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Geology paper 12

STRUCTURAL EVOLUTION OF MEHAR/MAZARANI FOLD BELT AREA, PAKISTAN

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PCPL is the operator of the Mehar Block since 29th December 1999. The area in geological terms represents the first line of fold belt coming out of foredeep to the east. The current interpretation of the Kirthar Fold Belt (KFB) is of thick-skinned tectonics involving pre-existing extensional faults developed during late cretaceous times (Dr. J Warburton, Nov. 2000)and Mehar - Mazarani Fold Belt (MMFB) is part of the KFB . However, in order to develop a better understanding of the evolution of the MMFB, it is desirable to develop an understanding of the configuration of the basement and overlying sediments through times. An attempt is being made to integrate surface geology, well data, 2D seismic data and other parts of the Pakistan basin as analogue to build a model that would help in understanding the relationship between the structural geology and stratigraphy of area through time. This would eventually help in determining new Play fairway of this area.

As mentioned above,the evolution of MMFB through time has been modelled (Fig 1a & 1b and Fig 2a & 2b) using seismic lines ,surface geology , gravity , magnetic data and available well data.. From Pre-Cambrian to Late Cretaceous, the area experienced extensional /shear tectonic due to Rifting /Drifting of the Indian Plate evolving rifted Trantensional basin consisting of normal extentional /shear faults on a Passive Margin. From Early Palaeocene to Recent is a phase of Ophiolites Obduction and Collision resulting in the Folding, Thrusting and development of foredeep on an active margin.

The pre- existing normal extensional faults are oriented NW –SE nearly parallel to the Jacobabad High and in the foredeep which is manifested by the interpretation of the these faults present on composite seismic lines.The Mehar –Mazarani Thrust Fault (MMT) on the other hand is a west dipping and North South trending thrust fault (Fig 2a) . These re-activated extensional normal faults are also present in the core of the Mehar –Mazarani Fold (MMF) which has been uplifted by MMF thrust fault as seen on North South oriented seismic composite line (Fig 2a). This indicates that the recent thrusting of MMF is not along the pre-existing Extensional Faults, otherwise the orientation of the MMT should have been along the fault plane of the pre-existing extensional fault (NW-SE).

The Gravity (Fig 3) and Magnetic data (Fig 4) indicates that the Basement is dipping to West and there does not appear to be any basement controlled inversion structuring involved. The negative Bouguer anomalies west of the area support the interpretation that sediments including the Infra – Cambrian Salt may be getting deeper and thicker in this area. The presence of Infra Cambrian Salt is supported by Plate Tectonics which suggest that during Infra-Cambrian and Cambrian Indian and Arabian plates were probably part of the same basin (Fig 5) .This support also comes from drilling of Marwi -1 in the south and a number of wells drilled in the northern fold belts and Platform areas.

A model is proposed for the structural evolution of the Mehar –Mazarani Fold Belt. The area has seen continuous episodes of uplift, erosion and rifting /drifting from Infra-Cambrian to Late Cretaceous times. The basement faults have been involved and were re-activated during these tectonic phases. The Cretaceous age, source (Sembar), reservoirs and seals were all deposited in passive margin environment .The late Cretaceous rifting re-activated pre-existing normal faults and also uplifted the area north and east of MMFB (1a & 2b) into what is now called Jacobabad High. The late Cretaceous sediments were eroded from the Jacobabad High as can be seen by the toplap nature of Late Cretaceous seismic reflectors. The Gross Wedge shape nature of Paleocene to Oligocene sediments from MMFB area towards the high indicates that the Paleo high was active during this period. Thick Miocene sediment buried the MMFB area farther as India started colliding with Asian Plate until recent times when the impact of collision inverted the strata into Mehar – Mazarani Fold Belt (MMFB) and Mitto Anticlinal Fold (MAF) (Fig 2c & 1b).

The MMFB appears to have been popped up by deep seated detachment in the Infra Cambrian .This detachment was triggered by the deep seated Basement Wrench faults located west of the foldbelt and are part of the Ornach –Chaman transform fault system (A Kaml, November 1991 and R Ahme, July 1999) . The vertical movement of the MMT is due to the ramping over the faulted and westward tilted basement, and also due to the horizontal shortening created by Jacobabad paleo-high. The ramping phenomenon is similar to the structures like Dhurnal in the Potwar Basin. The Back thrust is also created by the movement of the incompetent Upper Goru Shales into the core of the structures to accommodate space and may also cause shallow secondary detachment. 3D seismic is required to image these complexities and in understanding the implications for the future exploration and development phases.

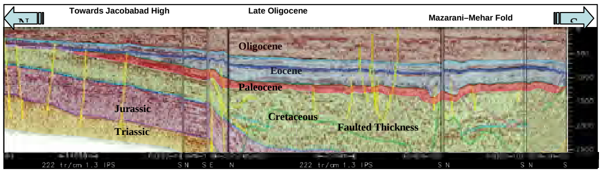

Figure 1a: Oligocene: Marine sedimentation only limited to southern part of the Indus basin, whereas northern part was uplifted due to Himalayan Orogeny and received no sedimentation.

