

An overview of Structural Styles and Hydrocarbon Potential, Sulaiman Foldbelt, Pakistan

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Summary

This research encompasses the study of structural styles and evaluation of the hydrocarbon potential of Sulaiaman Fold belt (SFB), Pakistan. The Sulaiman Range is approximately 300 km long in the north-south strike direction. The Sulaiman Fold Belt formed large depression in its southern, eastern and south eastern part which is known as Sulaiman Depression. Reservoir rocks present in the Study area ranging from Cretaceous-Eocene with appealing proven source rocks which have been capable of expelling both oil and gas successfully. The presence of seepages also validates the maturity of source rocks.

Based on seismic data interpretation it is revealed that Structural Styles in the north-eastern part of the Sulaiman fold belt are trending North-South and perpendicular to tectonic transport and stress direction and the base of the structures gradually dipping Eastward beneath the deformation frontal part in Eastern Sulaiman Fold Belt. However, in southwest it changes its orientation to an east west trend in Sulaiman Lobewith gentle dips and resembling with the dominos structural styles.

Petroleum Geology

The Triassic Alosai Formation has also been drilled in Zindapir Anticlinorium (Figure 1). The older rocks have been drilled in several wells of the adjoining region of Punjab Platform and extend in the west towards Sulaiman Lobe (Raza et al, 1989, 2008), indicating the presence of Infracambrian-Permian rocks in the sub-surface of Sulaiman fold belt.

Lower Goru Sands (Early Cretaceous) and Jurassic Carbonate (Chiltan Limestone) are reservoir target for the future exploration in Zindapir.

Exploration History

Dhodak-1 (1976) was first commercial discovery in Dhodak Structure of Zindapir Anticlinorium, which is in the frontal part of the Eastern Sulaiman Fold Belt. Discovery was made in the Late Cretaceous and Paleocene reservoirs. Zindapir-1 (1986) was second well which was drilled by OGDCL to a TD of 4406m in Alozai Formation (Triassic) of Zindapir structure with hydrocarbon shows. Afiband-1 (1986) was drilled by OGDCL in 1986 without successful discovery in Afiband structure. Dewan-1 & Dewan 5-A (2005 & 2007) encountered hydrocarbons in Goruand Chiltanformations, and prove the existence of active petroleum system in the deeper horizon of Middle Jurassic–Early Cretaceous rocks. Dewan-1 (2005) , Dewan 5-A (2007) were drilled in Rodho Structure. Yaqoot -1(2009) was drilled by Dewan Petroleum Limited with commercial discovery of gas condensate in Afiband Structure. Table 1 is showing Exploration History with varying success ratio in Zindapir Anticlinorium.

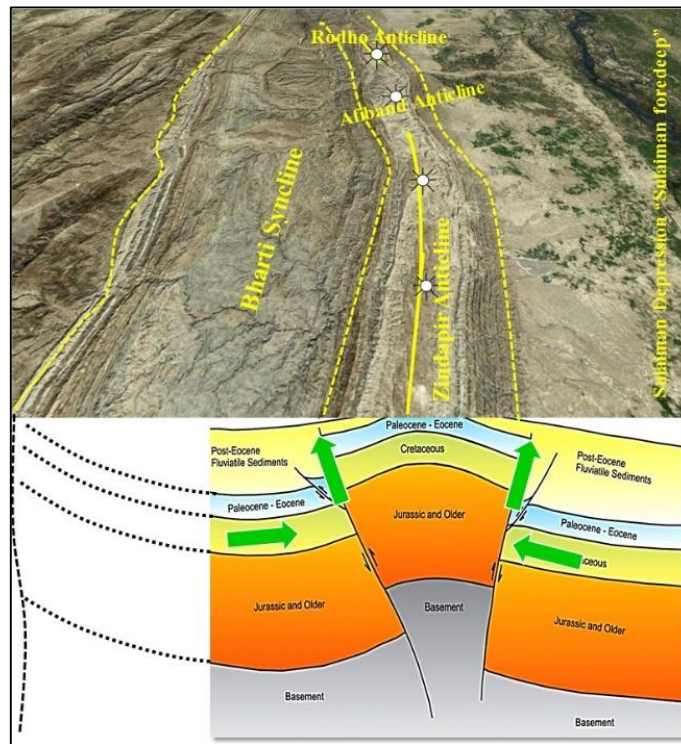


Fig.1 Structural cross section of Zindapir Anticline with migration pathways (Modified after Nazir A. 2018)

Theory / Method / Workflow

Seismic data is widely used for the interpretation of structure, stratigraphy and traps with hydrocarbon potential. Seismic data 2D/3D has been used for the current study to interpret the structural styles within the study area.

Results, Observations, Conclusions

The hydrocarbon discoveries in Dhodak, Rodho and Afiband prove effective source rock nearby Zindapir Anticlinorium, indicating Bharti Syncline in west and Sulaiman Foredeep in the east as potential kitchen area for Sembar-Goru play. Maximum Burial is present in Bharti Syncline and Punjab Platform. The faults seem ideal path ways. Probably those hydrocarbons play role in the filling of structure which were migrated later. The anticlinorium was formed initially and fragmented later.

