

Depositional modeling and shale gas potential of the Sembar Formation in the Sulaiman Range, Pakistan

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The Sembar Formation in the Sulaiman Range has a thick succession of black to dark-gray shale. The lithofacies analyses based on field observations, petrography, scanning electron microscopy (SEM), backscattering electron microscopy (BSEM), and energy-dispersive x-ray spectroscopy (EDX) are done for depositional modeling of the formation. The analyses reveal the presence of calcareous shale lithofacies, siliciclastic shale lithofacies, and argillaceous shale lithofacies, representing deposition of Sembar Formation in coastal to inner shelf settings. The organic geochemical source rock analysis yield favorable total organic carbon (TOC) and Rock Eval results, showing the presence of both Type II & III kerogens, which are capable of producing gas. Few beds exhibit poor to moderate quality source rock, as indicated by low TOC and Rock-Eval values. The T_{max} versus hydrogen index (HI) values reveal that some of the beds are thermally mature at current outcrop levels. The TOC values, thermal maturity, bulk rock mineralogy and formation thickness reveal that the Sembar Formation is having brittle nature, i.e., abundance of quartz as compared to clays, and is capable of fracking process, indicating that the Sembar Formation is having very good potential to serve as unconventional shale gas reservoir, particularly in the northern part of the Sulaiman Range.

Keywords: Sulaiman Range; Sembar Formation; TOC; Unconventional shale gas reservoir