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Single- and multiphase (gas-water) flow in gas shales and tight-gas systems

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Production of hydrocarbon gases from tight reservoirs such as gas shales and coals involves a complex set of transport processes (compressible Darcy flow, slip flow, Knudsen diffusion, molecular diffusion). Furthermore, gas transport in these systems is controlled by capillary pressure, solubilization and sorption/desorption isotherms. Conventional reservoir engineering concepts fall short of describing these processes adequately.
In the context of long-term research on gas transport in fine-grained carbonaceous rocks and coals a set of complementary experimental methods has been developed in our laboratory particularly suited for these types of sedimentary systems. These encompass single and multiphase permeability, gas-breakthrough, diffusion and high-pressure sorption tests. Fluid flow tests can be performed under approximate in-situ stress, pressure and temperature conditions. These procedures are used in combination with standard petrophysical (BET, Hg injection porosimetry), geochemical (XRF, AAS, ICP-MS) and mineralogical methods (XRD) in order to study the interrelationship of gas storage and transport properties of gas shales.
Our research aims at improving the understanding and quantitative description of multiphase (gas/water) transport in gas shales and tight-gas systems. Special emphasis is put on the close connection of experimental work and numerical analysis of the laboratory results. The concepts for gas transport in coals and shales developed during recent studies, in particular the relationship between effective permeability of gases and capillary entry pressures will be addressed in this contribution.