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Parameters controlling mechanical stratification of gas-bearing shale complexes: integration of wellbore logging and core profiling (Peri-Baltic Basin, Poland).

Radomir Pachytel, Marek Jarosiński, Kinga Bobek, Joanna Roszkowska - Remin, and Michał Roman
Polish Geological Institute, Energy Security, Poland (rpac@pgi.gov.pl)

In our study of mechanical properties of gas-bearing shale complexes from exploration wells in Pomerania, we take advantage from having access to continuous, several hundred meters long core profiles which are supplemented with complete sets of geophysical logging from the same shale intervals. We are focused on different approaches to discriminate the Consistent Mechanical Units (CMUs). Such units are essential for mechanical modeling of stress and strain in shales and their scale is highly dependent on the purpose of analyses.

We have done a precise lithological and structural core profiling, which results in distinguishing Consistent Lithological Units (CLUs) at a centimeter scale. The geophysical logs, essential for mechanical studies, exhibit resolution from tens of centimeters to a meter. The meter resolution we have found appropriate for consideration of mechanics of hydraulic fracture propagation and therefore we have used it in CMUs analysis. The first challenge we have faced is to switch between scales of analyses without significant losses of information coming from the lower level of observation. The next challenge, is to find the mechanical parameter which is able to discriminate CMUs most efficiently. Brittleness Indexes (BIs) are commonly used parameters in order to characterize mechanical shale units, but at the same time these indexes are arbitrary defined to match individual requirements of the users.

In our study, we have determined the BIs in several ways, based either on mineral composition or on elastic modules, both supplemented with pore volume. The gamma ray (GR), Young modulus (YM), Poisson Ratio (ν) interpretation from acoustic logging, bulk density (RHOB), porosity interpretation (ø) and mineralogical profile (ULTRA, GEM) from spectral logging were computed. Detailed comparison of lithological profile and discriminated CLUs with above logs led us to conclusions about geophysical representation of dolomite and silica lithified shale, organic matter enrichment tuffite layers or disturbances in lamination, which are important for mechanical differentiation of shale complexes.

Finally, we have checked which of the calculated BIs matches best the lithological differentiation and the natural fracture density profile that allowed us for selection of the BI which, in our opinion, represents the potential for hydraulic fracture propagation.

Our study in the frame of ShaleMech Project (Blue Gas Program) is in progress and the results are preliminary.