Mapping Geothermal Heat Flow in the Barents Sea

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Abstract: Since the 1970s, petroleum activities on the Norwegian Continental Shelf (NCS) have significantly contributed to CO2 emissions. With growing concerns on environmental sustainability and the need to reduce greenhouse gases, harnessing geothermal energy has emerged as a promising solution by providing a sustainable power source for platform. This study evaluates the reliability of geothermal parameters —subsurface temperature, rock thermal conductivity, and heat flow— in the Barents Sea, to access the possibility for geothermal energy development. The described methodology is equally applicable to geothermal exploration in offshore and onshore settings.

We use a comprehensive dataset comprising multiple temperature measurements from 23 wells and single bottom hole temperature readings from 48 wells. In addition, well logs, completion reports, and other relevant data are incorporated (all data from Diskos database). Bulk thermal conductivity was calculated by interpreting various lithologies based on well logs response and applying lithology-specific equations (Fuchs et al., 2015). Temperature corrections were applied using the Central Danish Basin and Horner correction techniques (Waples et al., 2004; ZetaWare, 2002), with the most reliable method selected based on its correlation with bulk thermal conductivity. For wells with multiple temperature measurements, heat flow was calculated, while in wells with a single temperature reading, we used the average heat flow derived from the multiple measurement wells.

The reliability of the corrected temperatures is strongly influenced by the time since the end of mud circulation (TSC), with longer TSC yielding more accurate temperatures. Thermal conductivity values varied by lithology, with higher mean values recorded for carbonates (5.2 W/m·K), followed by sandstones (3.2 W/ m·K), and shales (2.5 W/m·K). The estimated average heat flow is 71 mW/m², which matches the published average of 72 mW/m² for the Barents Sea (Pascal, 2015).

The heat flow exhibits a distinct pattern, with higher values in the northern part of the Barents Sea, and gradually decreasing towards the south. This can be explained by oceanic-continental crust heat transfer, as well as crustal thinning, uplift and erosion (Pascal, 2015).

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