Structural Identification and Hydrocarbon Evaluation Followed by Seismic Attribute Analysis of Balkassar Area, Upper Indus Basin, Pakistan

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Abstract

A study area has been selected for seismic attribute analysis and re-interpretation of the Chorgali and Sakesar Formation in Balkassar area upper Indus basin Pakistan. The Balkassar oil Field is located in the periphery of Southern Potwar platform zone (SPPZ) and structurally appears as an open anticline on the surface. The purpose of this research is to identify hydrocarbon prospective areas through seismic attribute analysis and re-interpretation.

The data for this project include a set of 2D seismic data over Balkassar area in SEGY format, sets of log data. The seismic interpretation of the study area indicates that Balkassar is a gentle anticline bounded by thrusts. Seismic interpretation is confirmed by 2D seismic modeling through correlation of seismic response with velocity contrast between formations. The top of Chorgali formation and Sakesar formation in the study area forms an anticlinal structure trending in a northeast to southwest direction, with slopes in the west and east are bounded by thrusts. From correlative study of seismic lines and contour maps following results are deduced Balkassar is a pop-up structure bounded by thrusts. Fault throw varies along the thrust and greater at north of western fault. This is possibly due to salt diaprism.

Selected seismic attributes were extracted from the near top of Chorgali horizon from 2D seismic data. The seismic attributes generated were instantaneous phase, instantaneous Q factor, trace envelope and instantaneous frequency. From these attributes, the instantaneous phase attribute was interpreted to obtain stratigraphic information and instantaneous Q factor, trace envelope and instantaneous frequency attributes to derive anomalous target area. High instantaneous Q factor in central part of core of the pop-up structure and on western side indicate relatively high porosity. Trace envelope is high and instantaneous frequency is low in the same region. From the generated seismic attributes, the high trace envelope, high instantaneous Q factor and low instantaneous frequency anomaly is indication of hydrocarbon presence in northwestern and central part of thrust-bounded anticline.

Seismic attribute analysis indicates the presence of hydrocarbons in encircled regions. High Instantaneous Q factor in encircled region indicate relatively high porosity. The same region has high trace envelope value, which means a high impedance contrast is present in this region. The region is also a low instantaneous frequency anomaly, which indicates the presence of hydrocarbons in this region. Instantaneous phase enhances continuity of events. Instantaneous phase attribute shows that reflectors are continuous within elevated part of anticline but becomes fairly muddled and incoherent beyond thrusts. I suggest hydrocarbon presence can be detected more efficiently using 3D seismic attributes such as spectral decomposition. In addition detailed fracture analysis can be done using 3D curvature and coherency attribute to map porosity on top of reservoir.