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Comparison between results of detailed tectonic studies on borehole core vs microresistivity images of borehole wall from gas-bearing shale complexes, Baltic Basin, Poland.

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Structural analysis of borehole core and microresistivity images yield an information about geometry of natural fracture network and their potential importance for reservoir stimulation. Density of natural fractures and their orientation in respect to the maximum horizontal stress has crucial meaning for hydraulic fractures propagation in unconventional reservoirs. We have investigated several hundred meters of continuous borehole core and corresponding microresistivity images (mostly XRMI) from six boreholes in the Pomeranian part of the Early Paleozoic Baltic Basin. In general, our results challenge the question about representatives of statistics based on structural analyses on a small shale volume represented by borehole core or borehole wall images and credibility of different sets of data.

Most frequently, fractures observed in both XRMI and cores are steep, small strata-bound fractures and veins with minor mechanical aperture (0,1 mm in average). These veins create an orthogonal joint system, locally disturbed by fractures associated with normal or by gently dipping thrust faults. Mean fractures' height keeps in a range between 30-50 cm. Fracture density differs significantly among boreholes and Consistent Lithological Units (CLUs) but the most frequent means falls in a range 2-4 m-1. We have also payed an attention to bedding planes due to their expected coupling with natural fractures and their role as structural barriers for vertical fracture propagation. We aimed in construction for each CLU the so-called "mean brick", which size is limited by an average distance between two principal joint sets and between bedding fractures.

In our study we have found out a discrepancy between structural profiles based on XRMI and core interpretation. For some CLUs joint fractures densities, are higher in cores than in XRMI. In this case, numerous small fractures were not recorded due to the limits of XRMI resolution. However, the most veins with aperture 0,1 mm, cemented with calcite, were clearly visible in scanner image. We have also observed significantly lower density of veins in core than in the XRMI that occurs systematically in one formation enriched with carbonate and dolomite. In this case, veins are not fractured in core and obliterated for bare eye by dolomitization, but are still contrastive in respect of electric resistance. Calculated density of bedding planes per 1 meter reveals systematically higher density of fractures observed on core than in the XRMI (depicted automatically by interpretation program). This difference may come from additional fracking due to relaxation of borehole core while recovery. Comparison of vertical joint fractures density with thickness of mechanical beds shows either lack of significant trends or a negative correlation (greater density of bedding fractures correspond to lower density of joints). This result, obtained for shale complexes contradict that derived for sandstone or limestone. Boundary between CLUs are visible on both: joint and bedding fracture density profiles. Considering small–scale faults and slickensides we have obtained good agreement between results of core and scanner interpretation.

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