

## Isotopically Light Methane Expelled from Thermogenic Mature Coal! What Is Going on?

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Gas composition and isotope values of gas liberated from coals on the Norwegian Continental Shelf (NOCS) by simple crushing have been analyzed and compared to those from fluid inclusion gases. The fluid inclusions were extracted from sandstones in contact with the coals. The coal gas was found to be isotopically similar to that liberated from inclusions. The methane is very light with  $\delta^{13}\text{C}$  values in the range of -58 to -72‰ and isotopically very different from most of the gas discovered on the NOCS in which methane values generally fall in the range of -42 to -45‰. Most of the coal samples have a vitrinite reflectivity of 0.8 to 1% Ro. The inclusion samples contain dominantly methane (70 to 90%) while the coal gas is much wetter.

The study shows that the examined coals have expelled biogenic gas: 1) over a temperature window where quartz overgrowth formation takes place (80-120degC), 2) in sufficient amounts to become trapped in inclusions and 3) over a sufficient time interval to become trapped. This suggests that volumes of biogenic produced methane have been expelled from the investigated coals at a surprisingly high temperature (depth of burial ~4000m) and that this light methane besides being trapped in inclusions also can migrate – potentially into commercial traps and mix with thermogenic high maturity gas – which is isotopically heavy and thereby skew the overall gas isotope values towards lighter values (values in the -45 to -55‰ range). No isotope fractionation during expulsion is observed.