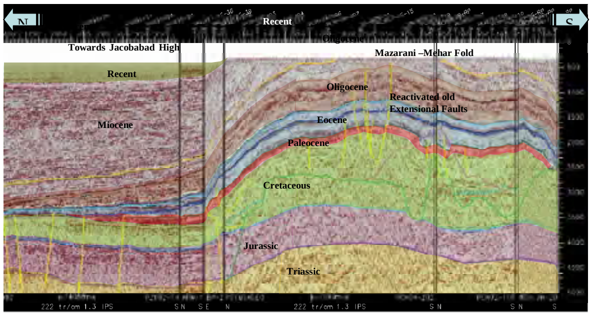

Figure 1b: Recent ; Indian plate continues to converge with Asia @ 2-7 cm /year. In the Mazarani- Mehar area The abnormal thickness of the Cretaceous is due the Mehar-Mazarani Fault . Eocene and Oligocene rocks thin, Paleocene rocks pinch out and thickness of cretaceous rocks decreases towards the Jacobabad High situated in north East of the block.sedimentation.

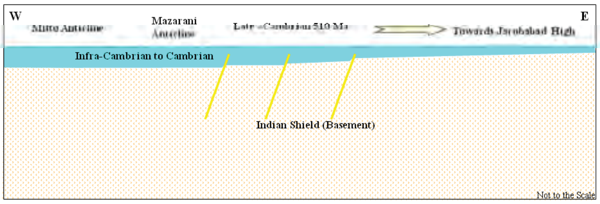

Figure 2a.

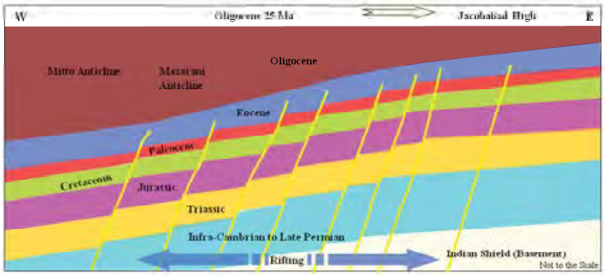

Figure 2b.

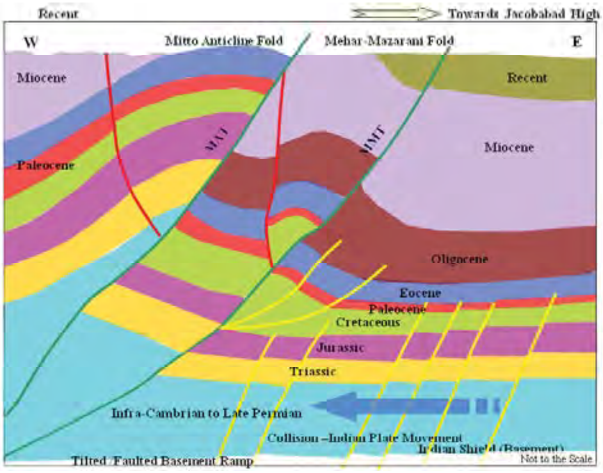

Figure 2c.

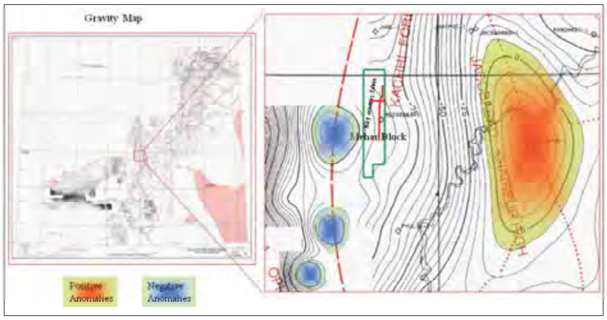

Figure 3.

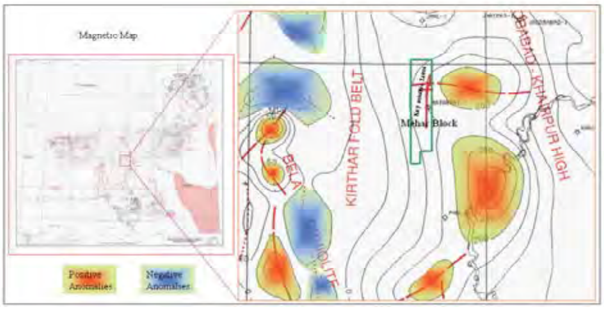

Figure 4.

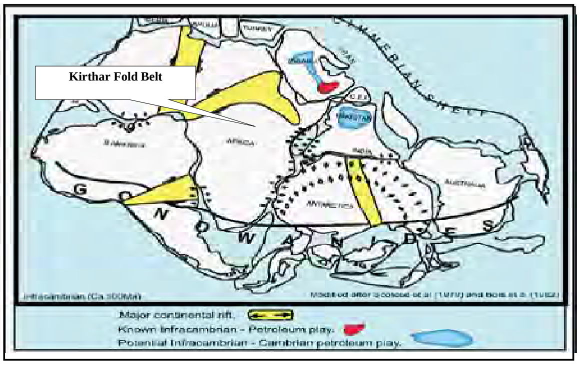

Figure 5.