FROM GAS GEOCHEMISTRY TO GAS GEOLOGY

Martin SCHOELL and Yongchun TANG

Since the seminal work of Colombo et al. 1964 gas geochemistry was for almost 40 years an empirical science which was limited to grouping gases, defining basic processes of gas formation (bacterial vs. thermogenic) and empirically assessing maturity of thermogenic gases. Since about 10 years a new approach of pyrolysis-based calibration of isotope models of gas formation based on closed and open pyrolysis allows a more quantitative assessment of issues of gas formation in petroleum systems, such as positive gas-source correlation, timing of gas formation and estimating the gas potential, which, so far, could not be addressed with empiric gas isotope geochemical techniques.

Systematic analyses of various source rocks with sealed-gold tube pyrolysis revealed that each source rock generates isotopically characteristic gases during the course of maturation. This **source specificity** of gas isotopes allows the positive identification of source rocks from the comparison of produced gas isotope data with the laboratory calibration. This approach allowed the identification the Åre coal as a significant source of gas in the Haltenbanken area. In addition experiments and gas isotope modeling of gases from secondary cracking of oils allows their differentiation from primary cracking gases.

One of the key questions in gas geology is assessing gas formation processes and their timing. Data from the Njord Field in the Haltenbanken area (Fig.1) offer new insights that

- gases are derived from different sources (i.e. primary cracking of Åre kerogen and secondary cracking of oil and
- gases migrate at different times into the same reservoir

The Njord Field has different compartments and we find “old” gases (35my) derived from primary cracking of coal and “young” oil cracking gases that invaded one reservoir compartment only ~10My ago, providing evidence 1) for the concept of episodic migration of gases into gas and oil fields and 2) that compartmentalization of gas and oil fields is related to the filling processes from the source areas.

For this quantitative approach it becomes important that geologic data, in particular basin modeling data, are integrated with the geochemical models. The most critical input into the new isotope models is the heating rate of the source as it determines the timing of gas formation.

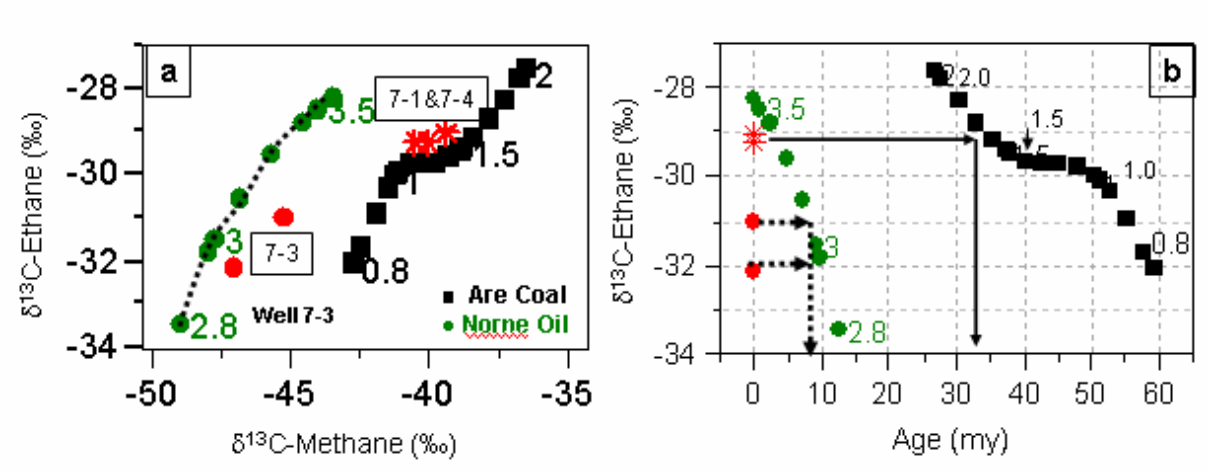

Figure 1.
(a) Methane and ethane carbon isotope data for sealed gold tube pyrolysis calibrations of primary cracking gas from Åre coal as well as gas from secondary cracking of an oil from the Norne Field. Increase of maturation is indicated by % Easy Ro values next to the stippled trajectories. Superimposed are gas data from the Njord Field from Wells 7-1, 7-4 and 7-3.
(b) Ethane isotopes related to age of gas formation for primary cracking of Are coal and secondary cracking of a Norne oil. Ages are based on the assumption of a heating rate of 1C/My.

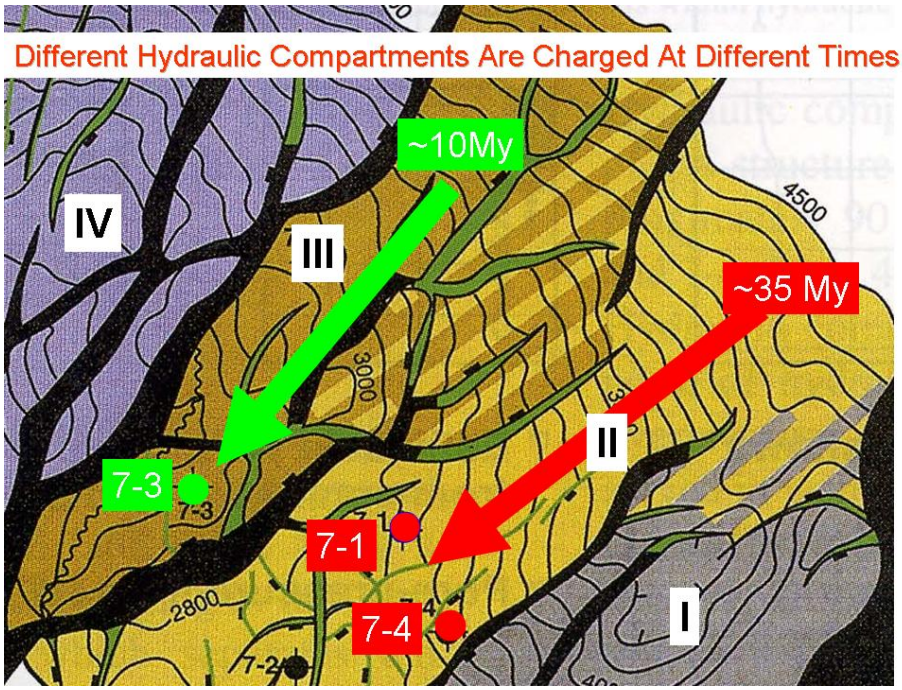

Figure 2.
Times of migration and filling of compartments in the Njord Field based on isotope data of gases.