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Shale gas formations from the northern Poland – analysis of rock classification

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Shale gas formations from the northern Poland spread from the Baltic Basin in the north to the Lublin Basin in the south of Poland. Nowadays, shale gas reservoirs are under careful consideration regarding hydrocarbons exploration [1]. The object of the analysis composes of two sweet spots – Jantar Member (Paslek formation) from Lower Silurian, Llandovery and Sasino formation from Upper Ordovician [2].

The target of the analysis of rock classification was to estimate the heterogeneity of shale gas formations [3]. The data consist of laboratory measurements results on core samples from one well L -1: oxides (Al_2O_3, CaO, Cr_2O_3, Fe_2O_3, K_2O, LOI, MgO, MnO, Na_2O, P_2O_5, SiO_2, TiO_2 and V_2O_5), mineral content, thorium and uranium concentration, total organic carbon, compressional wave velocity, bulk density, density, clay bound water and free water volume from NMR experiment as a sum of capillary bound water and free water, hydrocarbons volume from extractable organic matter analysis, total porosity from helium pycnometer and effective porosity from mercury porosimetry.

Heterogeneous Rock Analysis Clustering (HRA in Techlog) was applied to the data set in order to estimate rock classes based on multivariate inputs. Firstly, the data was transformed by Principal Component Analysis algorithm for the purpose of obtaining the independent inputs. Next, the K-mean clustering is carried out to create HRA classification. The data was divided into three sets: all available data, only oxides and mineral content (parameters describing skeleton), data without oxides and mineral content (parameters describing pore space). All calculations were performed until they received the optimal solution defined by silhouette and fall-off figure, 2D crossplot of clusters.

HRA analysis provided the information about parameters which are the most important in shale gas characterization and heterogeneity estimation. Two principal components were determined and referred to organic matter and clay mineral type by PCA analysis. The most heterogeneous formation appeared to be Sasino formation but in case of pore space structure – Jantar Member. Generally, the most heterogeneous, regarding all mentioned deposits, was pore space and the most homogeneous – skeleton.

References:
[1] Poprawa, P. (2010) Geol Rev 58: 226–249
[2] Jarzyna et al. (2016) *Abstract submitted for the 35th IGC*
[3] Wawrzyniak-Guz et al. (2016) *Abstract submitted for the 35th IGC*