A Complete S2S (Seismic to Simulation) Solution to Modela Late Eocene Karstified Reservoir — A Case Study from the Western Offshore Basin, India

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Abstract

Karstification imparts severe challenges in Oil and Gas business right from drilling to production. Drilling challenges include but not limited to severe mud loss, bit free fall, sudden jump in ROP etc. within karstified zone. Reduction in ultimate oil recovery due to abrupt increase in GOR or Water Cut in the karstified zones are the manifestations of very high vertical permeability anisotropy in the karsts which is very tough to capture. In this paper a case study of mapping the extent of karstified zone, explanation of facies & hydrocarbon distribution and history matching of pressure and production data of twin interconnected fields from Western Offshore Basin, India is presented. The main conditions for the karst formation are presence of paleohigh; presence of unconformity; decrease of sea level that create sub aerial conditions for carbonate dissolution. This has resulted intensely karstified top level in Bassein Formation. Vasai East Field was discovered in 2001 having oil and gas in Bassein Formation. The South Bassein gas field is under production since 1988 for Bassein Formation. The pressure recorded in first exploratory well was 153 kg/cm^2 compared to hydrostatic pressure 178 kg/cm^2.The pressure in Vasai East got depleted because of aquifer connectivity. Most of wells in Vasai East field show quick build-up of water cut and exponential increase in GOR within very short span of time. Karst acted as the conduits where permeability anisotropy practically becomes negligible. Delineation of the karstified zone through was carried out integrating a multi-attribute seismic signature. Two

staged approach was taken up (for Facies Modeling). Principle Component Analysis on the recorded log suites, followed by K-Means cluster analysis to identify and distinguish different electrofacies. Dimensionless aquifer radius (Rd) from the H-O plot was found to be 1.839 for South Bassein Field and 1.002 for Vasai East Field indicating strong influx for South Bassein Field and depletion mode drive for Vasai East Field. Permeability modeled in this way was modified locally by taking guidance of Build-Up (BU) test data and Karst Facies Volume. In Vasai East field detailed history match at the well level was carried out. This match was possible only by the integration of Karst Volume as a guide to permeability anisotropy modification guide and detailed integration of different well wise completion strategy. Simulation of karstified reservoir can be carried out effective (effectively), if the rock type can be captured with the integration of seismic and log data and karst facies. The approach stated in the paper can be applied for efficient modelling of any karstified reservoir.