[PS]Role of Salt in Decoupling Deformation and Fault Evolution in the Smørbukk Area, Halten Terrace, Offshore Mid-Norway*

Debapriya Paul[1] and Shankar Mitra[1]

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[1]Geology and Geophysics, University of Oklahoma, Norman, OK, USA (Debapriya.Paul-1@ou.edu)

Abstract

Thick layers of mechanically weak evaporite between basement and cover units are prevalent in many extensional settings. The rheological heterogeneity due to the presence of such layers causes decoupling of the deformation between the shallower and deeper units. The degree of decoupling is dependent on the mechanical stratigraphy of the weak layer and its overburden as well as the amount and rate of fault displacement. Even if the mechanical stratigraphy is favorable for decoupling of deformation, hard linkage of basement and cover fault can occur by an increase in the amount and rate of fault displacement. A structural analysis of the Smørbukk area of the Halten Terrace, offshore Mid-Norway shows the controls of various parameters on the structural style. The area has a thick sequence of Middle-Late Triassic evaporites interbedded with dolomite and anhydrite-rich shale (collectively referred to as 'salt') between the Permo-Triassic sedimentary basement and the Jurassic cover. Seismic interpretation of a 3-D time migrated seismic dataset and structural restorations of depth converted sections provided means to investigate the fault evolution and the role of the salt in decoupling the shallower from the deeper units. The results show that extensional deformation was partitioned above and below the salt layer by the development of major faults that detached at the level of base of salt. The positions of such major basement-detached faults are controlled by underlying basement faults. Most of the basement faults have a two-phase activation history: first, during the earliest phase of rift initiation, and second during the rift climax stage. Hard linkage of basement and cover faults occurs in some only during the rift climax stage. The development and activity of newer basement-detached faults and the reactivation of some older basement faults during this stage are probably related to an increase in the strain rate.

ROLE OF SALT IN DECOUPLING DEFORMATION AND FAULT EVOLUTION IN THE SMØRBUKK AREA, HALTEN TERRACE, OFFSHORE MID-NORWAY

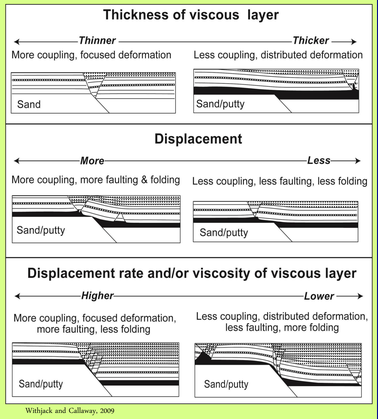
Debapriya Paul and Shankar Mitra

The UNIVERSITY of OKLAHOMA
Mewbourne College of Earth and Energy
ConocoPhillips School of Geology and Geophysics
ConocoPhillips

1. Introduction:

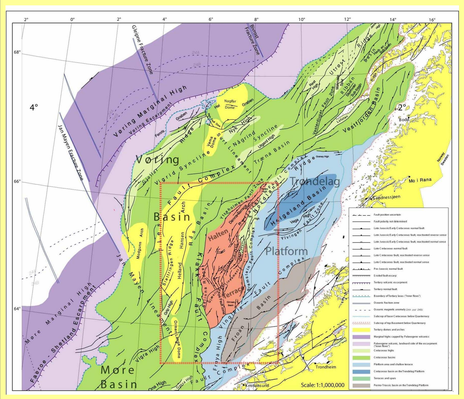
Thick layers of mechanically weak evaporite between basement and cover units can cause decoupling of the deformation between the shallower and deeper units, or hard linkage of the basement faults with those in the cover units. The degree of decoupling is dependent on the mechanical stratigraphy of the weak layer and its overburden as well as the amount and rate of fault displacement.

