A Novel EM Driven Approach to Frontier Exploration in the Barents Sea*

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General Statement

The Barents Sea is a vast offshore area in northern Norway spanning from the Russian border to the deep ocean margin. It comprises a wide range of geologic settings, from Tertiary plays in the west, to Triassic in the northeast, and to Paleozoic in the southeast. Large parts of the area in the west and northeast (Figure 1) are still virtually unexplored.

Exploration started in the early 80's and led to several promising discoveries, including Snohvit (Norway), discovered in 1984 and Stokman (Russia) discovered in 1988. However, after these discoveries, there was a row of disappointing wells, dry or with shows until there was a total stop in exploration drilling from 1994 until 2000, when the Goliat Discovery was made. Again this led to new optimism in the area, but until 2011, this was the last commercial discovery. From the wells drilled prior to 2011, a number of lessons have been learned:

- There is a working hydrocarbon system in the area.
- Late uplift and erosion change the pressure regime, affecting reservoir and seal properties.
- There is a challenge to find proper reservoir quality and trap volume to hold commercial amounts of hydrocarbons.
- Seismic as standalone tool has proven inefficient in detecting these volumes.

CSEM Data and Exploratory Results

Since 2003, EMGS has acquired a large amount of controlled-source electromagnetic (CSEM) data, covering all the different geologic provinces. In 2008 and 2010, two extensive multi-client programs were carried out prior to the 20th and 21st license rounds on the NCS, covering a total of 16 000 km^2 (Figure 1).

In 2011, two new major discoveries were made in 20th round licenses, both properly imaged by EM. Other EM surveys on earlier discoveries also demonstrate that the major hydrocarbon accumulations, such as Snohvit and Goliat, are seen on EM data, while minor, non-commercial discoveries do not exhibit any significant EM responses. This proves that CSEM data can provide a valuable addition to the exploration

database, since EM is sensitive to saturation and volume, and therefore can indicate where the economic accumulations are. A substantial number of interesting observations are yet to be investigated in order to increase the understanding of EM measurements in the area (Figures 2 and 3).

Earlier this year, an agreement with Russia concerning the so-called 'Grey Zone' (Figure 1) has opened a totally new area for exploration; among experts this is regarded as very promising. Regarding the lack of success in the exploration history of the Barents Sea, we believe that new information and ideas are essential in order to improve the chance of success in the region. In our opinion, the use of EM data can increase the success ratio significantly in future exploration in the Barents Sea.