The intensity of the compressional stresses is evident from the throw of the faults. Interpreted seismic lines will be incorporated in detailed presentation and full length manuscript.

Petro Mod

Basin Model suggests that the Goru source rock is in Wet Gas Window and it has never generated gas in its history in the Zindapir area. Upper Goru was deposited in the Early Cretaceous time and attained Top oil window in Early Paleocene and Top Condensate/Wet Gas window in Late Eocene time. Lower Goru was deposited in the Late Cretaceous time and attained Top oil window in Early-Middle Eocene and Top Condensate/Wet Gas window in Early Miocene time, but it has never acquired main gas generation phase. Currently, the area was under uplift causing the erosion to top of Paleocene at the time of trap formation. Hence the source rock never attained gas gradient at Zindapir-1.

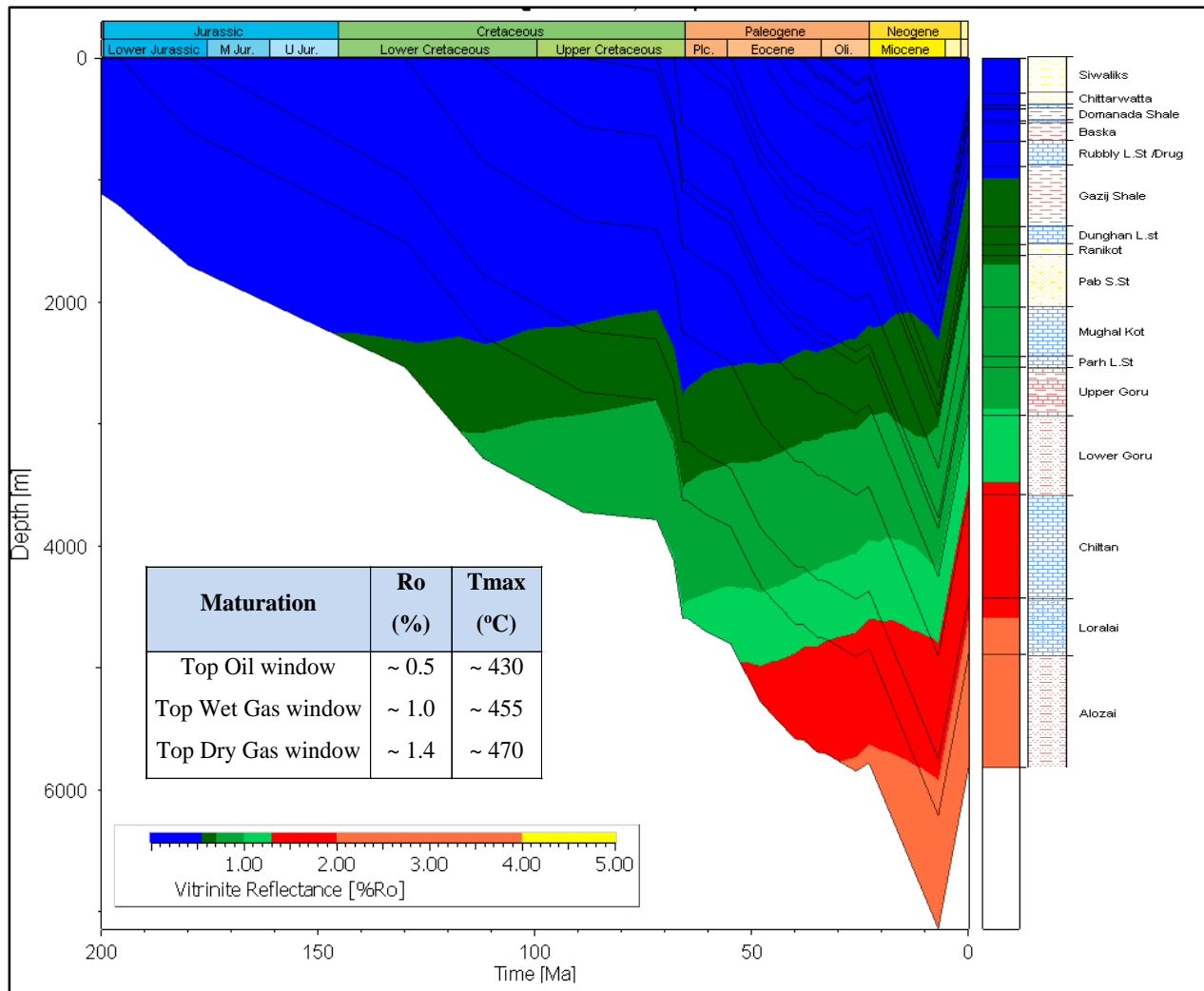


Fig.3 Basin Modelling of Zindapir-1

Structural styles trending NW-SE with clear indication of difference in wrenching stresses on the east and west. The faulting is less severe and the folds are quite gentle in the lobe part. The horizons present ranges from cretaceous on the top to possible Triassic in the deep.

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