When you can smell a rat- how utilize seafloor sampling to de-risk your prospect

Klaus Dittmers & Richard Hatton

A source to think approach

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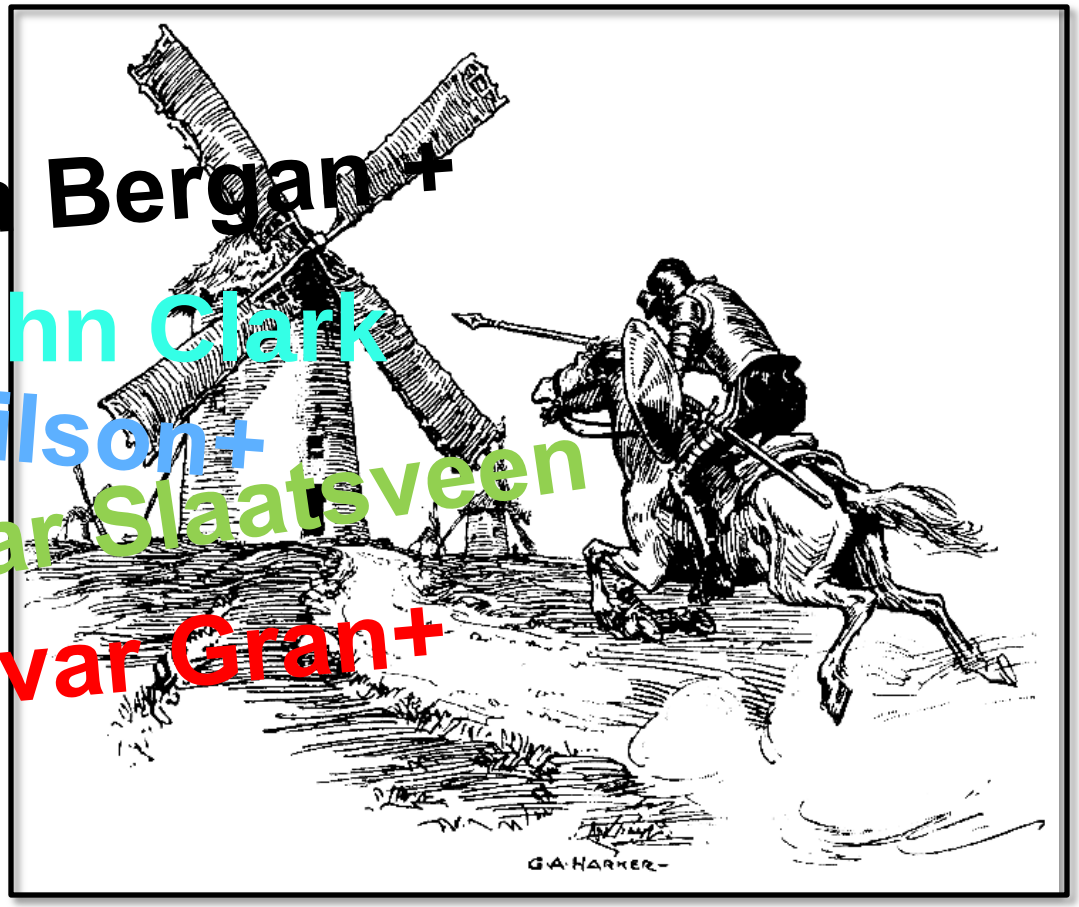
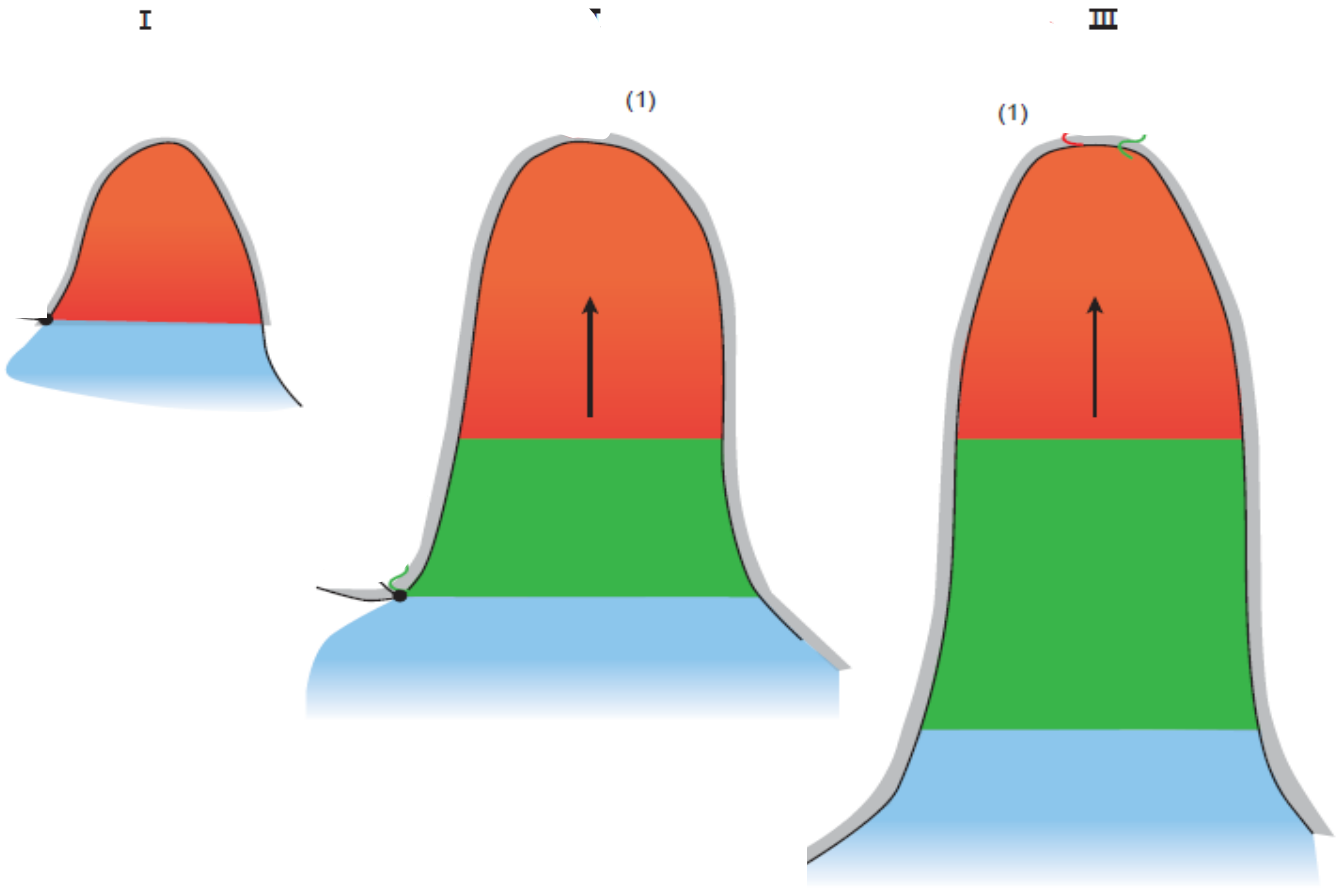
Acknowledgements:

