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DOES ROUGHLY 40% OF THE TROLL GAS HAVE AN EARLY MATURE COAL ORIGIN?

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In this study coals and adjacent sandstones were sampled from cores retrieved from depths between 3.4 and 5km on the Norwegian Shelf. The optical maturity of the coals varied between 0.53 and 1.12% Ro with most values in the 0.8 – 1.0% range. Gas was liberated from the coals by crushing and from fluid inclusions in the sandstone by sling mill. The fluid inclusion gas was very dry while the coal gas was wet probably reflecting preferential leakage of the smallest molecules from the coal during retrieval and storage of the cores.

Equally isotopically light methane (C_1) was released from the coals and from the adjacent fluid inclusions in sandstones (-60.9 to -72.7Y). This suggests that the coals are the source of the gas and that no isotope fractionation takes place during gas expulsion from the coals. The very light isotope values would normally be ascribed biogenic activity. However, recent data opens for an early thermogenic origin (Schoell *et al*., 2005).

Galimov (1988) reports isotopically light C_1 (-60.3 to -47.0Y) from all the Cenomanian supergiant gasfields of northern West Siberia. These gasfields makes up more than 30% of the World's proven gas reserves and are currently at depths of ~1000 – 1200m. The source rocks consist of coaly humic material, which is believed to have formed the isotopically light C_1 through low temperature thermogenic processes (Stroganov, 1973; Monnier *et al*., 1983; Galimov, 1988). It is suggested that some varieties of coal on the Norwegian Offshore Continental Shelf (NOCS) may have the same petroleum potential as those described from Russia based on the light C_1 isotopes recorded in our study. If correct this has obvious and significant implications for future exploration on the NOCS.

Figure 1 clearly shows our C_1 isotope values to be outliers as compared to the majority of gas isotope values from the NOCS. It is interesting to observe that the Frigg and Troll gas and the associated Draugen gas also plot with isotopically lighter C_1 values than the isotope database and are skewed towards the light isotope values from our study. We speculate that these gases represent mixtures of gases with isotope values on par with those seen from the isotope database and early thermogenic isotopically light coal gas. We calculated tentatively the mixing ratio for the Troll gas according to the following formula; $^{13}C_1$ of Troll = X% early thermogenic $^{13}C_1$ + [100 - X]% normal thermogenic $^{13}C_1$. The percentage early thermogenic

gas (X) that would have to mix with normal thermogenic generated gas following the "Kerogen Type II" trendline (Fig. 1) is 30%, with the "Åre coal" trendline 35% and with the "Spekk shale" trendline 43% following the relationship above.

The total recoverable dry gas reserves on Troll are $1250x10^9Sm^3$ (44.6 Tcf) (Horstad and Larter, 1997). If ~40% of this is generated through early thermogenic processes this amount to $\sim500x10^9Sm^3$ dry gas, which indeed is significant.

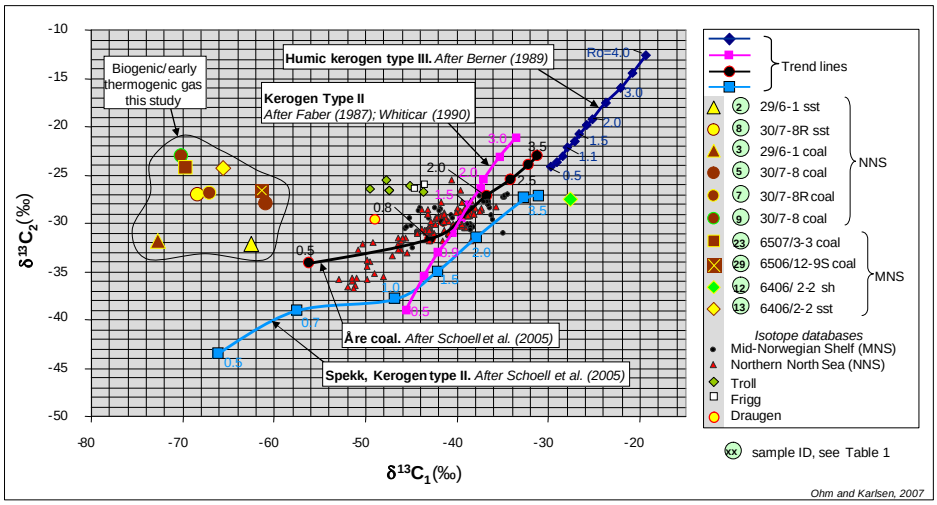

Figure 1. Methane, ethane isotope plot showing empirical and experimental isotope relationships of gases expelled from various source rock types with increasing maturities. The gas isotopes of our study is outlined and it is clear that the Draugen, Frigg and Troll gases plot between our data and those representing normal gas mature source rocks (isotope database and trendlines).

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