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N2, CO2, and Ar adsorption to characterize micro- and mesopores of shales

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The storage and flow mechanisms in shales depend largely on their microstructure. We use two parameters to characterize microstructures, namely specific surface area (SSA) and pore-size distribution (PSD). We use N_2 adsorption at 77K to quantify SSA and PSD of nanopores. There are two limitations of the N_2 adsorption method due to (1) uncertainties in molecular area due to the quadrupole moment of N_2 molecules result in 20% uncertainty in calculated BET SSA, and (2) kinetic restriction of N_2 molecules prevent it to access narrow pores (< 0.7 nm). To circumvent these limitations, we also used other adsorptives, such as CO_2 and Ar, for the measurements.

We present results from adsorption measurements of CO_2 at 273 K and Ar at 77 K on shales and compare them to N_2 adsorption at 77 K. Adsorption measurements with CO_2 at 273 K allows for detailed characterization of ultramicropores (< 0.7 nm), which are inaccessible to N_2 molecules. Our results from CO_2 adsorption reveal significantly larger micropore SSA in comparison to N_2 probed SSA. Ar molecules do not have quadrupole moment and resolve the uncertainties of molecular area for BET calculation.

References

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