Thanks to partners and the RWE/DEA team



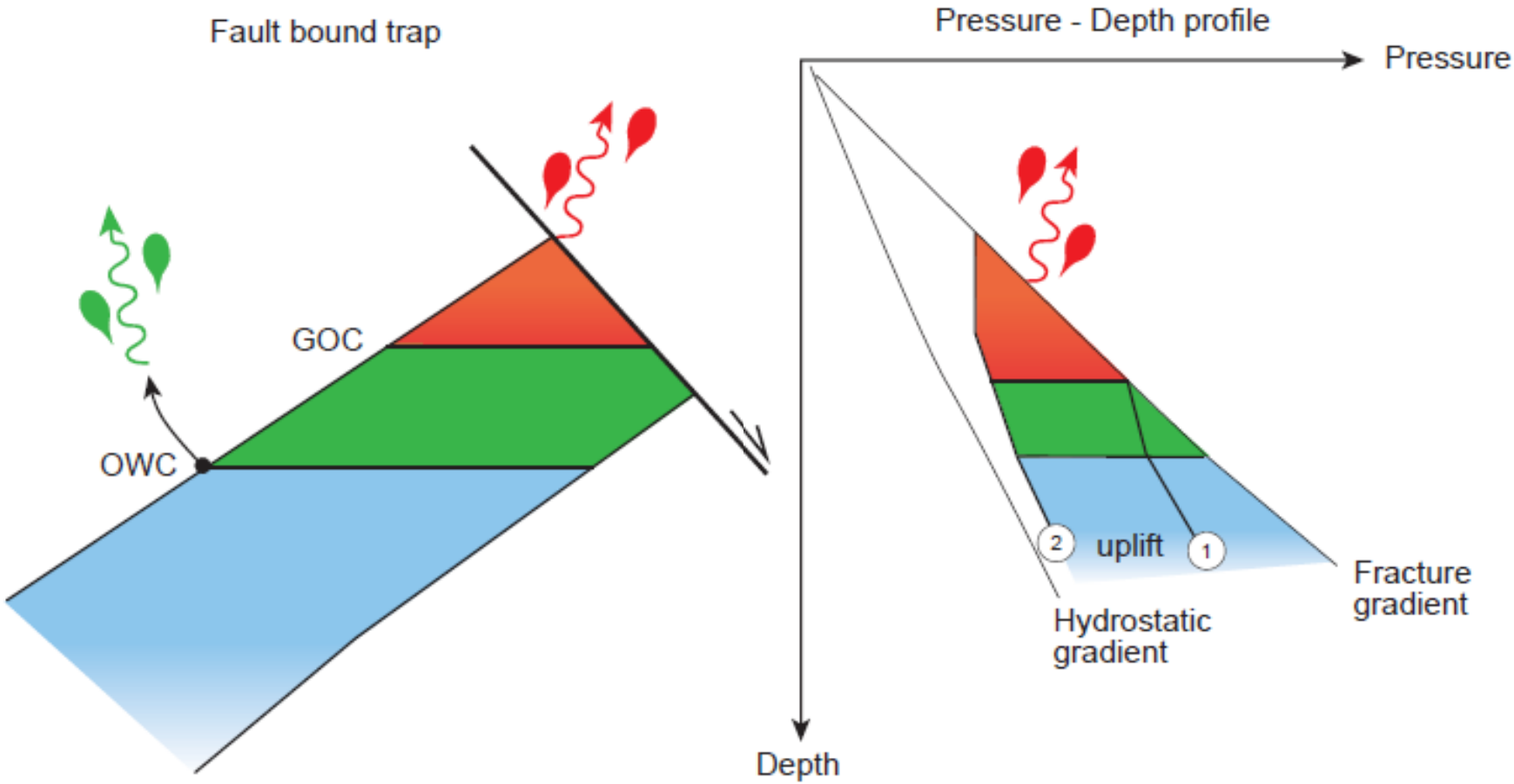
AkerBP
Lundin
Marathon
Engie

The dynamic Trap concept

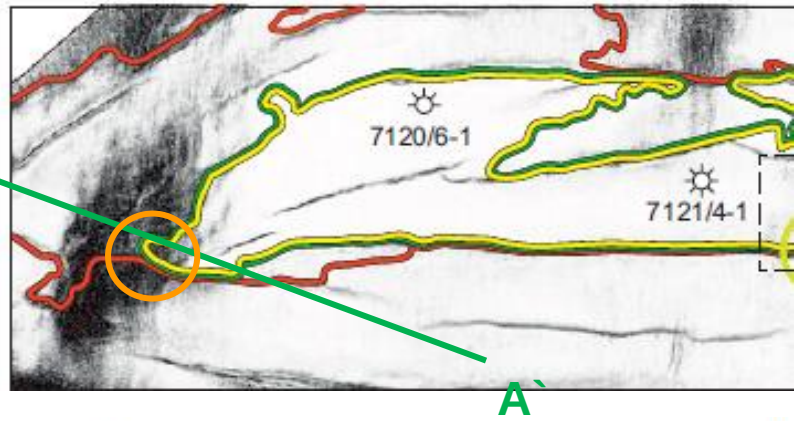


Sales (1993)

The dynamic Trap concept cont.



