GEOLOGICAL CONTROLS OF METHANE SEEPS IN THE KATTEGAT AREA BETWEEN DENMARK AND SWEDEN

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The presumptions of the methane seeps in the northern Kattegat area were examined as part of the METROL EU project on methane contribution from the marine environment. Previous estimates on total gas escape from the whole of the Kattegat area were based on detailed measurements around sub-tidal seeps. These measurements were, however, carried out mainly to understand the near surface processes involved, biological as well as chemical and paid only little attention to the role of geology controlling the location of the seeps.

It appears that gas seeps mainly occur in areas where glacigene marine deposits are found at shallow sub-bottom depth, as has been shown by a number of shallow acoustic surveys. Furthermore, migration of gas preferably occurs where Eemian - Early Weichselian marine deposits were affected by glaciers to great depths during the expansion of the Scandinavian ice sheet prior to Late Glacial Maximum 20 ka. Knowledge of the deformation processes of older marine sediments by glaciotectonics could be obtained from previous on-shore drillings (up to 200 m deep) as well as from coastal cliffs exposures. Numerous wells were drilled in coastal areas of northern Denmark during the 1930'ties and 1940'ties in order to exploit the shallow gas occurrences existing in that part of the country.

Thus, it may be concluded that gas charged fine-grained deposits in the Kattegat and Skagerrak area were pushed to shallower localities by Scandinavian glaciers during the last - Weichselian - ice age. In near coastal areas these deposits are now covered by sand that allow the gas to escape to the sea-floor before it is consumed by methanothrops. Carbonate crusts associated with the gas seeps, show that part of the methane has been oxidized, as crusts were depleted with respect to the carbon-13 isotope compared to normal marine carbonates. Subsequent erosion, partly due to

isostatic rebound after glaciation, has exposed spectacular submarine "landscapes" like the bubbling reefs.
Radiocabon dating of methane from different seep areas confirm that the gas is more than 40,000 years old old (limit of the radiocarbon method). By contrast, shallow gas in muddy sediments outside the seepage areas was found to be less than 3000 years old.