

Bannu Basin, Fold-and-Thrust Belt of Northern Pakistan: Subsurface Imaging and Its Implications for Hydrocarbon Exploration

Ismail Ahmad Abir¹, Shuhab Khan², Gulzar Aziz³, and Shahina Tariq⁴

¹School of Physics, Universiti Sains Malaysia, Pulau Pinang, Malaysia.

²Department of Earth & Atmospheric Sciences, University of Houston, Houston, TX, United States.

³ION Geophysical, Houston, TX, United States.

⁴Department of Meteorology, COMSATS Institute of Information Technology, Islamabad, Pakistan.

ABSTRACT

The Trans Indus-Salt Range, located in northern Pakistan, is one of the most tectonically active fold-and-thrust belts and comprises three main regions: the Potwar-Salt Range, the Kohat-Surghar Range and the Bannu Basin-Khisor Range. Of these, the Bannu Basin is the least studied and only a handful of publically accessible datasets and publications are available. Recently made public 2D seismic profiles and well data from the Bannu Basin indicate the presence of salt as well as evidence for a main detachment surface which is Cambrian/Infra-Cambrian in age. Our findings suggest that the Salt Range Formation could be the main detachment for the entire basin. Interpretation also shows a Miocene-Eocene basin-wide unconformity that marks the Himalayan orogenic event which separates the pre-Himalayan from the syn-Himalayan sedimentary units. On the basis of seismic reflection data, we conclude that the basin experienced three main tectonic settings. An early stage of pre-Himalayan passive tectonic environment is followed by the compressional Himalayan tectonics which resulted in uplifted areas sourcing the fluvial fill of the subsided basin. During this time, sedimentation from the northern margin of the basin may have influenced the southward flow of salt. This is followed by a more recent stage of thrusting that produced folds and thrusts deforming all of the sedimentary units. Structural geometries suggest that prospective traps are developed mainly in the anticlines outlining the eastern and western boundaries of the Bannu Basin, as well as the southern zone of the basin. Furthermore, the presence of salt diapirism and transpression zones together with numerous oil seeps in and around the basin increase the probability of hydrocarbon accumulation and indicate great potential for future exploration.