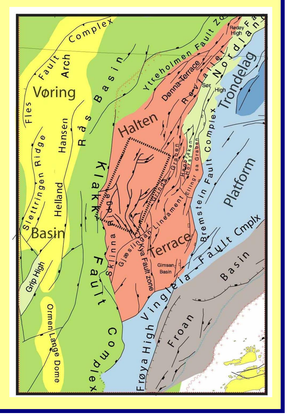
Structural interpretation and related prospect development in the offshore Mid-Norway area is dependent on the role of salt in controlling the structural geometry, because of the generally poor quality of seismic data in the area. The objectives are to determine a) the relative ages of fault development in a rift system b) The control of preexisting sub-salt faults in localizing basement-detached faults within the salt and overburden and c) the role of salt in decoupling the extensional deformation and factors promoting the hard or soft-linkage of fault above and below the salt layer. It is present as a mechanically weak layer between the sub-salt pre-rift units and the overburden syn-rift and post-rift units, thus enabling to study its decoupling effect.



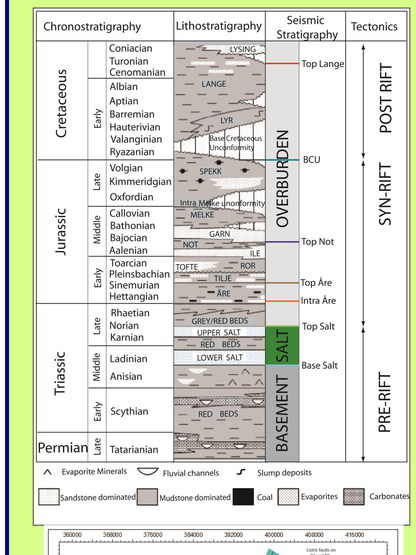
Withjack and Callaway, 2009

2. Tectonic Setup

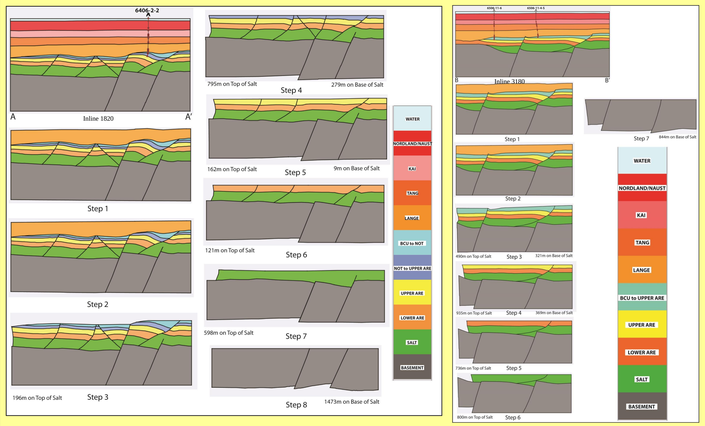


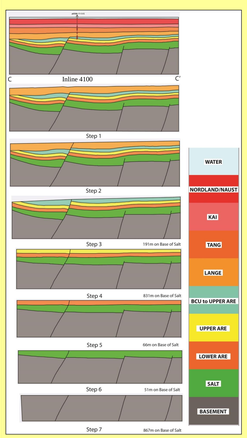


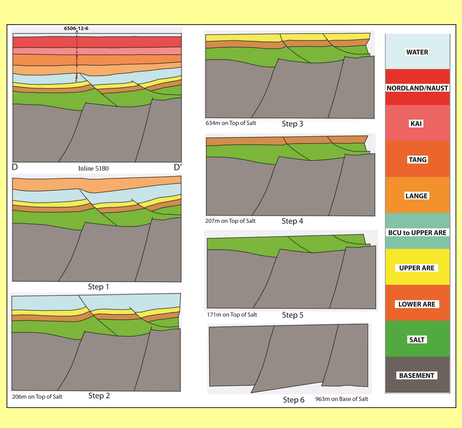
3. Regional Stratigraphy



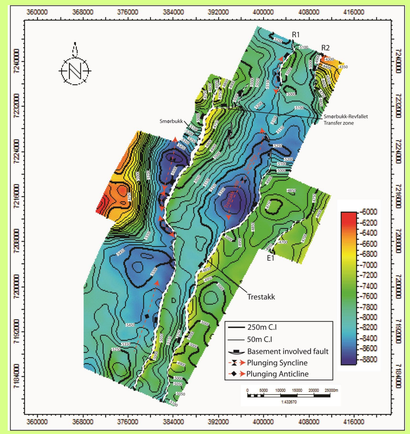
4. Structural cross sections and restorations



