CHANGES OF CHEMICAL AND ISOTOPIC COMPOSITION OF POLISH SHALE GASES

M. Janiga[1], I. Matyasik[1], W. Bieleń[1], P. Brzuszek[1], M. Kania[1], M. Kierat[1],

[1] Oil and Gas Institute – National Research Institute, Poland

Introduction

The isotopic composition of methane, ethane and propane reflects the maturity of the organic matter (VRo) and the type of gas. These relationships are described by Whiticar equations (Whiticar, 1994). In the case of gas exploration from shale formations, the isotopic composition additionally allows to estimate the amount of gas in place and allows to recognize inversion of carbon isotopic composition of methane, ethane and propane (Janiga, 2015).

Gas samples were acquired from four concession placed in Baltic basin. Analyses of chemical and isotopic composition were performed for gas samples from cores degassing (wells: L-1, O-2, W-1, K-1 and B-1), from well tests (well B21-2/14) and from drill cuttings/drilling mud degassing (well B21-3/15). All wells were exploring Silurian and Ordovician shale formations. All data was collected and interpret during realization of Blue Gas project "MWSSSG" no BG1/MWSSSG/13 (The National Centre for Research and Development).

Methods and results

Analyses of the chemical composition of the gas samples were made using the Agilent chromatographs model 7890 A, equipped with TCD and FID detectors. Carbon and hydrogen isotopic composition of individual gaseous hydrocarbons was determined using isotope Delta V Advantage spectrometer with chromatograph Trace GC Ultra from Thermo Scientific.

Diagram indicating the type of gas, depending on the carbon and hydrogen isotopic composition of methane (Peters, 2005) shows that the most of gases are mixed type and oil associated type, one sample is biogenic gas and a few are condensate associated.

Isotopic composition analyses shows the different thermal maturity of individual shale formations in different wells and no inversion of carbon composition of methane, ethane and propane. On the charts ($\delta^{13}C\text{-}C_1$ vs $\delta^{13}C\text{-}C_2$ and $\delta^{13}C\text{-}C_2$ vs $\delta^{13}C\text{-}C_3$) containing thermal maturity (VRo) based on Whiticar formulas one can see that gas composition does not correspond strictly to theoretical values. Samples represent a wide range of thermal maturity ranging from below 0,5 to 1,1% VRo for $\delta^{13}C\text{-}C_1$ vs $\delta^{13}C\text{-}C_2$ and from 0,7 to 1,4% VRo for $\delta^{13}C\text{-}C_2$ vs $\delta^{13}C\text{-}C_3$. Whiticar formulas used to estimate the thermal maturity of the source organic matter for the gas from Polish shale formations need modification.

Isologica software chart template - marine shale model (figure 1) allows to determine organic matter thermal maturity and percentage of bacterial fraction using $\delta^{13}C$ of methane and ethane. Data correspond to thermal maturity level of approximately 0,8 to 1,7% VRo and show mixing with biogenic gas (approximately to 30%, only one sample – 40%).

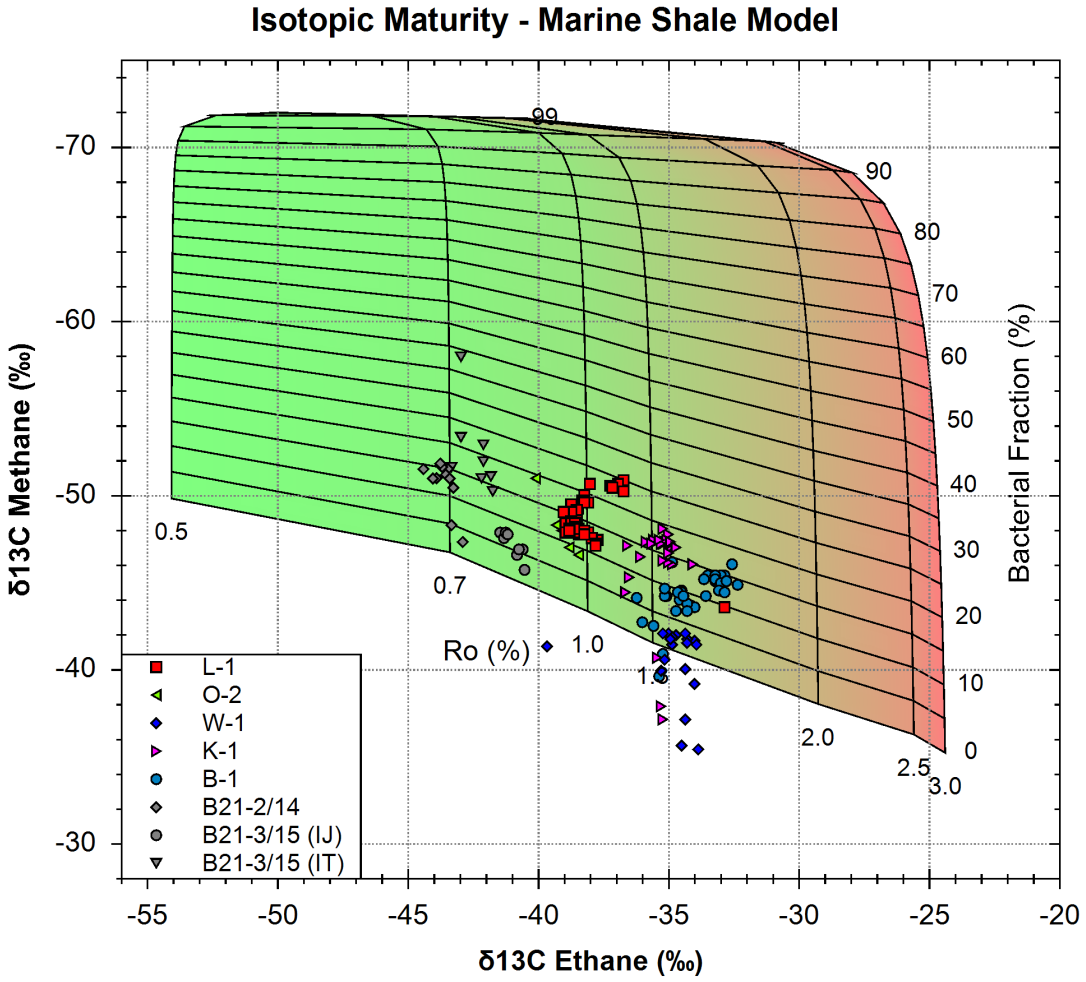

Figure 1 *Isotopic maturity – marine shale model for analyzed Baltic basin wells (Isologica chart template)*

Conclusion

These analyses shoved that Polish shale formations are specific and require individual approach. It means that Whiticar formulas should be modified. For these samples using Isologica software is more useful for gas evaluation (type of gas, mixing, thermal maturity).

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References

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