

Basin Modeling and Petroleum System Analysis in the Easternmost Hammerfest Basin – Barents Sea

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ABSTRACT

Petroleum exploration discovery in the easternmost Hammerfest Basin is contrary to the western part. The last decade exploration only found some minor discoveries and several dry holes. Hence, this 3D basin and petroleum system modelling study has been performed to get better understanding about the basin history and lack of petroleum discovery in the study area. Five exploration wellbore together with one 3D seismic data and eighteen 2D seismic data are the primary data for this study. The easternmost part of the Hammerfest Basin is a larger rift basin that underwent extensional tectonics. The area is a normal-hyperthermal basin with a geothermal gradient of 33oCkm-1. The basin has undergone some tectonic activities such as rapid subsidence and uplift-erosion (Oligocene-Miocene and Plio-Pleistocene) as result of exhumation and glaciation processes. Two petroleum systems have been identified in the study area with the main source rocks found in the hydrocarbon generation window for both Upper Permian Ørret Fm (peak expulsion phase) and the Middle Triassic Kobbe Fm (early expulsion phase); with vertical migration drainage style, low-impedance entrapment style, and normally charged. These source rocks are getting more mature towards the central sag-part in the basin with the main kitchen area located around the closure of 7124/3-1 wellbore (overpressure found at the depth of approximately >2200 m). Other potential source rocks such as Snadd Fm and Fuglen-Hekkingen Fm are marginally mature and immature, respectively. Both reservoir (Tubåen and Stø Fm) and seal rocks (Fuglen and Hekkingen Fm) are widely developed with good quality. The hydrocarbon trap geometry is faulted and 4-way dip closures, formed as half graben geometry during the syn-rift period (Late Jurassic-Early Cretaceous). In addition, no hydrocarbon expulsion is found in the well 7124/4-1 (western side of study area). This is assumed as the main cause of the dry holes or no hydrocarbon accumulation in the well 7124/4-1 and surrounding area. Based on the petroleum system analysis, large lateral distance of secondary migration is not likely in the study area since there is no sufficient amounts of expelled hydrocarbons (normal charge). Besides, uplift and erosion affected the petroleum systems especially in terms of hydrocarbon generation, preservation and accumulation.