**AAPG HEDBERG CONFERENCE**
**"Hydrocarbon Habitat of Volcanic Rifted Passive Margins"**
**September 8-11, 2002, Stavanger, Norway**

# West Greenland basin development – new evidence of old sediments

**F. G. CHRISTIANSEN[1], J. C. OLSEN[2], S. PLANKE[3], H. E. F. AMUNDSEN[3], J. A. BOJESEN-KOEFOED[1], F. DALHOFF[1], R. MYKLEBUST[2], H. NØHR-HANSEN[1] and M. SØNDERHOLM[1]**

[1]The Geological Survey of Denmark and Greenland (GEUS),
Øster Voldgade 10, DK-1350 Copenhagen K, Denmark
[2]TGS-NOPEC, Baardsrudveien 2, N-3478 Nærsnes, Norway
[3]Volcanic Basin Petroleum Research, Oslo Research Park,
Gaustadalleen 21, N-0349 Oslo, Norway

The sedimentary basins in the Labrador Sea – Baffin Bay region have previously been interpreted as the result of two main rifting episodes, one in the Early Cretaceous, and one in the Palaeogene. The Palaeogene rift episode was associated associated with extensive Late Paleocene volcanism and continental break-up between Canada and Greenland in the Labrador Sea and Baffin Bay.

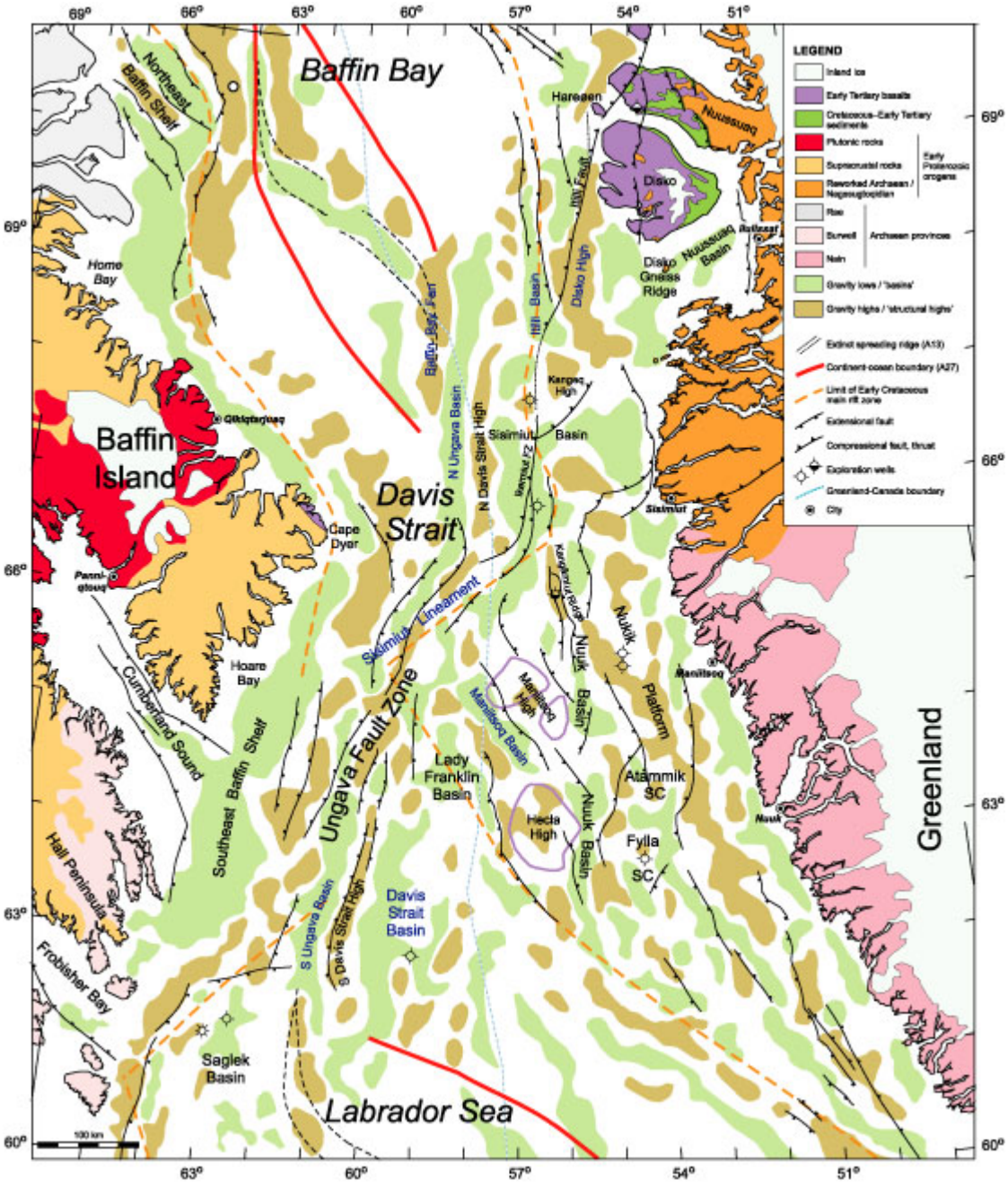
An extensive regional seismic acquisition programme has been carried out during the last couple of years. Integrated seismic-gravity-magnetic (SGM) interpretation and reinterpretation of drilling and field results have provided a wealth of new information and lead to additional exploration models. The new seismic data and the SGM interpretation suggest a much earlier history of basin development in the region and furthermore challenge part of the plate tectonic spreading models including the position of the COB (Continent–Ocean Boundary) in Palaeogene time.