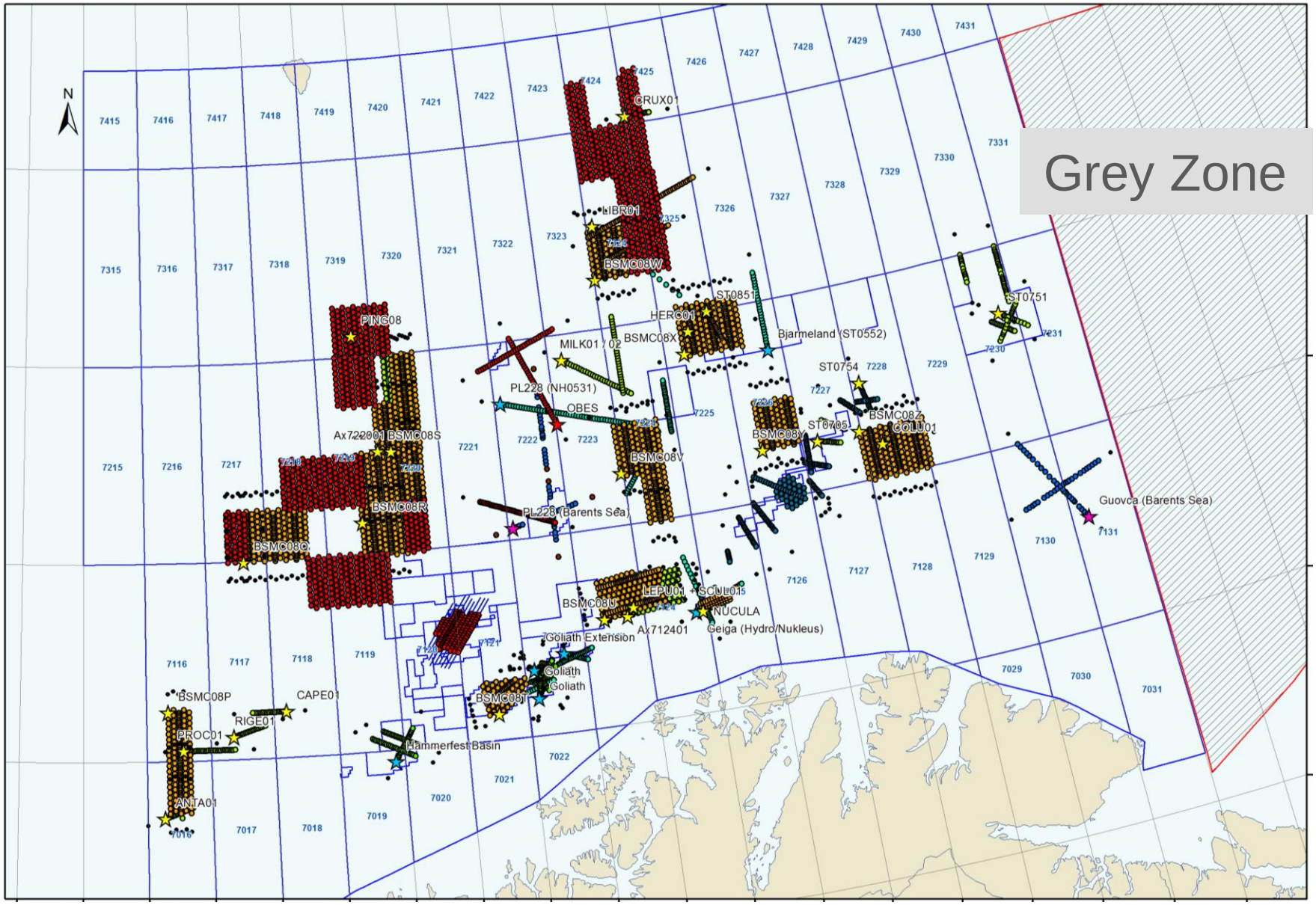

Figure 1: EM coverage in the Barents Sea. Areal coverage of Multi-client data is shown in yellow (2008) and red (2010). Location of the disputed area ('Grey Zone') is indicated.

