NEW STUDIES ON PETROPHYSICAL PROPERTIES OF SHALES FOR POTENTIAL GAS EXPLORATION

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The Baltic sedimentary basin has several organic rich shale formations that are identified in the sedimentary pile, related to the Cambrian, Ordovician and Silurian systems that provide some prospects for exploration of the unconventional hydrocarbons. Unconventional hydrocarbon topic is very important in energy resource branch. In Lithuania The Lower Silurian shale succession is considered the most perspective in terms of oil and gas potential due to high organic matter content and considerable thickness. However, there is only scarce data on other key shale parameters that are important in determining the reservoir quality of the Silurian shale package. The present study is focused on characterisation of new petrophysical properties of the Lower Silurian shales in west and central Lithuania.

In this work we focused on the whole rock cation exchange capacity (CEC), the relative sensitivity of a rock sample to fluids by adopting the capillary suction time (CST) method and the stability characteristics using Roller oven equipment to conduct the stability tests. These properties are very important in evaluating economical capabilities of the potential exploration.

Free gas can be produced immediately, while pressure decline by dewatering of shales is needed to exploit adsorbed gas in wells. The adsorption capacity of gas primarily depends on the content and mineral composition of clays, which is sensitive to the burial history of the basin. Smectite is characterised by the highest absorbed gas capacity, whereas illite has a lower adsorption capacity and kaolinite is characterised by the lowest adsorption capacity [1]. The measured Cation Exchange Capacity (CEC) values of the Lower Saurian shales vary from 0.2 to 8.8 meq/100g. Results of this study suggests that organic matter has a primary impact on the CEC in the studied samples.

Clays dispersed from shales have varying swelling capacity that can lead to difficulties in fractured system operation. Two mechanisms are responsible for clay swelling, namely surface hydration and osmotic swelling. Surface hydration has relatively little effect on clay swelling compared to osmotic process. It occurs when the concentration of ions at the fracture surface is higher than that of the back-flush fluid. Accordingly, osmotic swelling could be reduced if the concentration of acids in the working fluid is higher than that in the shale [2]. The capillary suction time (CST) method predicts the behaviour of the shale zone during drilling. The measured CST ratio values are rather low and are in accordance to the mineral composition of the Lower Silurian shales: predominating illite has a low swelling capacity, while kaolinite and chlorite do not swell to an appreciable extent. A 7 %KCl solution in water was found to be the most suitable for controlling reactive clay.

The Roller oven shale stability test is commonly carried out to evaluate rock erodibility. The Lower Silurian shales samples show different resistance to erosion. All analysed samples demonstrate a moderate erodibility with water additive combinations. A 7%KCl solution shows the best effect on retaining the erosion. The obtained analytic results are in accordance to published results indicating that K^+ ions added to the water-base mud effectively inhibit the clay from dispersing [3].

This study presents key petrophysical properties of shales that are important for the prognosis of reservoir performance during hydrofracturing and shale oil/gas exploitation.

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[3] J. Hallman, Potassium Formate Improves Shale Stability and Productivity in Underbalanced Drilling Operations, Paper # 2003-028 presented at the CADE / CAODC Drilling Conference,October 2003, Calgary, Alberta, Canada.