Hermanrud et al., 2014
Fault intersections: leak



Petroleum column-height controls in the western Hammerfest Basin, Barents Sea

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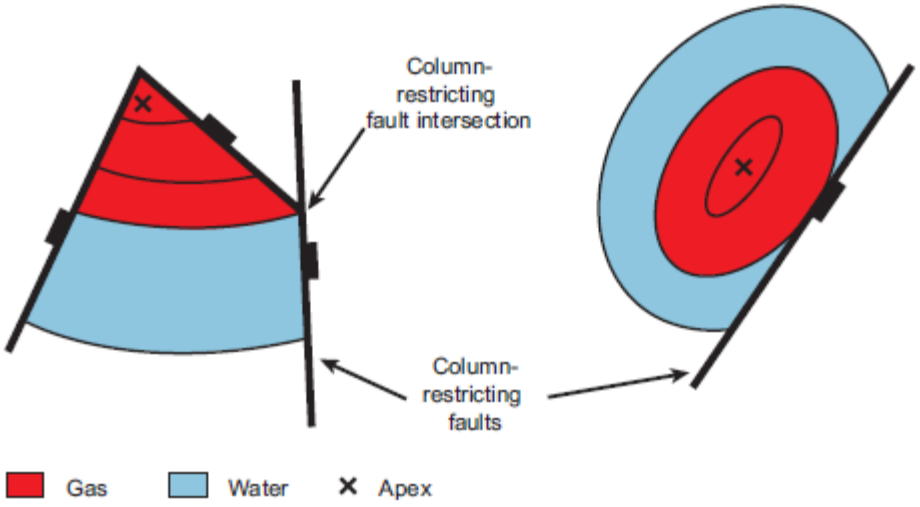
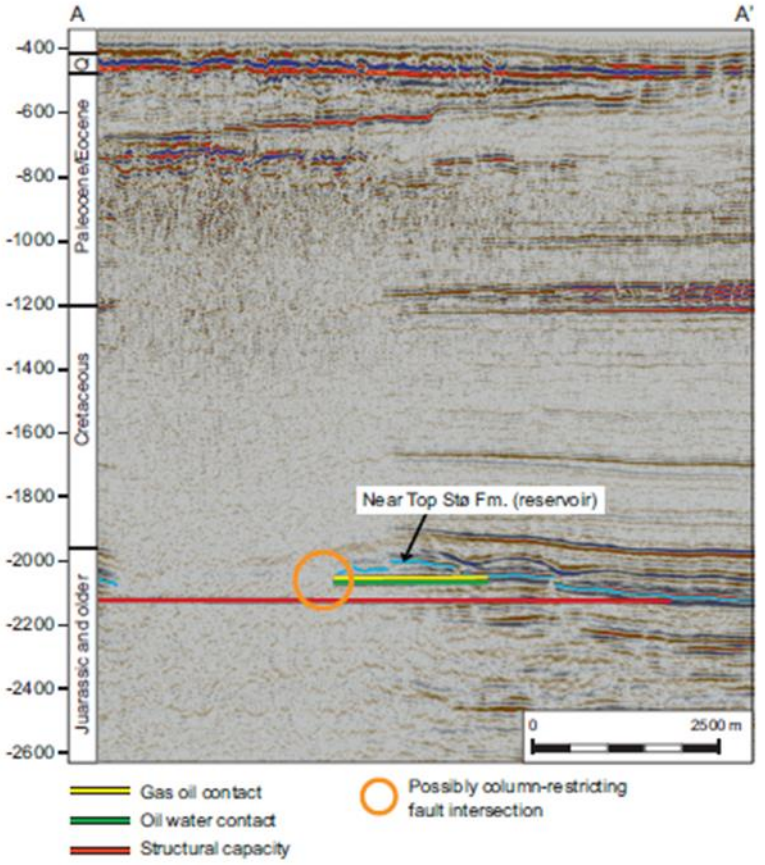
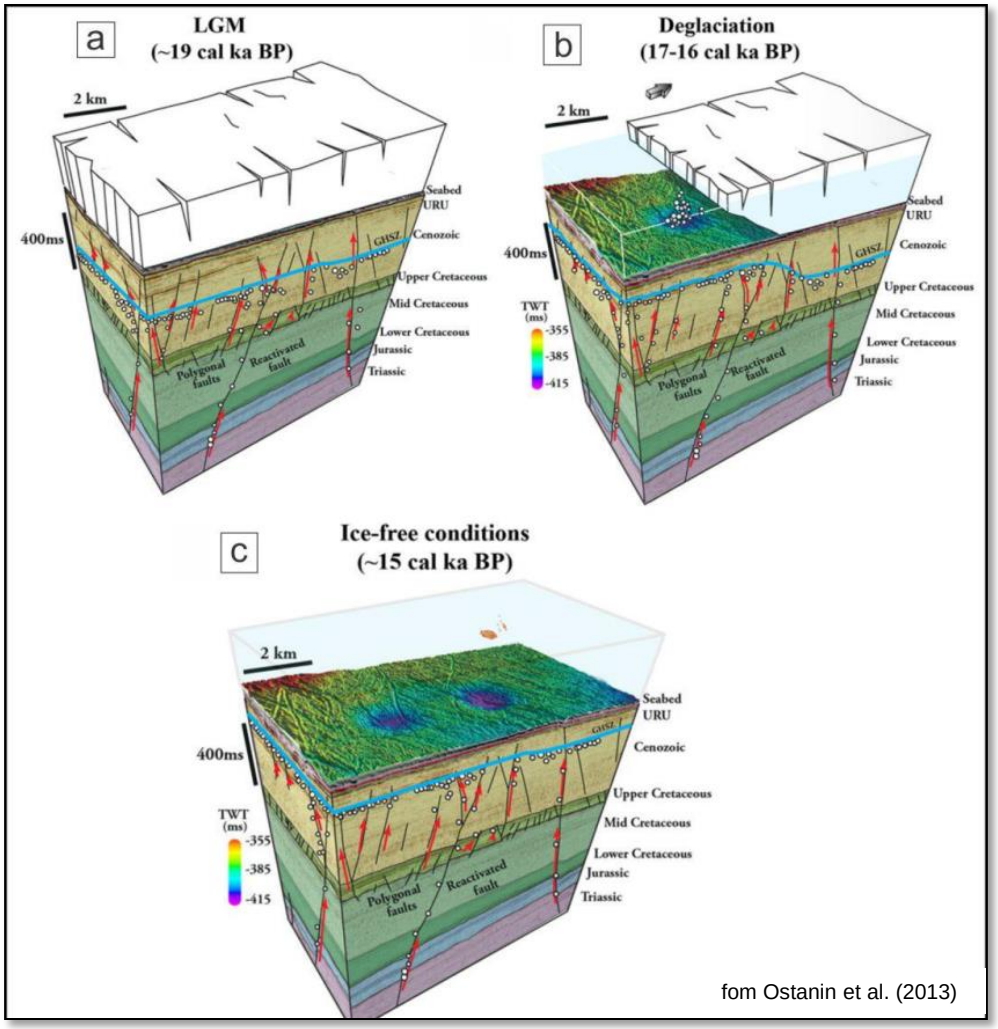
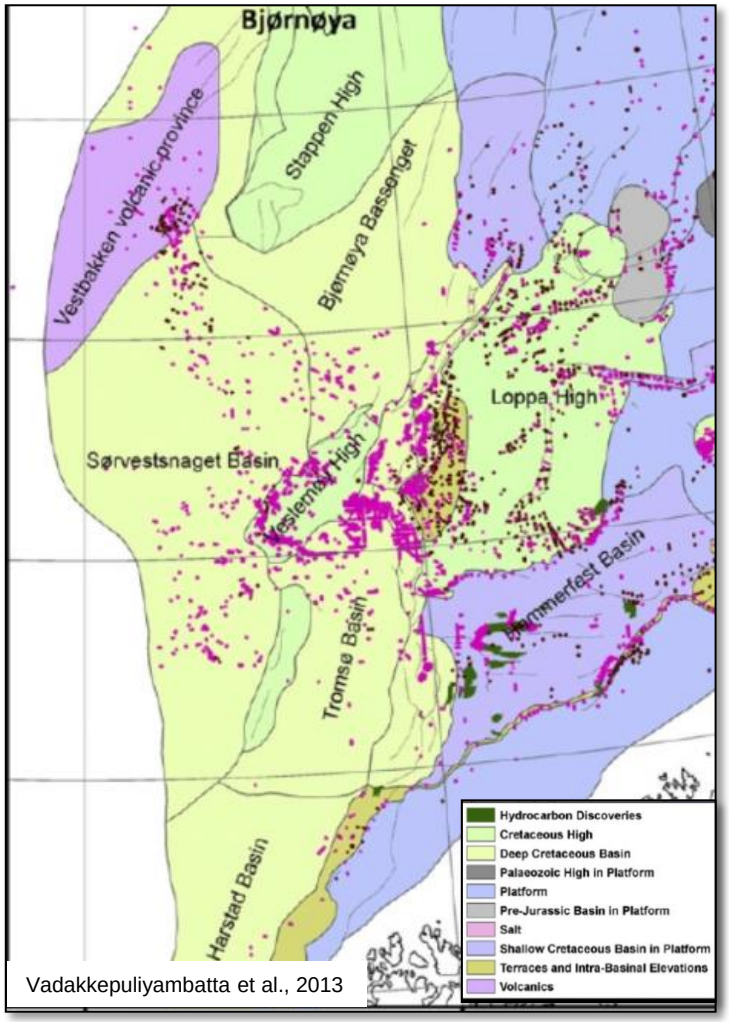