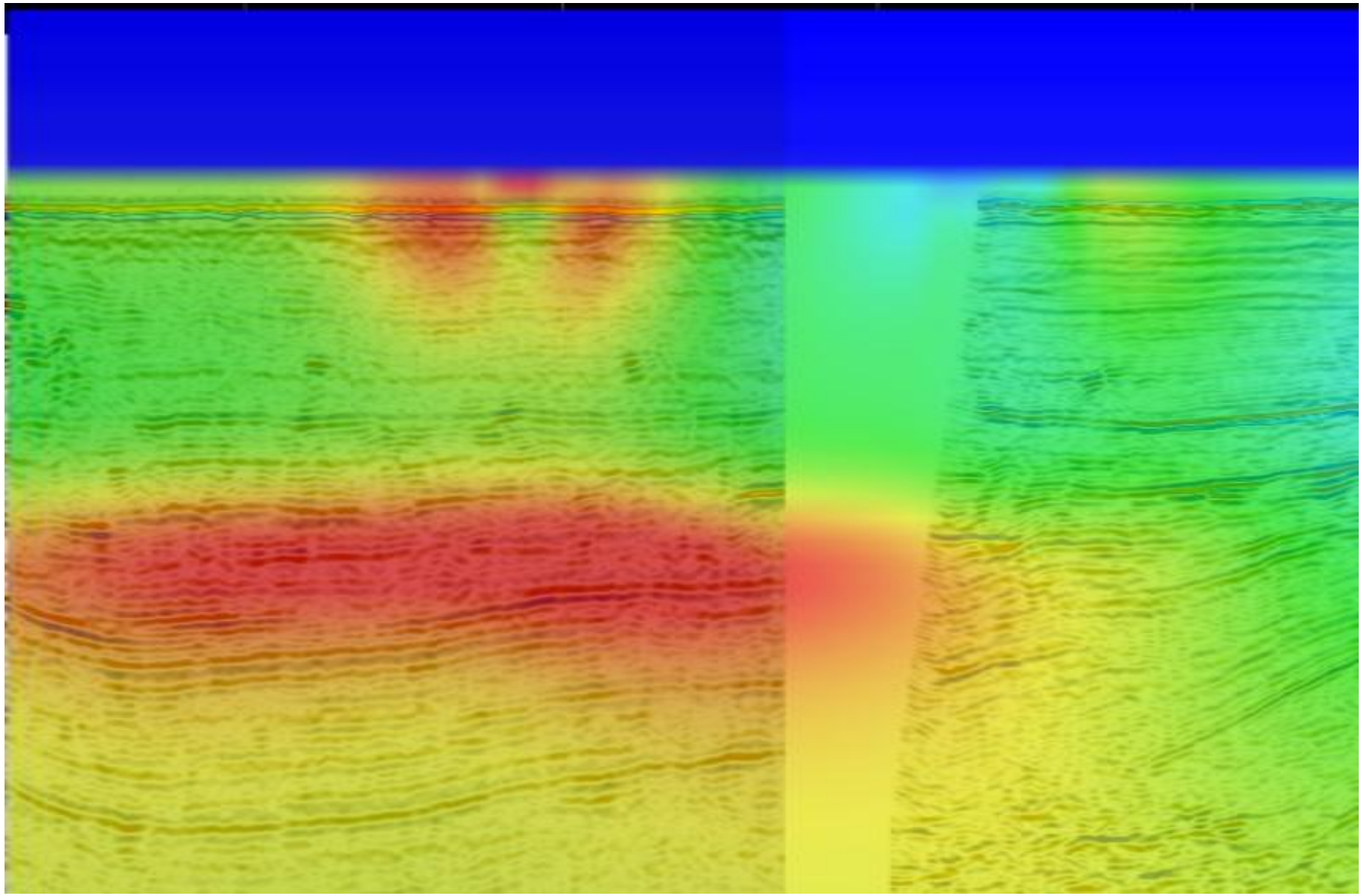

Figure 2: Anomaly in the Tertiary/Upper Cretaceous, Western Barents Sea.

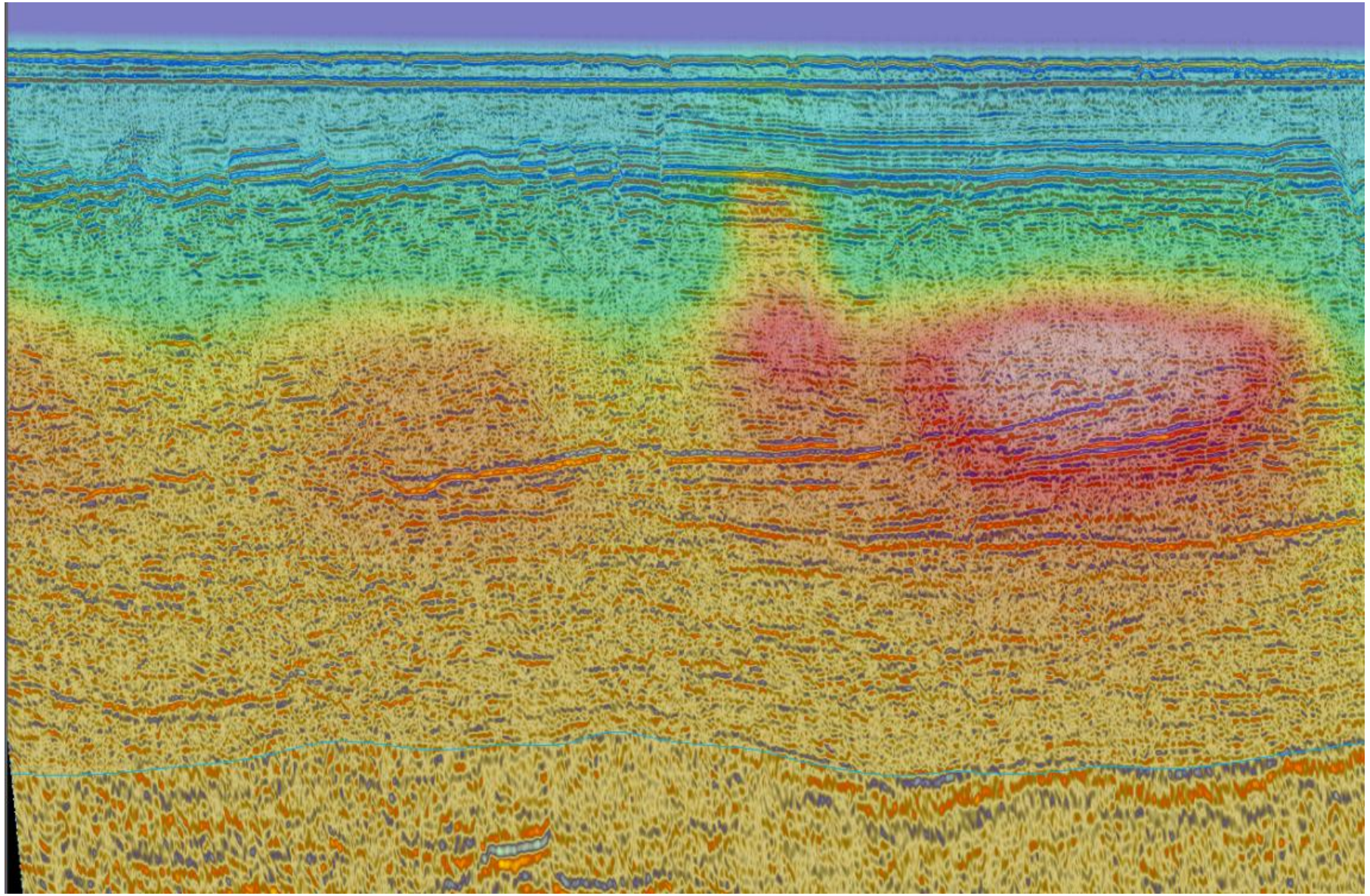

Figure 3: Anomaly in the Triassic; northeast Norwegian Barents Sea .