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EVALUATION OF FLUID CONTINUITY AND RESERVOIR QUALITY BY MUD GAS ISOTOPE MAPPING - A CASE STUDY FROM THE GRANE FIELD, OFFSHORE NORWAY

Linda SCHULZ, Elin REIN, Vibeke HATLØ and Marian VÅGE

Norsk Hydro, Oil and Energy Research Centre, Sandsliveien 90 , N-5020 Bergen

Stable isotope measurements on mud gases have in recent years been successfully used to characterize hydrocarbon type, evaluate fluid continuity, map oil-filling histories and detect reservoir compartmentalisation (e.g. Wilhelms et al. 2001, Ellis et al., 2003, Weissenburger and Borbas, 2004, Rein and Schulz, 2007). Here we present a case study from the Grane field, offshore Norway. The Grane field is situated 185 km west of Stavanger and was set in to production in September 2003. The results from the geochemical analyses performed on samples from the exploration wells have shown that the Grane oil has been extensively biodegraded and thereafter mixed with "fresh" oil that is currently slightly affected by recent biodegradation. The present day reservoir temperature is around 70°C, which suggests that biodegradation may still be an ongoing process in the reservoir (Wilhelms et al., 2000).

Our study includes 540 mud gas samples from 18 horizontal well traces. The wells are oil producers and cover the central, western, northern and southern part of the field (Figure 1). The samples were analysed for $\delta^{13}C$ isotopes on methane, ethane and propane using a GC-IR-MS instrument, with the objectives of detecting barriers to fluid flow and variation in the degree of thermal maturity and biodegradation in the reservoir.

The dissolved gas in the Grane reservoir is characterized by light methane isotope values (from –50 to –56 ‰) and heavy propane isotope values (-17 to –25 ‰). The isotopic signature of both methane and propane vary across the field and along many of the horizontal well traces. The isotope variations seen imply that the degree of thermal maturity and/or bacterial carbon isotope fractionation is not consistent within the reservoir. The results have given information on fluid migration in the Grane area, and have also made it possible to detect diffusion barriers, and thereby possible fluid flow barriers in the reservoir. Zones that may have poorer than average reservoir quality, have been identified. Altogether this information is valuable to get an optimal reservoir management.

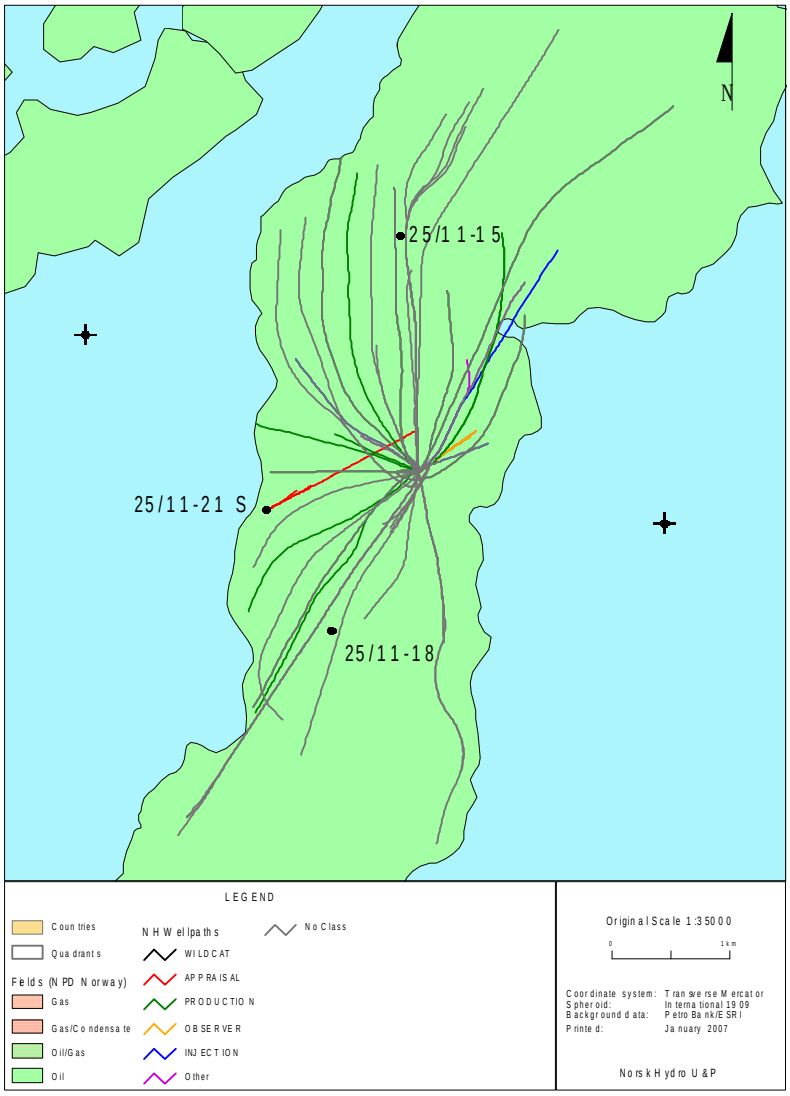

Figure 1. Map of the Grane oil field showing the drilled well paths. Annotated wells are vertical exploration wells.

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