Integrated Petrophysical and Geomechanical Characterization of Cambay Shale, Cambay Basin, India

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Summary

The Natural Gas Demand is expected to increase significantly at a CAGR of 7 % from 226.7 MMSCMD in 2012-13 to 713 MMSCMD in 2009-30. India is having number of sedimentary basins with high potential of commercially producible formations. It also has potential of producing Shale Gas which can fulfill the increasing demand of natural gas and energy. Thick Cambay Shale of Cambay Basin has been proved as the good hydrocarbon bearing source rock having high thermal maturity and organic matter content. A pilot study which includes Petrophysical and geomechanical analysis have been done on the shale samples of Cambay Shale to understand its Petrophysical and mechanical properties. This study can help in constructing fairway map for the whole basin if data from other blocks is available. The constructed map may be used to exploit the basin in more efficient and economical way.

Introduction

The Cambay Basin is an intracratonic basin of Late Cretaceous age located along the western continental passive margin of Indian platform of Western Indian State of Gujarat (Fig.1). It has been prognosticated as the main shale gas reservoirs with resource potential of around 231 BCF/mi², high organic matter content (3.0%) and good thermal maturity. During Early Eocene a widespread transgression resulted in the deposition of a thick, dark and grey pyritiferous shale sequence, known as Cambay Shale which is divided in to Older and Younger Cambay Shale with an unconformity in between (Kumar, 2013). Based on the various pilot investigations on Cambay Shale sections, it has been observed that this Shale is a potential hydrocarbon source rock, thermally matured and falls within oil window with TOC values in between 4% to 5 % (average, Upper Cambay Block) and Hydrogen Index values from 150 to 100 mg Hc/gm TOC (Mathuria *et al*, 2011). The thermal maturity in South Cambay (i.e. 0.5 % to 1.8 %) is higher than the north Cambay (i.e. 0.6 % to 0.8 %) as discussed by Pathy et al, 2016. The thermal maturity distribution in the entire Cambay Basin has been shown in Fig. 2. Various exploration studies have been performed by Tewari et al. (1995), Madhavi et al. (2009), Banerjee and Rao (1993), Chandra et al. (1994), Banerjee et al. (2002), Garg and Philip (1994), Ariketi (2011), Sharma and Sircar (2016) and Dayal et al (2013) to prove the hydrocarbon potential of Cambay Shale of Cambay Basin. All these studies need to be validated by the integrated quantitative investigations on Cambay Shale Samples.

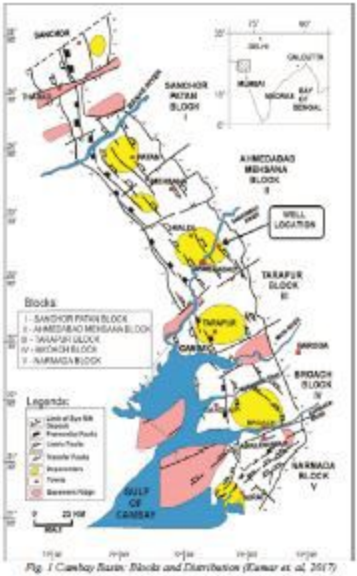

Fig. 1 Cambay Basin: Blocks and Distribution (Kumar et. al, 2017)

In this study, a unified experimental approach has been presented to obtain the useful information on petrophysics, mineralogy, pore characterization and Geomechanics of this shale. Some Core Samples, Few Thin Sections, Cuttings and Powdered Samples were collected from the Upper (North) Tectonic block of this basin and various laboratory measurements like Low/High Pressure Porosity (LPP/HPP), Nuclear Magnetic Resonance Porosity (NMR), Permeability Analysis, Scanning Electron Microscopy (SEM), Fourier Transform Infrared Spectroscopy (FTIR), and Triaxial Testing were performed to understand the Elements distribution, Mineralogy, Geomechanics and Petrophysical nature of this shale. Image analysis, intrusive and non-intrusive methods are the approaches used for

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