The potential field data have been very useful for depicting major regional structures and especially the 100-km high pass filtered Bouger anomaly maps reveal the position of possible very deep sedimentary basin in the border areas between Greenland and Canada. Recent high-quality seismic data prove the existence of locally up to 8 s TWT deep sedimentary basins where only the upper half or less may be correlated to known Cretaceous and Palaeogene sequences. The age and nature of the deeper sedimentary sequences are unknown. However, regional analogues and the existence of reworked clasts and microfossils in wells and in onshore outcrops suggest that Lower Palaeozoic and Mesozoic sediments may be present in the deep sedimentary basin. Ordovician carbonates are common on the Labrador shelf and oil-stained Ordovician limestone has also been recorded from a breccia in the Fossilik area on the West Greenland craton. Reworked Carboniferous, Triassic, Jurassic and Lower Cretaceous palymorphs have been identied in the Qulleq-1 well as well as in other wells. Especially the presence of Oxfordian–Kimmeridgian dinoflagelates is very encouraging for the petroleum exploration possibilities. The geochemistry of oil seeps and oil-stained carbonates and volcanics onshore West Greenland also suggests the presence of several pre-Upper Cretaceous marine source rocks in the region.

Improved seismic data quality has lead to enhanced seismic imaging of deep sedimentary successions that can be traced under a cover of volcanic rocks north of 68ºN (south-west and west of Disko and Nuussuaq) and on the Hecla and Maniitsoq Highs. The potential field data and the new seismic data have also lead to a reinterpretation of some of the highs that previously were thought to be basement. This is the case e.g. in the previous Fylla and Sisimiut-West licences areas, where there are evidence of structured older sediments in tilted extensional fault blocks and also within compresional structures along the Ungava Fault Zone. There is also evidence of deep sedimentary sequences below volcanic deposits that previously have been described as oceanic crust with seaward dipping reflectors and terminating in steep escarpments.

With ongoing seismic data acquisition in several poorly covered key areas it is still too early to develop a comprehensive tectonic model for the Labrador Sea – West Greenland region. However, there seems to be strong evidence for a system of connected older rift basins, several episodes of strike-slip movement along the Sisimiut Lineament and the Ungava Fault Zone with formation of pull-apart basins. These observations call for renewed discussion of the extent and timing of sea-floor spreading and associated volcanism, the position of the COB and of how earlier episodes of volcanism may have caused geophysical anomalies.

Many of the emerging basin models obviously have very strong implications for the prospectivity of the Labrador Sea – West Greenland region, especially because the chances for finding Cretaceous and older oil-prone source rocks seem higher than previously believed.


Baffin Bay
Davis Strait
Labrador Sea
Baffin Island
Greenland
Ungava Fault Zone
Lady Franklin Basin
Davis Strait Basin
Saglek Basin
Hareøen
Nuussuaq
Disko
Disko Gneiss Ridge
Nuussuaq Basin
Disko High
Kangeq High
Sisimiut Basin
Nuuk Basin
Nuuk
Maniitsoq
Atammik SC
Fylla SC
Hecla High
Maniitsoq High
Maniitsoq Basin
Nukik Platform
Cape Dyer
Hoare Bay
Cumberland Sound
Home Bay
Frobisher Bay
Hall Peninsula
Southeast Baffin Shelf
Northeast Baffin Shelf
Sisimiut Lineament
N Ungava Basin
S Ungava Basin
N Davis Strait High
S Davis Strait High
Ralph Bay Fan
Hill Fault
LEGEND
Inland ice
Early Tertiary basalts
Cretaceous–Early Tertiary sediments
Plutonic rocks
Supracrustal rocks
Reworked Archaean / Nagssugtoqidian
Rae
Sunwil
Nain
Archaean provinces
Early Proterozoic orogens
Gravity lows / 'basins'
Gravity highs / 'structural highs'
Extinct spreading ridge (A13)
Continent-ocean boundary (A37)
Limit of Early Cretaceous main rift zone
Extensional fault
Compressional fault, thrust
Exploration wells
Greenland-Canada boundary
City
69°
66°
63°
60°
57°
54°
51°