

Well-hidden but well alive, a comprehensive review of offshore satellite oil seep repeats inside Orphan Basin.

Clément Blaizot

Satellite Oil Seeps Consultant

Summary

In the aftermath of the disappointment of highly anticipated nearby Ephesus well, we propose to provide a complete satellite offshore seeps review inside Orphan Basin, Labrador and Newfoundland. In order to maintain the momentum in the area, we want to underline the high seep potential deeper to the east until Orphan Knoll and to the south until Flemish Cap as we are stubborn it's far from game-over in the region.

A prolific neighborhood regarding O&G discoveries... and a set of evidence inside Orphan Basin

There couldn't be such an appropriate name such as "Orphan" for a basin apparently so reluctant and infertile to fill-in the barrels, above all when considering the striking contrast with its nearby prolific adjacent basins (Figure 1): Jeanne d'Arc directly to the south and Flemish Pass to the southeast.

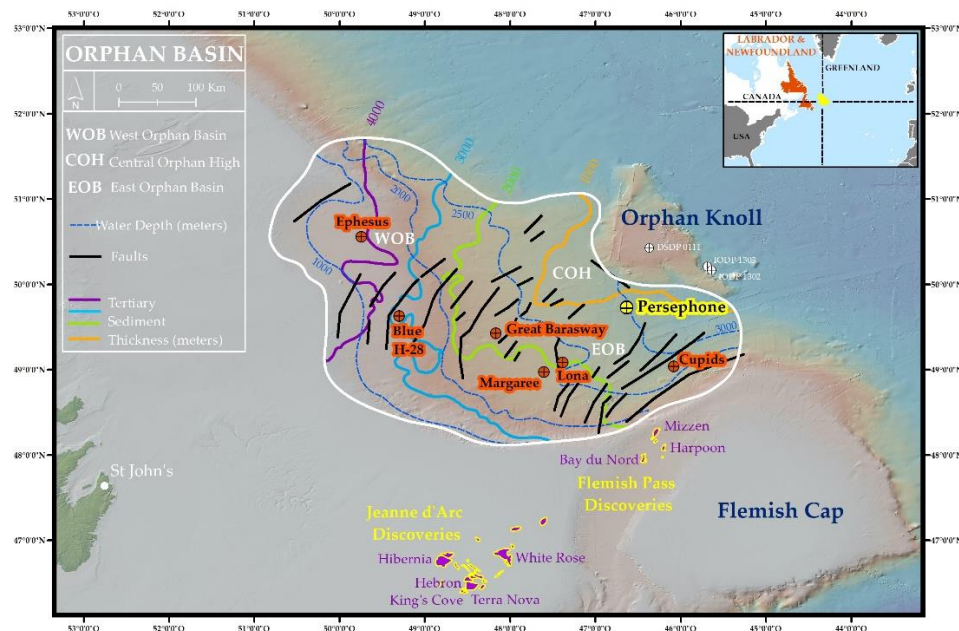


Figure 1: Study area, discoveries, wells, structural elements and tertiary sediments thickness contours.

Orphan's discoveries drought certainly did not prevent from establishing several times the presence of source rocks over the years through the drilling of some very informative key wells

such as in 2006 at Great Barasway (thick Jurassic section containing Tithonian and Kimmeridgian source rock) and later at Lona, Margaree and Cupids wells, all unsuccessful, but some encountering source rock and/or unveiling oil traces according to Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB).

Geological background of Orphan Basin

Geologically, the large Orphan Basin can be considered as an aborted tentative of an ocean opening through the Jurassic times, within the northern part of the Pangea supercontinent. Alike all Jurassic rifted domains associated with crustal thinning, it encompasses a great variety of thickness and facies. Structurally, the largely extended Caledonian -Appalachian thrusts running SW-NE will be reused as low angle detachment faults mainly sliding to the NW. Their association with antithetic counter faults dipping to the SE will create several tilted blocks (Cawood et al, 2021) which will separate several intervening Jurassic grabens. Within these sub-basins, total thickness of the Jurassic strata can reach 5 kms whereas basement tilted block can be devoid of any Jurassic deposits being only transgressed in Upper-Cretaceous times. Therefore, in this kind of fragmented tectonic context, a detailed seismic mapping is clearly needed to pursue a correct exploration as the excellent oil and gas Jurassic source-rocks proven everywhere in the northern Atlantic rifts will be only present in the subbasin and that conversely the major structural prospects will be in the tilted blocks.

Last and not least, the thickness of the overburden (Cretaceous to Tertiary) is also a key data to map the location of the oil and gas windows in space and time. As far as Tertiary thickness is considered (Enachescu, 2006), the Upper Jurassic source rocks within the West Orphan Basin could be in the gas window, in the oil window in the East Orphan Basin whereas in Orphan Knoll and Flemish Cap areas they could be rather immature. Convincing eastern repetitive oil seeps should then advocate on the possible long range hydrocarbon migrations from the west or on the existence of older and deeper source-rocks in pre-Tithonian strata, at the initial stage of the graben opening.

Satellite Oil Seep Detection Method

The following SAR (Synthetic Aperture Radar) satellite oil seep screening aims at highlighting seep anomalies and differs from the traditional approach: we chase recurrence of seeps over time in the quite same place. To achieve this, we analyze many different satellite dates. It provides a global coverage of at least 60 different SAR dates per every each X/Y of study area. To sum up, our detection relies on four main principles:

- a) Large datasets enabling high coverage of Satellite data to statistically assess the true potential of a given area,
- b) Spatial Proximity and Time Recurrence,
- c) Man-made manual discrimination between natural oil seeps, pollution (spills) and “lookalikes” (atmospheric, bathymetric, oceanic artefacts or algal blooms),

- d) Quality of immediate context of seeps (the *neighborhood*) rather than properties of the seepage itself.

We selected 5 deepwater main seep anomalies from 2000m to 3500m WD within Central Orphan High (COH) and East Orphan Basin (EOB). By “seep anomaly”, we mean a concentration of seepages found in the same place at several different dates. All in all, more than 200 single oil seeps of fair to considerable confidence are found inside the study zone.

Conclusions

The repetitive oil seep anomalies, shaping “flower-shape structures” featuring good seepages morphologies unveiled within the central and little explored eastern part of Orphan Basin up until Orphan Knoll certainly can help confirming the great and untapped potential of Orphan basin and may also trigger high expectations on ExxonMobil’s Persephone prospect.

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References

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