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High-Pressure and High-Temperature Sorption of Methane on Black Shales

Matus Gasparik, Amin Ghanizadeh, Yves Gensterblum, Phillipp Weniger, and Bernhard Krooss

Institute of Geology and Geochemistry of Petroleum and Coal, Energy and Mineral Resources Group (EMR), RWTH Aachen University, Aachen, Germany

Improved estimations of Gas-In-Place (GIP) for shale gas reservoirs require reliable experimental sorption data for high pressures and high temperatures. In the framework of European Shale Gas Research project (GASH, www.gas-shales.org) a manometric method was used to measure methane sorption isotherms on various shales from Europe and the USA. Established procedures originally developed for CBM research were modified to: (1) improve the accuracy of sorption measurements for materials with low sorption capacity (5-10% of that for coals) and (2) extend the experimental conditions to pressures and temperatures representative of shale gas reservoirs.
It is generally assumed that at high temperatures (> 100°) sorption does no longer contribute significantly to the total gas storage capacity of shales. Experimental data on high-temperature / high-pressure sorption are, however, still missing. Part of our work was therefore focused on providing reliable experimental data at pressures up to 25 MPa and temperatures up to 150°C.
Moisture content has a strong effect on gas sorption capacity due to competition of methane and water molecules for sorption sites and/or pore restrictions in the presence of water. However, sorption measurements on moist samples at different temperatures pose some experimental difficulties. A simple and effective method was developed allowing for measurements of multiple isotherms at constant moisture content in the system. This procedure ensures that the moisture state of the sample remains unchanged and is not affected by evacuation cycles as in conventional measurements. Uncertainties in assessing the temperature dependence of sorption isotherms on moist samples can thus be significantly reduced.
The following aspects analyzed in this study will be discussed:
• Variation of methane sorption capacity with Total Organic Carbon (TOC) content, mineralogy and thermal maturity
• Temperature dependence of methane sorption capacity over a wide range of temperatures (38°C – 150°C)
• Dependence of sorption capacity on particle size (pore accessibility)
• Effect of moisture on sorption capacity