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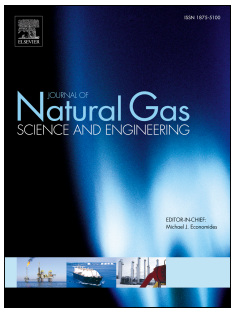

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Influence of Organic and Inorganic Content on Fractal Dimensions of Barakar and Barren Measures Shale Gas Reservoirs of Raniganj Basin, India

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Abstract

The carbonaceous shale beds of Barren Measures and Barakar Formations of Raniganj basin have been investigated for organic and inorganic content influence on the matrix containing micro, meso, macropores, structures and related fractal dimensions. ~~The shale core samples analysed for TOC, vitrinite reflectance, high pressure methane sorption, XRD, FTIR and low pressure N_2 sorption isotherm.~~ The significant amount of TOC suggests slow suspension during the consolidation of the sediments in an abundant river channel owing to low energy environmental conditions. ~~and~~ The adequate thermal maturity indicates shale beds of both the Formations are good to excellent source rock for dry hydrocarbon genesis. ~~The quartz, K-feldspar, muscovite and carbonate contents of Barren Measures and Barakar Formation shales ranged from 8.80-25.80, 3.85-10.80, 1.30-34.30, 0.90-19.80 % and 4.20-19.30, 1.30-11.60, 1.36-23.40, 6.50-25.78% respectively. A distinct phase of O-H stretch vibrations between 3750 and 3400 cm^{-1} represents dominance of the kaolinite (Phyllo silicates group mineral). The absorbance bands within 3000-2800 cm^{-1} display presence of kerogens (organic materials) in shales, which is slightly prominent in the Barren Measures shale than that of the Barakar shale.~~

The plot of $\ln(\ln(P/P_0))$ versus $\ln(V)$ have shown three distinct straight line sections within the whole relative pressure range (0.0000-1.0000), further denoted as Region I (P/P_0 = 0.0002-0.0090; D_1), Region II (P/P_0 = 0.0090-0.3000; D_2) and Region III (P/P_0 = 0.3000-1.0000; D_3) and the linear fitting equations were obtained with different slopes. ~~All the three linear range shows good fitting suggesting the fractal characteristics as categorised D_1, D_2 and D_3 were calculated from fitted separate segments. The values of D_1, D_2 and D_3 are varying from 0.9780-2.0120, 1.8270-2.4610 and 2.6900-2.8650 for Barren Measures, whereas, 1.6540-2.1040, 2.1180-2.6060 and 2.6870-2.7990 for Barakar shales respectively~~. The ~~mean~~ values of D_1, D_2, D_3, signifying the complexity of micro-, meso- and macropores ~~structure of larger pore (macro) is more than that of the small pore (micro)~~, providing supplementary sites for gas adsorption. Fractal dimensions have shown a positive correlation with clay content, whereas negative correlation with total organic content indicates that inorganic content plays a vital role in the rugged surface formation useful for gas storage. The positive linear correlation of fractal dimensions (D_1 and D_2) with Langmuir volume accentuated that smaller pores (micro and meso) ~~have higher~~ contains ideal ~~fractal dimensions~~ rugged surfaces suitable for gas adsorption due to heterogeneity, irregular pore surfaces, complex pore openings and structures. Furthermore, D_3 shown negligible negative correlation with V_L specifies the larger pore size do not provide sites for adsorption space, because of the altered smooth surfaces formed during diagenesis. An empirical method for estimation of sorption capacity (ESC) has been proposed taking into account of the positive and negative influence of the fractal dimensions, clay, minerals and total organic content. The strong positive linear relationship of Langmuir volume (V_L) with an empirically estimated sorption capacity (ESC) (R^2 = 0.86) and about 90 % curves match,