AAPG European Region Annual Conference
Paris-Malmaison, France
23-24 November 2009

STRUCTURAL and PETROLEUM POTENTIAL EVOLUTION of NUUSSUAQ and SVARTENHUK, WEST GREENLAND

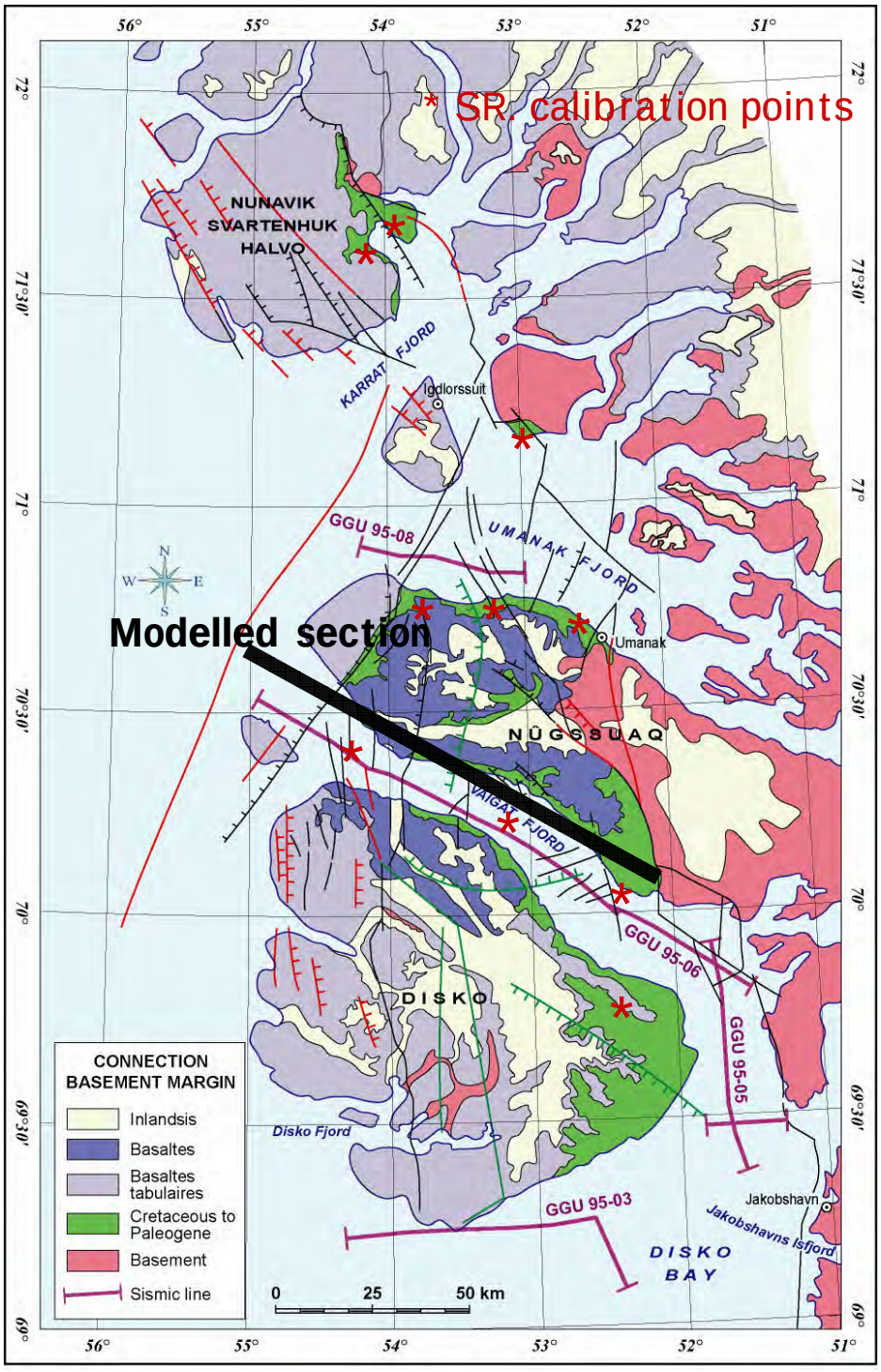
Nadine Ellouz-Zimmermann, William Sassi
IFP, Dept of Geology , 1-4 av de Bois-Préau, 92856 Rueil-Malmaison cedex.
nadine.ellouz@ifp.fr, william.sassi@ifp.fr

Studying the passive margin of the central West Greenland bears is of specific interest for hydrocarbon potential appraisal in volcanic margins, because it exhibits: (1) a frozen geodynamic evolution since Eocene times due to a jump in accretionary processes from Labrador sea to North Atlantic ocean; (2) an important exhumation which brought the deep ocean/continent transition -composed of volcanic traps and seaward dipping reflectors- and the Cretaceous basins at the surface; (3) a direct access to field observations of the pre-Palaeogene sedimentary sequences, which are usually poorly imaged in the offshore seismic profiles, due to a recent uplift.

