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Shale Gas Geomechanics for Development and Performance of Unconventional Reservoirs

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Mechanical properties of individual shale formations are predominantly determined by their lithology, which reflects sedimentary facies distribution, and subsequent diagenetic and tectonic alterations. Shale rocks may exhibit complex elasto-viscoplastic deformation mechanisms depending on the rate of deformation and the amount of clay minerals, also bearing implications for subcritical crack growth and heterogeneous fracture network development. Thus, geomechanics for unconventional resources differs from conventional reservoirs due to inelastic matrix behavior, stress sensitivity, rock anisotropy and low matrix permeability. Effective horizontal drilling and hydraulic fracturing technologies are required to obtain and maintain high performance. Success of these techniques strongly depends on the geomechanical investigations of shales. An inelastic behavior of shales draws increasing attention of investigators [1], due to its role in stress relaxation between fracturing phases. A strong mechanical anisotropy in the vertical plane and a lower and more variable one in the horizontal plane are characteristic for shale rocks. The horizontal anisotropy plays an important role in determining the direction and effectiveness of propagation of technological hydraulic fractures. Non-standard rock mechanics laboratory experiments are being applied in order to obtain the mechanical properties of shales that have not been previously studied in Poland. Novel laboratory investigations were carried out to assess the creep parameters and to determine time-dependent viscoplastic deformation of shale samples, which can provide a limiting factor to tectonic stresses and control stress change caused by hydraulic fracturing.
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