielkopolska Province of the Polish Permian Basin

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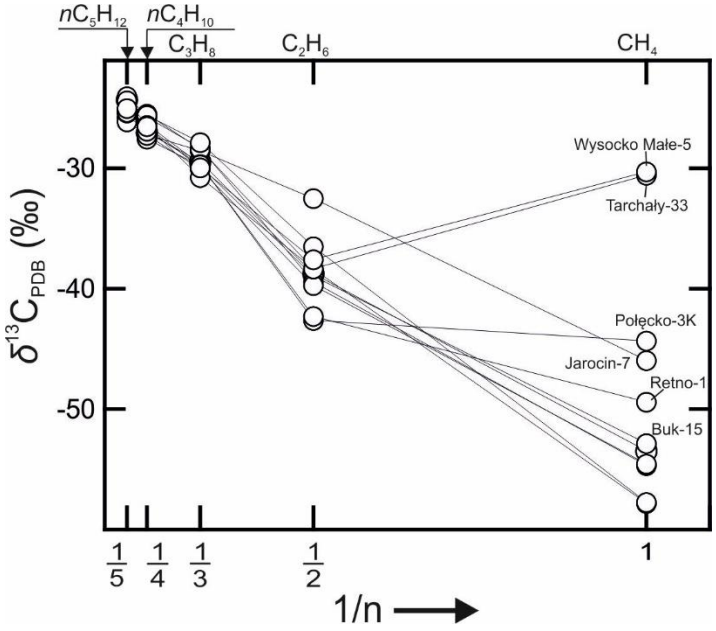
The aim of this study was to determine the origin of hydrocarbons of natural gases accumulated in the Main Dolomite (Ca2) carbonate reservoir of the Polish Permian Basin. The study area is located in western Poland and belongs to Wielkopolska Petroleum Province. The discussed natural gas accumulations occur within the Ca2 carbonates which are underlain and overlain by impermeable sequences of evaporates forming a closed hydrodynamic system composed of both source and reservoir rocks for petroleum deposits [1].




The analysed hydrocarbon gases accumulated in the Ca2 reservoir vary in their both molecular and isotopic compositions. Fig. 1 shows a relationship between stable carbon isotopes of $CH_4$, $C_2H_6$, $C_3H_8$, $n$-$C_4H_{10}$ and $n$-$C_5H_{12}$ versus reciprocal C number of the analysed natural gases. The plot reveals the presence of two genetic groups of analysed natural gases. The first group is represented by two gases from Wysocko Małe-5 and Tarchały-33 wells. They are characterized by partial inverse $\delta^{13}C(CH_4) > \delta^{13}C(C_2H_6) < \delta^{13}C(C_3H_8)$ order. Such partial and even complete reverse orders of natural gases generated by Carboniferous source rocks have *Fig. 1. Stable carbon isotope composition of analysed natural gases vs. the reciprocal of their carbon number.*

been discovered by Kotarba et al. [2]. Zumberge et al. [3] and Kotarba et al. [2] concluded that complete and partial reverse isotopic orders indicate very complicated generation, migration, mixing and accumulation of natural gases. Natural gases from the first group originated from Type-III kerogen of Carboniferous source rocks and migrated to the Ca2 carbonates. The second group contains the rest of the analysed gases and is characterized by normal order $\delta^{13}C(CH_4) < \delta^{13}C(C_2H_6) < \delta^{13}C(C_3H_8)$ in mostly concave pattern. The stable C and H isotope compositions indicate that these gases are only thermogenic (Połęcko, Jarocin and Retno) and of both microbial and thermogenic origin. They are genetically related to dispersed organic matter of Ca2 carbonates and originated from Type-II kerogen. Natural gas from Połęcko-3K well shows convex pattern that may suggest the presence of Carboniferous natural gas, however a relationship between $\delta^{13}C(CH_4)$ and $C_{HC}$ index reveals that this gas was also generated from Type-II kerogen but during two or more thermogenic generation phases. The presence of thermogenic gases of Wysocko Małe, Tarchały, Połęcko, Jarocin and Retno deposits suggests that during microbial phase traps within Ca2 carbonates had not been formed yet. Microbial component of

rest of the gases suggests that traps within the Ca2 carbonates had already been formed and sealed by the underlying evaporites which prevented its escape.

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*References:*

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