Kerogen Kinetics and Gas Shale Pore System Analysis of Permian Shales of Raniganj Field, India

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The shale gas prospect of organic rich shales were analyzed for Permian shales including Raniganj, Barren Measure and Barakar Formation of Raniganj Field, India using rock eval pyrolysis techniques. The nanometer-scaled pore systems of gas shale reservoirs were examined using scanning electron microscopy. To understand the pore system of these rocks, the total porosity, pore-size distribution, organic geochemistry, mineralogy, and image analyses by were performed. As a tight reservoir, the most of the pores in shale are micro to nano pores. Compared to conventional reservoirs, the pore structure of shale presents strong heterogeneity and anisotropy. Quantitative characterization of nano-pore heterogeneity and anisotropy is of great importance for precise calculation of gas reservoir capacity and the optimization of gas wells layout. A weakly positive trend was observed between the TOC content of organic-rich shales and the quartz content. Both matrix and organic pores were developed in grey to black shales, as observed by SEM, along with intergranular pore, interlayer pores, dissolve pores and fracture pores. Furthermore, with increasing TOC content, the pore size distribution (PSD) curves of organic-rich shale showing positive correlation with organic matter content followed by clay content. Bimodal PSD versus surface area and unimodal PSD versus pore volume were analyzed, indicating that surface area is mainly associated with micropores and fine mesopores (<10 nm) and larger pores are the chief contributor to pore volume. The pore size distribution, as interpreted by BJH theory specify that few samples have larger peak at 4nm (40Aº) to 10 nm (100Aº) while other samples have limited pores below 20nm (200Aº) and most of the pores are in the range of 20nm (200Aº) to 55nm (550Aº). BJH adsorption average pore size diameter ranges from 5.4921nm (54.921Aº) to 29.754nm (290.754Aº). Multiscale transport mechanism of shale gas in micro/nano slit pores ranging from nanometer to millimeter were studied by, including different pore types i.e. interlayer, intergranular, pore and fracture in contact with organic matter, pore and fracture in contact with other types of minerals, dissolved and micro-cracks. Microcomputer tomography resolved micropores connected with pore throats of nano-sized diameters.

Keywords: Shale Gas, Microstructure, Kerogen, Raniganj