Collisional Tectonics and its Effects on Hydrocarbon Entrapment and Progression: A Case Study from NW Corner of Indian Plate*

Shabeer Ahmed1,2, Uzair Hamid Awan1,3, Rana Faisal Shahzan1, and Shakeel Ahmad1

Search and Discovery Article #30601 (2019)**
Posted April 1, 2019

*Adapted from poster presentation given at 2019 AAPG Middle East Region GTW, Regional Variations in Charge Systems and the Impact on Hydrocarbon Fluid Properties in Exploration, Dubai, UAE, February 11-13, 2019
**Datapages © 2019 Serial rights given by author. For all other rights contact author directly. DOI:10.1306/30601Ahmed2019

1Basin Study and Exploration research, OGDCL, Islamabad, Pakistan (shabeer.cpag@gmail.com)
2University of Sindh, Jamshoro, Pakistan
3Bahria University, Islamabad, Pakistan

Abstract

Regions characterized by collisional/compressional tectonics are important in the context of entrapment and progression. Faults formed in collisional tectonic settings can entrap hydrocarbon and become barriers for hydrocarbon migration. Mann et al. (2003) carried out research on tectonic settings of the world’s 877 giant hydrocarbon fields and classified the tectonic setting of these giant fields in six classes as continental passive margins (304 giant fields), continental rifts (271 giant fields), collisional margins produced by terminal collision between two continents (173 giant fields), collisional margins produced by collision between two continents (71 giant fields), strike slip margins (50 giant fields), and subduction margin (8 giant fields). The area selected for this study is characterized by collisional tectonics between the Indian and Eurasian plates. The study area is located on the northwest corner of the Indian Plate, which is an important region of Pakistan producing hydrocarbons. Seismic and well data have been used for the study of entrapment mechanisms provided by collisional tectonics. Kinematics of the Indian Plate has been studied with the help of GPlate software. Broad thrusted anticlines formed as the result of collisional tectonics within the region are the major structural traps. The generalized methodology use for this study is generation of synthetic seismograms, identification and marking of prospective horizons and faults on seismic data, modeling of major entrapment structures of the study area, to study the effects of collisional tectonics in the progression of traps of area with the help of GPlates, calculation and measurement of reservoir rock characteristics with the help of petrophysical analysis, preparation of rock physics section to study rock physical and engineering properties, seismic attribute analysis, and geomechanical analysis to understand the mechanical properties of reservoir rocks. The Indus Basin, which includes the Kohat-Potohar main depression, relates to the kind of continental downward basin which accounts for approximately 48 percent of the world’s well-known oil resources. The Potohar Basin is among the oldest regions of the world discovering oil accumulations, where the first discovery was made at Khaur in 1914. To date, around 150 exploration wells have been drilled. The Potohar fold zone is prolific, with several structural leads (Shami and Baig, 2003). The Missa-Keswal oil and gas field is located in the eastern part of Potohar Basin. Its structure is a thrust bounded anticline, having SW-NE orientation. It was first drilled by Gulf Oil Company, with the Qazian-1 as the first well. That was a dry well with no commercial production of hydrocarbon, however, OGDCL, after undertaking further seismic studies, drilled various
successful wells. The field was revealed in June 1991. Presently this field is generating around 6 thousand barrels of oil and approximately 10 MMCF of gas every day (Shami and Baig 2003).

Selected References


The tectonic evolution of Indian Plate began with sequential separation of lithospheric plates associated with Gondwanaland. Work on the tectonic history of Indian Plate has been carried out by many researchers (Dietz and Holden, 1970; Biswas, 1982; Chatterjee, 1992, Storey, 1995; Kazmi and Jan, 1997; Chatterjee et al., 2013) and is still under progress. The area is characterized by collisional episodes of Indian plate had greatly facilitated the formation of hydrocarbon fields in the area (Grelaud et al., 2002).

Recent seismicity (Jadoon et al., 2008) and structural cross-section from NW corner of Indian Plate (According to Pakistan Energy Year Book, 2017).

Potential hydrocarbon zones are: continental passive margins (304 fields), continental rifts (271 fields), strike slip margins (50 fields), subduction margin (8 giant fields) and collisional margins produced by terminal collision (71 fields), which are classified into giants (4 fields) and medium size (67 fields). The structural style of fields has been interpreted as pop up anticlinal structure. Thrust Frontal Fold belt (TFB) is also a predominant structural style of the area.

This fascinating tectonic of Indian Plate and its effects on hydrocarbon entrapment and progression is explained in this study. Cross section based on seismic line (Fig. 8).

Further detailed study on the basis of 3D seismic data is recommended.

Some Generalized stratigraphy (Fig. 9).

Fig. 11. Chronological sequence of thrusting and shortening in the Kohat- Patala Shales of Paleocene are believed as good hydrocarbon source (Kazmi and Jan, 1997; Chatterjee et al., 2013). Oil window prevailed from Early Miocene to Recent. Patala Shales of Paleocene are believed as good hydrocarbon source (Kazmi and Jan, 1997; Chatterjee et al., 2013). Oil window prevailed from Early Miocene to Recent. Patala Shales of Paleocene are believed as good hydrocarbon source (Kazmi and Jan, 1997; Chatterjee et al., 2013). Oil window prevailed from Early Miocene to Recent. Patala Shales of Paleocene are believed as good hydrocarbon source (Kazmi and Jan, 1997; Chatterjee et al., 2013). Oil window prevailed from Early Miocene to Recent. Patala Shales of Paleocene are believed as good hydrocarbon source (Kazmi and Jan, 1997; Chatterjee et al., 2013). Oil window prevailed from Early Miocene to Recent. Patala Shales of Paleocene are believed as good hydrocarbon source (Kazmi and Jan, 1997; Chatterjee et al., 2013). Oil window prevailed from Early Miocene to Recent. Patala Shales of Paleocene are believed as good hydrocarbon source (Kazmi and Jan, 1997; Chatterjee et al., 2013). Oil window prevailed from Early Miocene to Recent.