geoconvention
Virtual Event
September 13 - 15
2021

New Exploration Opportunities Revealed with Enhanced Seismic Datasets Offshore and Onshore Argentina and Peru

Karyna Rodriguez and Neil Hodgson
Searcher

Summary

Seismic data has been and continues to be the main tool for hydrocarbon exploration. Enhancing legacy seismic datasets and making them easily accessible with machine learning functionality is proving to be extremely valuable in gaining regional and local understanding of petroleum systems. Seismic data streamed through a web-based platform allows for rapid data access, complex queries, and efficient use of computer power – fundamental criteria for enabling Big Data technologies such as deep learning.

Enhancing Seismic Data

There are 2 main ways of enhancing legacy seismic data. The first is via a “Rectification” process which involves accessing all post-stack data available in a basin, correcting the navigation/location of the seismic lines and merging different surveys by correcting time shifts, matching the phase and balancing the amplitudes. The result is a merged and enhanced dataset which can be used for regional interpretation. This enhanced dataset is then loaded to the cloud where it can be viewed and downloaded to be used with any interpretation software. Rectified datasets generated onshore and offshore Peru and Argentina have provided powerful evaluation tools which have led to the identification of new exploration opportunities.

The second way to enhance seismic data is by reprocessing from field data through a pre-stack migration sequence which includes deghosting (removing source and receiver notches from the frequency spectrum). This is not only an environmentally friendly way of recycling seismic data but has also led to new insights into the basins offshore Argentina and Peru.

Positive Geothermal Gradient Indications Offshore Peru

Peru offshore southern basins are largely unexplored with source rock presence, distribution, quality and maturity remaining as the key risks. There are good source rock indications from drilled wells in the Trujillo and Salaverry Basins, indications of the Carboniferous Ambo Group source rock in the Lima and Pisco strike slip basins and asphalt layers encountered in Lower and Middle Jurassic formations in the Mollendo Basin. However, the strongest evidence of a working hydrocarbon system in these basins, is observed in a reprocessed seismic dataset covering the offshore basins. Improved imaging of Bottom Simulating Reflectors (BSRs) strongly points to the presence of a gas hydrate stability zone. The thickness of gas hydrate zones mainly depends on sea floor temperature, pressure (directly related to depth) and existing geothermal gradient. Where BSR thickness, seafloor temperature and pressure are known, geothermal gradient can be calculated. The BSR- derived geothermal gradient was calculated and extrapolated throughout the basin which resulted in a better understanding of source rock presence, maturity, distribution and possible migration pathways.

Syn-rift Source Rock in the Malvinas Basin

The largely underexplored West Malvinas Basin lies just to the east of the Austral Basin in southern Argentina, where up to 2 billion barrels of oil equivalent have been discovered to date. Source rock presence and quality is still considered to be one of the key risks in the Malvinas basin. Reprocessed 2D seismic data was integrated with conditioned well logs in a full petroleum systems evaluation, where seismic observations, from reprocessed seismic data, strongly point to syn-rift lacustrine shales in the Jurassic Tobifera Formation (Figure 1). Understanding the lateral distribution of lacustrine shales is key to unlocking the charge story. Data quality of reprocessed 2D seismic data allowed a detailed interpretation below the Base Cretaceous unconformity, enabling interpretation of the Jurassic source rock section. Shallow gas indicators in the Malvinas Basin provide proof of a working petroleum system. Their distribution was mapped within the basin using both traditional methods and a Machine Learning process. Indications of greater density of shallow anomalies can be attributed to a potential Jurassic syn-rift charge origin.

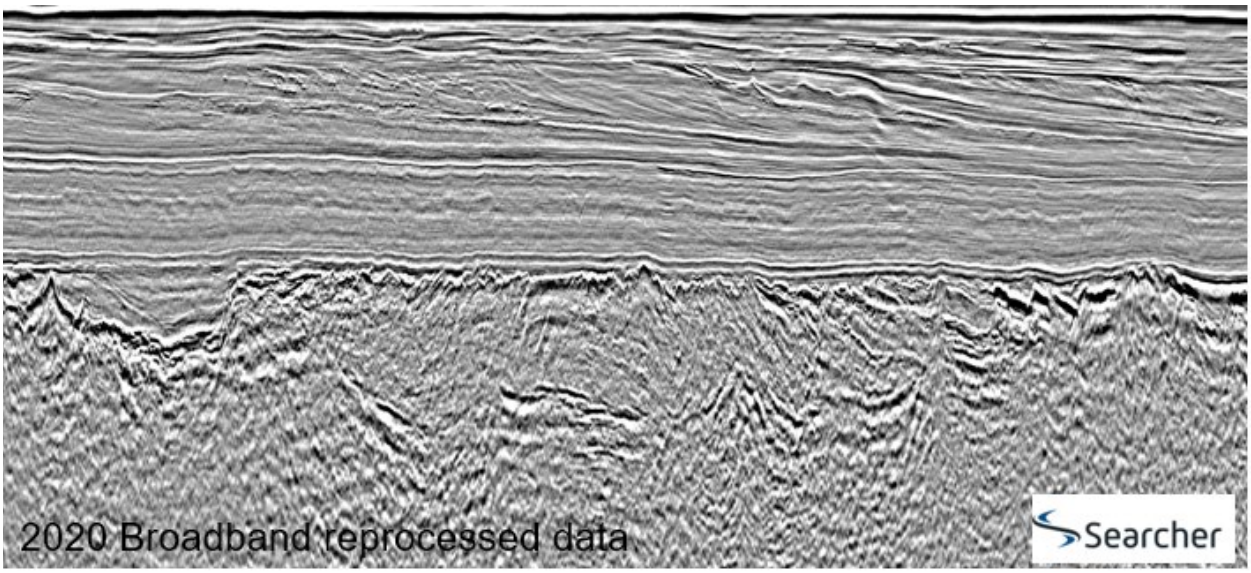

Figure 1: Reprocessed seismic data from the Malvinas Basin showing a clear syn-rift section with inferred source rock presence revealing a potential petroleum system

Conclusions

Offshore Peru has proven hydrocarbon systems and ample evidence of significant untapped hydrocarbon potential. The enhanced seismic datasets provide a consistent regional dataset that hands a gift in understanding to the explorer beginning to unlock this potential. In the Malvinas Basin reprocessed seismic data provides greater confidence on the presence of a potential dual source working petroleum system, addressing one of the key risks in the Malvinas Basin and increasing the chance of success in future exploration activities.