

Shale Gas Potential of North Cambay Basin, Gujarat, India

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Abstract: Shale gas exploration and exploitation in India is in nascent stage, basic shale gas specific data requires to be generated. The prognosticated resource potential of Indian Shale gas basins is around 2000 TCF. The Cambay Basin is an intracratonic basin located along the western continental passive margin of Indian platform in the Western Indian state of Gujarat. The formation of this basin occurs due to the break-up of Gondwana super continent which makes it an intracratonic rift graben basin. The petroliferous Cambay basin in western India with interbedded carbonaceous in its thick Tertiary sequence forms a potential shale gas prospect. Cambay shale has been the main hydrocarbon source rock in the Cambay basin because of the high total organic carbon content and thermal maturity. Due to the favorable lithological change with structural support and short distance migration, Cambay formation has good generation, expulsion and accumulation of hydrocarbons. Fine grained, clastic and organic rich Cambay, Tarapur and other Tertiary shales have sources of oil and gas for the basin. The quantity, quality and type of organic matter play an important role in the generation of gas. In this study, around 10 sedimentary rock samples from the North Cambay Basin, Sanchor-Patan Tectonic Block were analyzed by Rock –Eval Pyrolysis - 6 to predict the generation and accumulation of gas in this basin. This technique was adopted to obtain the independent parameters on organic matter composition, its thermal maturity, and kerogen typing. Also, a mathematical expression of Hydrogen Index (HI) vs. Rock Eval maximum temperature (T_{max}) pathline for a particular kerogen is generated to understand the characterization of the kerogen with respect to its original generation potential. These results show that the sections are not mature at this moment but on complete thermal maturity they can act as a good source rock. The present study is suitable for good assessment of the petroleum potential of source rocks and rapid geochemical characterization of sedimentary organic matter.

Keywords: Shale, Thermal maturity, Kerogen Typing, Rock-Eval Pyrolysis

INTRODUCTION

The Cambay Basin, a rift sag Tertiary basin, in the western onshore part of India includes five tectonic blocks (i.e. Sanchor-Patan, Ahmedabad-Mehsana, Tarapur-Cambay, Broach-Jambusar and Narmada-Tapti), separated by faults aligned transverse to the general north-south axis of the rift (Fig. 1). It covers an aerial coverage of 53,000 sq. m trending NNW-SSE with a shale gas resource potential of 20 TCF (USGS, 2012). The dominant shale units are: Olpad formation of Paleocene age, Older Cambay Shale unit of Paleocene-Lower Eocene age, Younger Cambay Shale of Lower Eocene age followed by Kalol formation of Mid-Eocene-Oligocene age (Fig. 2). The Cambay Shale has been identified as the main hydrocarbon source rock in the Cambay Basin due to its high thermal maturity and richness in organic matter content. The quality, quantity and type of organic matter play an important in the generation and occurrence of hydrocarbons. However, it is difficult to generate the gas/oil – source genetic relationship due to complicated geology involving multiplicity of depressions, source rocks and reservoir (Banerjee *et al.*; 2000). The study area of this work is North Cambay Basin, Sanchor-Patan Tectonic Block (Fig. 3). Nearly 10

sedimentary samples have been collected to identify the best source rock for the generation and accumulation of gas in this basin. To generate the gas-source genetic relationship, geochemical characterization of these sedimentary samples is done. Geochemical parameters such as organic richness and kerogen typing are the prime requisite in shale gas exploration as these attributes control gas generation in shales. Rock Eval Pyrolysis is one of the most basic methods to study the thermal maturity of organic matter shales (Dayal *et al.*, 2013). The principal objective of this study is to predict the amount of hydrocarbons generated and organic matter type by analyzing the various parameters generated by Rock Eval Pyrolysis technique.

STRATIGRAPHY OF NORTH CAMBAY BASIN

Stratigraphy, tectonics and sedimentation of Cambay Basin have been worked out by various authors, the more significant contributions have been made by Sudhakar and Roy (1959), Zubov *et al.* (1996), Mathur *et al.* (1968), Chandra and Chaudhary (1969), Rao (1969), Sudhakar and Basu (1973), Bhandari and Choudhary (1975), and Raju *et al.* (1982). Stratigraphically, the basin has been divided