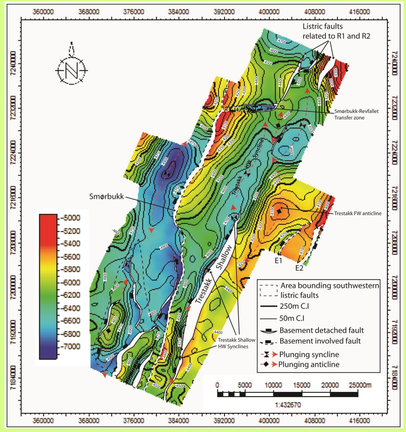




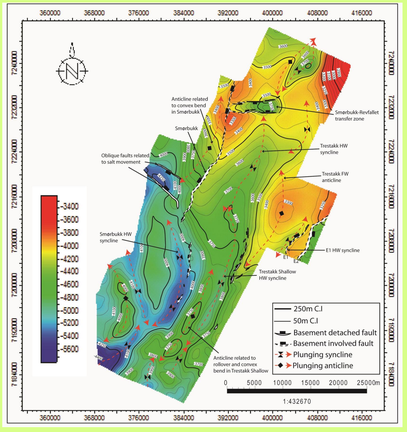
5. Control of subsalt basement faults in localizing basement detached faults



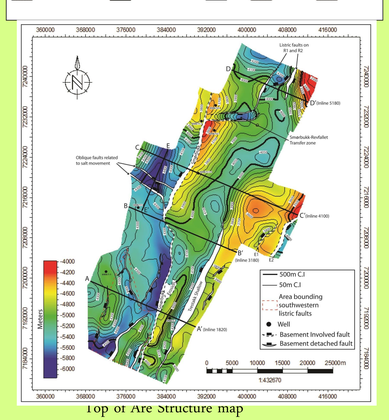
Basement Structure map



Top of Salt Structure map

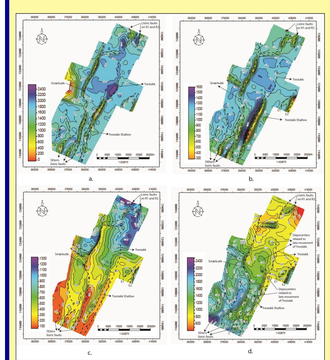


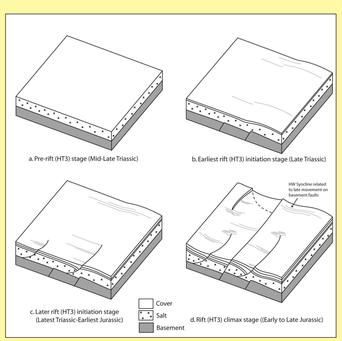
BCU Structure map



Top of Åre Structure map

6. Fault Activity





7. Conclusions

- Two styles of faulting: basement involved and basement detached.
- Basement involved faults developed earlier and provided discontinuities for the later large displacement basement detached faults.
- Basement detached faults with smaller displacements do not have any apparent basement control.
- All faults were active during the later 'rift climax' stage associated with maximum rifting activity.
- Mechanical stratigraphy was favorable for soft linkage of faults in the northern and southern part and hard linkage of faults in the central part of the study area.

Key References

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For communication: Debapriya.Paul-1@ou.edu