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Depth and composition dependent nanopore structures of Indian shale gas reservoirs: An implication on storage potential

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We investigated the nanopore structures of shale samples obtained from Cambay and Krishna-Godavari (KG) basins in India using low-pressure N_2 sorption method. The samples occurred at variable depths (1403-2574m and 2599-2987m for Cambay and KG basins, respectively) and have wide ranges of clay contents (56-90%) both in volume and mineralogy. The results of this study indicate the specific surface area (SSA) and pore diameters of the samples share a non-linear negative correlation. The SSA is a strong function of the clay content over the samples' depth. The specific micropore volumes of the KG basin have relatively higher (8.29-24.4%) than the Cambay basin (0.1-3.6%), which leads to higher SSA in the KG basin. From different statistical thickness equations, the Harkins Jura equation was found to be most suitable for the computation of BJH pore size distribution and t-plot inversion in shale. Shale samples from Cambay basin show unimodal pore size distribution, with a modal diameter of 4-5nm, while in the KG basin, show bi-modal to multimodal pore size distribution, mostly ranges from 3-12 nm. In the fractal FHH method, fractal exponent D_f-3 provides a better realistic result than fractal dimensions calculated from (D_f-3)/3. In our samples, pore surface fractal dimension (D_{f1}) show a positive correlation with SSA and a negative correlation with pore diameter, and pore structure fractal dimension (D_{f2}) shows a negative correlation both with clay(%) and depth. The experimental data obtained in this study are instrumental in developing the pore-network model to assess the hydrocarbon reserve and recovery in shale.