Geophysical Research Abstracts
Vol. 19, EGU2017-4944, 2017
EGU General Assembly 2017

Consistent lithological units and its influence on geomechanical stratification in shale reservoir: case study from Baltic Basin, Poland.

Radomir Pachytel, Marek Jarosiński, and Kinga Bobek
Polish Geological Institute, Energy Security, Warsaw, Poland (rpac@pgi.gov.pl)

Geomechanical investigations in shale reservoir are crucial to understand rock behavior during hydraulic fracturing treatment and to solve borehole wall stability problem. Anisotropy should be considered as key mechanical parameter while trying to characterize shale properties in variety of scales. We are developing a concept of step-by-step approach to characterize and upscale the Consistent Lithological Units (CLU) at several scales of analysis. We decided that the most regional scale model, comparable to lithostratigraphic formations, is too general for hydraulic fracture propagation study thus a more detailed description is needed. The CLU's hierarchic model aims in upscale elastic properties with their anisotropy based on available data from vertical borehole. For the purpose of our study we have an access to continuous borehole core profile and full set of geophysical logging from several wells in the Pomeranian part of the Ordovician and Silurian shale complex belongs to the Baltic Basin.

We are focused on shale properties that might be crucial for mechanical response to hydraulic fracturing: mineral components, porosity, density, elastic parameters and natural fracture pattern. To prepare the precise CLU model we compare several methods of determination and upscaling every single parameter used for consistent units secretion. Mineralogical data taken from ULTRA log, GEM log, X-ray diffraction and X-ray fluorescence were compared with Young modulus from sonic logs and Triaxial Compressive Strength Tests. The results showed the impact of clay content and porosity increase on Young's modulus reduction while carbonates (both calcite and dolomite) have stronger impact on elastic modulus growth, more than quartz, represented here mostly by detrital particles. Comparing the shales of similar composition in a few wells of different depths we concluded that differences in diagenesis and compaction due to variation in formation depth in a range of 1 km has negligible influence on the values of Young modulus. Both mineralogical and mechanical brittleness display differences not only between lithostratigraphic formations, but also for the lower-order CLUs which may influence development of tectonic and technological fractures. Using this approach, we can predict the areas that may be more prone to fracture propagation and branching during hydraulic fracturing treatment and also places that can create barriers to their development. Furthermore, we demonstrate relationship between CLU's mechanical properties and the density of natural fractures determined from core and Electric-Resistivity Borehole Imager analysis. As fracture friction may rule reservoir response to technological loads induced while drilling and fracking we also applied a method of massive determination of static friction coefficient on borehole core. Tuffite beds or other weak intercalations were included in the CLU's model as possible structural barriers for hydraulic fracture propagation. Distinguished set of CLUs is possible to be traced from well to well across tens of kilometers of the Baltic Basin.

Our study in the frame of ShaleMech Project funded by Polish Committee for Scientific Research is in progress and the results are preliminary.