EMPOWERING EXPLORATION STUDIES WITH SEISMIC DATA ANALYSIS TOOLS

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Presented here is a case of comprehensive study of an exploration area performed using petroleum system modelling tools paired with seismic analysis tools such as seismic inversion and spectral decomposition for delineating prospects and planning exploration activities.

The studied area is located in Central Kazakhstan and is over 1600 km2 big. It is a part petroleum region with proven hydrocarbon potential including some oilfields with reserves reaching 2 BBL of STOIIP. Geologically the area corresponds to one of a series of buried grabens formed as result of rifting in Jurassic. The great part of this project was that the most part of the studied area was covered by a 3D seismic data of a decent quality.

Because the paleograben was a self-contained petroleum system and given the lack of data on the petroleum system, particularly the source, this block is a true exploration challenge. Success would depend on the smart integration of all available data which included the 3D seismics and extracting maximum information from it.

The study started from classic stratigraphic and structural interpretation of well and seismic data resulting in structural framework and facies distribution concept. At the same time basin modelling evaluated the tectonic history: modern temperature logs show that the area is "cold", but higher heat flow rates are assumed for the earlier rifting regimes. The thermal evolution was restored based on literature search of analogs and studies of neighboring grabens. Information on source rocks was gathered from different sources, the geological concept suggests syn-rift strata which means a good chance of finding organic matter in number of levels within the graben. The final basin model was created using the final seismic and well data interpretation and the Petrel libraries of rock type properties, paleo-temperatures and kinetic models.

With this understanding of the petroleum system, the "sweet spot" zones were identified within the paleo-graben. As the next step a further in-depth analysis of the 3D seismic data was carried out. Scanning the graben infill strata with the spectral decomposition tool paired with attribute analysis helped to map a paleo-channels system and fan bodies in the upper part of the syn-rift strata. Running pre-stack inversion illuminated fault traps and pinch-out reservoirs with a visible fluid contact anomaly. The leads were evaluated and ranked and exploration wells were proposed followed by commercial discoveries of the fault-trapped reservoirs.

The project is an example of a successful implementation of Petroleum System modelling tools combined with seismic analysis tools such as spectral decomposition, inversion and attributes studies. The PSM helped to understand the migration and accumulation of hydrocarbons in the graben while the latter allowed to "see" in the seismic data, evaluate the leads and rank them for further exploration drilling.