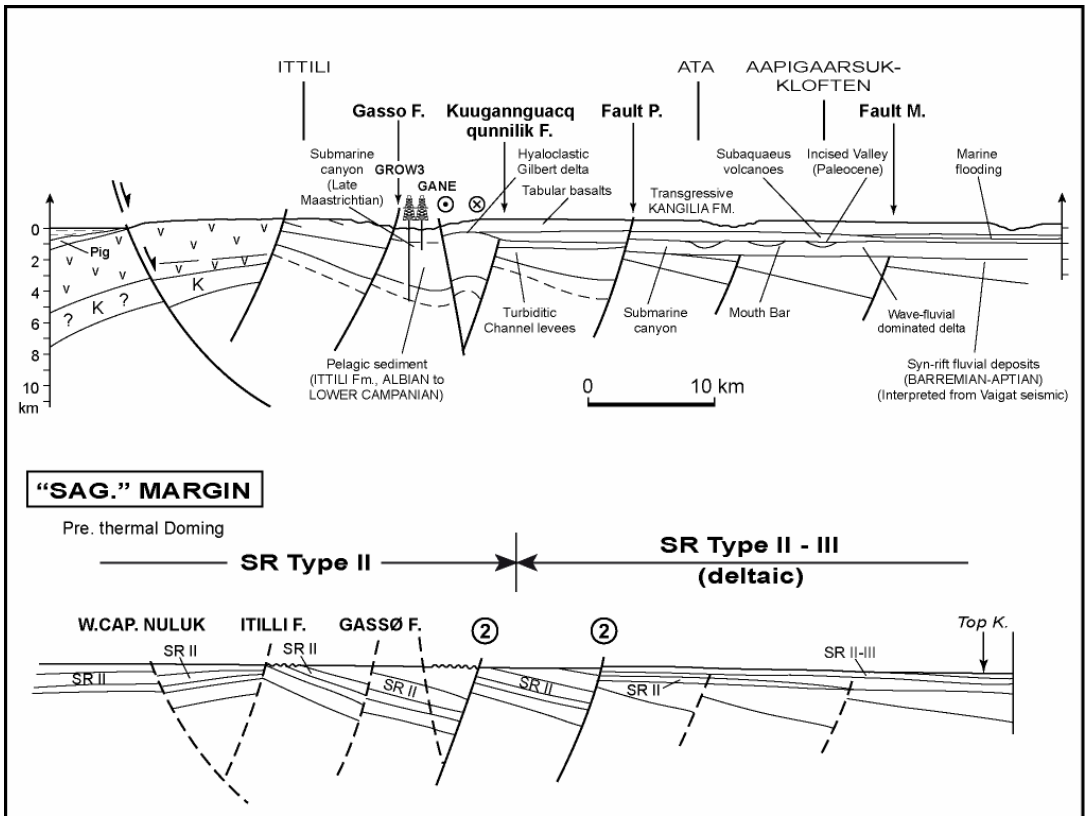
Four main evolutionary stages were recorded:

- an oblique rifting phase, which lasted 25 to 30 Ma reaching Albian times,
- a 30 Ma thermal subsidence phase (up to Late Campanian) not allowing to achieve the thermal relaxation of the margin,
- a thermal doming responsible for volcanic emplacement (related to hot-spot activity), evolving from the end of Cretaceous up to Danian,
- a long polyphased uplifted period for the uppermost part of margin.

Uplift due to thermal doming emplacement, led to a reorganisation of the sedimentary drainage pattern. During Danian time, and within a short period of time (roughly 0.5-5.0 Ma), the thermal doming was followed by dyke and sill injection, which were feeding a large volcanic lava flow discharge at surface. Later on, and along the Svartenhuk, Nuussuaq and Disko coastline, only a small amount of lacustrine and/or continental deposits intercalated within the Paleocene volcanic sediments were deposited.
The onshore hydrocarbon potential is still questionable as oil and gas-shows coming through the faulted volcanics, have been mapped at the surface and found in some wells along Nuussuaq and Svartenhuk peninsulas. However, in this area no important discovery has ever been made.
Based on field study and re-interpreted published seismic lines, a balanced cross section has been built, calibrated at some places by reservoir and source-rock sampling (figure below). several places have been investigated for reservoir and source-rock calibration. The thremal and maturity calibration of the two following thermal hypotheses has been based on our own field source-rock analyses (75 SR samples) as well as from published well maturity data.



This integrated field study led to model the impact of the emplacement of the huge lava flow respectively at regional and at local scales using 1D and 2D basin modelling. A Thrustpack forward modelling was undertaken along a re-interpreted (from Chalmers 1999) SE-NW section in Vaigat Fjord, to test various scenarios of heat generation simulating thermal doming and sill-dyke injection.



A comparison between Disko, Nuussuaq and Svartenhuk was attempted involving (1) the impact of the very thin volcanic series in the Vaigat compared to the Disko and Nugssuaq areas and (2) various erosion rates for the volcanic sealing complex.

The main results show that with a good calibration in the Vaigat modelled cross section, even with various erosion scenarii, a strong regional heat flow is not required to be imposed during the thermal doming phase. From the modelling, the petroleum potential appraisal indicates that the main critical point is more the trap imaging at depth, and the seal efficiency, as good reservoirs have been found and some HC expelled from Cretaceous source-rocks along parts of the sections.