EVALUATION OF GEOMECHANICAL AND ACUSTIC PROPERTIES OF SHALES USING DRILL CUTTINGS AS THE WAY TO BETTER UNDERSTAND THE FORMATION

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Recent discoveries of potential shale gas resources in Silurian formation require a profound understanding of their stratigraphy, mainly in order to identify the best strata for horizontal drilling and hydraulic fracture treatment. An extensive conductive hydraulic fracture is essential to impose a pressure drop in the formation and produce hydrocarbons at an economic rate. Diversified mechanical properties of rocks can have a significant impact on hydraulic fracture geometry. There are several laboratory methods used for the evaluation of mechanical properties which are based mainly on acoustic wave techniques, each having its advantages and disadvantages. However, in order to apply laboratory velocity data to log interpretation, it is necessary to know quantitatively the values of the velocities due to the different frequencies employed during acoustic well logging (several hundred hertz to about 100 kHz) and laboratory measurements (0.1 to several megahertz).

This paper presents a set of sample shale data from the Silurian formation. They represent a wide range of petrophysical and mechanical properties. The acoustic wave velocity distribution versus wave frequency ranging from kilohertz to megahertz was analyzed. Moreover, the correlation between wave velocities and mineral composition as well as the results of impedance spectroscopy are shown.

The difference between the velocities obtained from well logs and laboratory measurements for each of the analyzed depths was 18 and 12% for the P- and S-waves, respectively. This shift may be related to different pressure conditions, which may affect wave velocities, as well as the difference in saturation of shale samples. For selected formations, correlation with mineral composition and porosity was observed. The results clearly show the occurrence of carbonates and quartz in the form of both cement and detrital grains. The presented analysis of both geophysical and laboratory data makes it possible to develop a proper methodology for selecting cores or cutting samples for laboratory measurements. Moreover, the estimated correlations will allow extrapolation of determined trends in other prospecting regions.

NMR LABORATORY MEASUREMENTS OF VARIOUS TYPES OF SEDIMENTARY ROCKS USING 2, AND 23 MHZ SPECTROMETERS

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Application of nuclear magnetic resonance (NMR) for evaluation of rock core samples requires taking into account their specific features, e.g. pore size, illite composition, filtration properties, concentration of iron containing minerals. Therefore, the authors concentrated on several aspects of porosity assessment and fluid typing for various clastic sedimentary rock samples. The measurements were performed using 2, and 23 MHz NMR core analyzers equipped with various probeheads. 1D as well as 2D relaxation times distributions were obtained. Samples of various sedimentary rocks, i.e. shale, mudstone and sandstone samples, revealed different patterns in T1-T2 relaxation times distributions (T1-T2 maps) depending on lithology and petrophysical properties for samples in their native unpreserved state as well in brine saturated state. The measurements give possibility to assess porosity and water saturation.

Key words: *nuclear magnetic resonance, porosity, water saturation.*