

## SHALE HYDROCARBON MODELING FOR THE LOWER CRETACEOUS SEMBAR FORMATION BY APPLYING THE CONVENTIONAL WORKFLOW OF 1-D PETROLEUM SYSTEM MODELING

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### Abstract

The Southern Indus Basin of Pakistan has been selected in this study to evaluate the shale hydrocarbon potential of the Lower Cretaceous Sembar Formation, an organic-rich rock interpreted to have sourced conventional oil and gas accumulations. The workflow of the conventional 1-D Petroleum System Modeling (PSM) was proposed and applied to assess the Sembar maturity, comparative retention capacity, remaining kerogen, formation pressure and the remaining volume of the hydrocarbon (oil and gas) in shales of the Sembar Formation. The study was conducted based on data from the public domain of petroleum industry in Pakistan, including vertical well sections, well logs, seismic sections, regional geological sections and base maps. Results of Petroleum System (PSM) indicated that shales of the Sembar Formation are in the thermal window for gas and oil generation with an average maturity of vitrinite reflectance ( $R_o$ ) of 1.9 %. Hydrocarbon generation was found to have started in the Upper Cretaceous with a rapid burial started at 100 Ma when the rate of the hydrocarbon retained in the shales of the Sembar Formation was 0.4 million tons/Ma while at present the rate of the hydrocarbon retained in the Sembar shale is 0.2 million tons/Ma with an amount of remaining kerogen ranges between 9 to 34 megatons (Mtons). Shales of the Sembar Formation are interpreted to be over-pressured at present. The average modeling volume of the remaining shale gas is 9.44 billion cubic feet (bcf) and the average modeling volume of the remaining shale oil is 24.32 million barrels (Mbbl). This study concluded that Sembar Formation has potential shale hydrocarbon resources within the Southern Indus Basin as there is momentous retention capacity within the shale with substantial remaining amount of kerogen, formation is over-pressured and model shows remaining volume of shale oil and gas within the Sembar Formation at present.

**Key Words:** Shale Gas, Shale Oil, the Southern Indus Basin, Petroleum System Modeling (PSM), Retention Capacity, Formation Pressure, Remaining Kerogen