IDENTIFICATION OF NEW POTENTIAL SOURCE AND RESERVOIR ROCKS OF EARLY JURASSIC AGE, SUPPORTED WITH BASIN MODELING AND DISCUSSION OF EXPLORATION CONSTRAINTS IN THE NORTHERN KIRTHAR RANGE, PAKISTAN

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The Northern Kirthar Range (NKR) is located in Sindh and Balochistan provinces between latitudes 27°30' N and 30°00' N, covering hilly and mountainous area up to the ophiolite belt to the west and Kirthar Foredeep to the east. This area is represented by a north-south trending fold belt that has been the site for active petroleum search for more than 150 years. Discovery of commercial gas from Paleogene (Eocene and Paleocene carbonates) to Mesozoic aged reservoirs (Cretaceous sandstone and Jurassic carbonates) proved the adequacy of the petroleum habitat, which offers new exploration opportunities.

In this paper we discuss results of the outcrop samples, which suggest for the first time, existence of new potential reservoir and source rock within Early Jurassic. Reservoir potential has been identified in the massive fine grained sandstone of Spingwar Formation of Jurassic age having porosity and permeability of up to 24% and 329mD respectively.

Samples from thick black shales of Anjira Formation, although collected in highly weathered surface conditions in which large volume of in-situ Total Organic Carbon (TOC) tends to be biodegraded, showed of TOC of up to 0.7%. Vitrinite Reflectance data varying from 1.1 to 2.2%, suggests that source rock falls in oil to gas window.

Spingwar Formation can be explored at shallow depths (~1500-2400m) in uplifted areas in the interior of the Kirthar Range. In the Kirthar Foredeep (eastern Balochistan, and western Sindh) the depth of the Spingwar Formation is estimated to be greater than 5000m. This reservoir is likely to be charged by Anjira and other source rocks of Mesozoic age.

Results of 1D basin modeling acquired through Basin Mod 1DTM of a pseudo well at Shutrak anticline suggests that Anjira Formation reached early oil maturation window in Late Cretaceous (Cenomanian 100Ma), middle oil mature in Paleocene (Thanetian 52 Ma) and the main gas window in Eocene (Lutetian- Bartonian 42 Ma) time. Basin modeling results of Jhal- 1 well (Kirthar Foredeep) and Shutrak anticline,(east of Khuzdar) have been included in this paper.

The rugged and mountainous Kirthar Range offers immense challenge to successfully complete the geological and geophysical surveys. Despite these difficulties, geological survey and 2D reflection seismic program can be effectively accomplished if the methodology is optimized to the physiography of the area and the depth of the reservoirs. Operational and interpretational constraints of the G&G and methodology to mitigate interpretation problems are also presented in this paper.