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Natural fault and fracture network versus anisotropy in the Lower Paleozoic rocks of Pomerania (Poland)

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Knowledge of the anisotropy of rock fabric, geometry and distribution of the natural fault and fracture network play a crucial role in the exploration for unconventional hydrocarbon recourses. Lower Paleozoic rocks from Pomerania within the Polish part of Peri-Baltic Basin, as prospective sequences, can be considered a laboratory for analysis of fault and fracture arrangement in relation to the mineral composition of the host rocks. A microstructural study of core samples from five boreholes in Pomerania indicate that the Silurian succession in the study area is predominantly composed of claystones and mudstones interbedded with thin layers of tuffites. Intervals with a high content of detrital quartz or diagenetic silica also occur. Most of the Silurian deposits are abundant in pyrite framboids forming layers or isolated small concretions. Early diagenetic carbonate concretions are also present. The direction and distribution of natural faults and fractures have resulted not only from paleostress. Preliminary study reveals that the fault and fracture arrangement is related to the mechanical properties of the host rocks that depend on their fabric and mineralogical composition: subvertical fractures in mudstones and limestones show steeper dips than those within the more clayey intervals; bedding-parallel fractures occur within organic-rich claystones and along the boundaries between different lithologies; tuffites and radiolaria-bearing siliceous mudstones are more brittle and show denser nets of fractures or wider mineral apertures; and, fracture refraction is observed at competence contrast or around spherical concretions. The fault and fracture mineralization itself is prone to the heterogenity of the rock profile. Thus, fractures infilled with calcite occur in all types of the studied rocks, but mineral growth is syntaxial within marly mudstones because of chemical uniformity, and antitaxial within sillicous mudstones. Fractures infilled with quartz are restricted to tuffites and claystones with biogenic silica. Matching the complex microstructural and mineralogical data with the geomechanical analysis of the host rocks will be the base for further studies on induced fault and fracture development.
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