Abstract

A viable prospect with a good potential for hydrocarbon reserves requires four amalgamated components. Hydrocarbon source and the presence of reservoir that receives, contains and delivers the hydrocarbon to the wellhead. Top seal that is indispensable to keep the hydrocarbon trapped in the reservoir. Last, but not least, is the drillable feasibility of the prospect. The absence of any of the aforementioned criteria can lead to the abandonment of the whole prospect. However, the common known cause of reservoir breaching is seal failure. Some of the seal integrity symptom and prognosis can be foreseen during the prospect generation phase and ahead of spudding the well location. They can be categorized as follows:

Symptom:

- Subsurface structural failure such as faults
- Shallow faults that reach the mud line in deep water
- Intrusive salt-sediment interface
- Active diapiric Salt that impact the mud line topography
- Prospect closes against a salt weld
- Rocking basin

Diagnosis:

- The presence or lack of seismic velocity reversal vs. depth (top seal)
- High sand – shale ratio at the objective and lack of High Stand sequence
- Narrow drilling tolerance window (DTW) where the pore and fracture pressure are in proximity.
- The presence of large hydrocarbon column. It is a double-edged sword.
This article shows case histories where stratigraphy, structural setting, reservoir quality, hydrocarbon source, and seismic attributes support a viable prospect prior drilling. However, post drilling, these wells were deemed dry holes. A brief diagnostic assessment follows each case based on the above-mentioned causes of seal failure will be discussed. These issues need to be examined methodically during the process of generating a prospect. Geopressure coupled with sequence stratigraphy and basin modeling can help establish a winning endeavor.
The presence of large hydrocarbon column. It is a double edged sword. The presence or lack of seismic velocity reversal vs. depth (top seal) may indicate a prospect. Without seismic velocity reversal, a prospect may not exist, but the presence of seismic velocity reversal can confirm the presence of a prospect. The different process of salt emplacement greatly impact the prospect risk.

One of the rocking mini basins in the GOM. Notice the shift of the depositional axis (yellow arrows) during the Plio-Pleistocene time. The mud line topography is impacted by the shallow surface faults (A) and shallow salt.

The thick hydrocarbon column led to a considerable reduction of the Drilling Tolerance Window (DTW).

A seismic line shows sea floor mound on top of active salt diapir with two dry holes (left) and a discovery well (black GC). Prophet or DTW is closing against each other. It is seen as a pressure window (A). The high risk target is located on the top of deep eroded salt dome with possible partially four way closure.

A correlation between a dry hole (left) and a producer (right) on the same line. The dry hole does not show proof of hydrocarbon presence (left) while the other, Varnai producer (right) is seal at zone A, where residually and velicity reversed the exponential trend.