Play-Based Yet-to-Find Resource Assessment of the West Greenland Continental Shelf

Introduction

A play-based resource assessment of conventional hydrocarbons has been performed for the West Greenland continental shelf. The shelf is divided into three assessment units (AUs), each outlining a larger geological province. They are AU1: Davis Strait – Labrador Sea; AU2: Baffin Bay, and AU3: Nuussuaq Basin and Disko West. The evaluation is undertaken as part of the “Whole-of-Greenland Petroleum Resource Assessment Project” (Figure 1) providing an estimate of a quantitative, play-based Yet-to-Find potential of conventional hydrocarbons on the entire Greenland continental shelf. The project is carried out in order to facilitate business decisions and guide the industry towards the most prospective areas, as well as helping the Greenland authorities and politicians in strategic decision-making and in planning for future licensing rounds.

The West Greenland shelf constitutes one of the last huge frontier areas of the World covering more than 800,000 km² from the Labrador Sea in the south to Baffin Bay in the north, with only 15 exploration wells drilled. A large database is available, including more than 200,000 line km of 2D seismic data, six 3D seismic surveys covering more than 11,000 km², potential field data, well data from stratigraphic wells and 15 exploration wells as well as extensive outcrop studies of the onshore Nuussuaq Basin (cf. Dam et al., 2009).

West Greenland Geology

The tectonic evolution of the West Greenland Continental Margin is complex involving multiple phases of Cretaceous – Early Paleocene rifting, Paleocene-Eocene volcanism and the opening of the Labrador Sea and Baffin Bay, tranpressional movements, counter-clockwise rotation of Greenland causing Late Paleocene – Early Eocene compression, transtension and inversion followed by Neogene uplift of the margins (e.g. Gregersen et al. (2019) and references therein). Six tectono-stratigraphic phases are recognised, including pre-rift, early rift, subsidence, late rift, drift and post-drift (Figure 2).
Figure 2. Tectono-stratigraphic summary of the basins on the West Greenland margin from the Labrador Sea to the Baffin Bay. The columns include formations and units with gross lithology. Thick vertical lines show West Greenland wells. Basement rocks occurring at or near below TD of wells are marked with a red star. The columns to the right show the seismic stratigraphy, tectonostratigraphic phases and plays (based on Gregersen et al., 2019).
Eight plays have been defined and evaluated. Source rock intervals include Ordovician, Albian, Cenomanian-Turonian, Campanian, Paleocene-Eocene and Miocene. Reservoir rocks are present virtually at all stratigraphic levels. High-quality regional seals are well documented (Figure 2).

Resource Assessment

The assessment workflow includes four steps; 1) basin evaluation, 2) play analysis, 3) lead evaluation, and 4) Yet-to-Find estimation (Figure 3). The basin analysis is the basic activity describing the structural and stratigraphic framework leading into construction of palaeogeographic maps and identification of source rocks, reservoirs and regional seals that form the basis for definition of the plays. Regional 3D basin modelling has been carried out to assess source rock maturity. The geologic probabilities were determined based on play mapping in ArcGIS constructing numeric CRS maps and CCRS maps.

Volume estimates for 152 structural leads (features) mapped by the industry, GEUS and NUNAOIL have been integrated into the play analysis and the identified prospectivity has been calculated (Figure 4). 126 concepts and stratigraphic leads remain un-evaluated. The Yet-to-Find analysis is based on a feature (lead) density calculation approach for each of the identified play intervals calibrated with data from the most extensively explored previous licence areas (analogue areas). Based on these analogue areas the unidentified prospectivity has been calculated for the under-explored areas. Having calculated both identified and unidentified prospectivity, the roll-up of all play intervals provides the Total Mean Case Risked Recoverable MMBOE. A final portfolio analysis shows which areas of the West Greenland continental shelf are the more prospective for possible future exploration.

For AU1 the risked Total Mean recoverable is 5,500 MMBOE. For AU2 the risked Total Mean recoverable 9,100 MMBOE and for AU3 the risked Total Mean recoverable is 2,800 MMBOE.

Figure 3. Workflow for the “Whole-of-Greenland Petroleum Resource Assessment Project”.
The assessment presented is based on all available data collected and interpreted by the industry, GEUS and NUNAOIL, and reflects the state of geologic knowledge of the West Greenland continental shelf at the time of the assessment and is available as a free-of-charge service for exploration companies. For further information please visit www.greenland-resource-assessment.gl.

The assessment was carried out using the Player® GIS software provided by GIS-pax. The methodology and results of the assessment has been quality controlled by the Norwegian Petroleum Directorate and GIS-pax.

References