From the reservoir to the seafloor

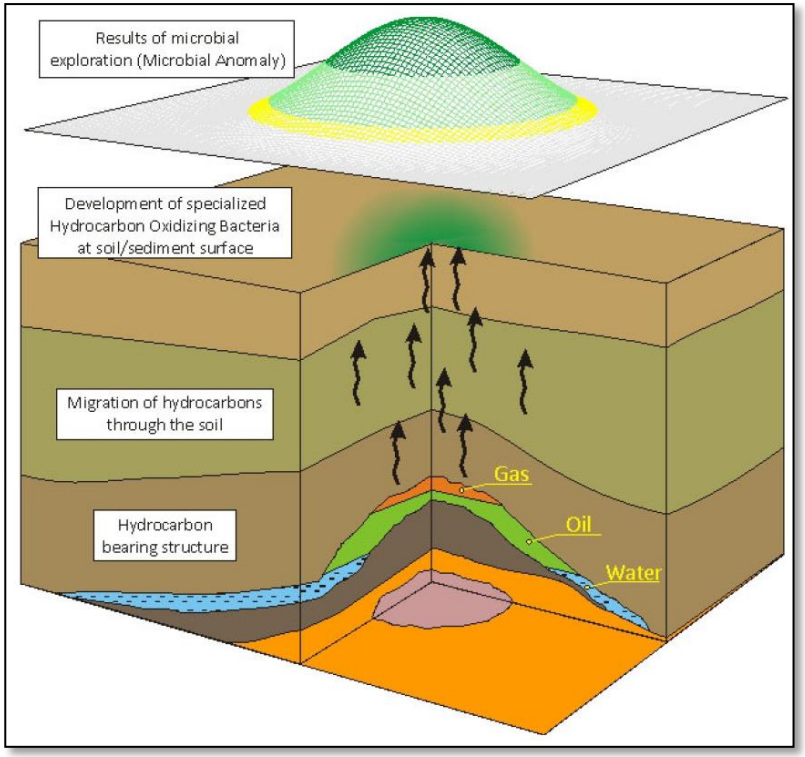


fom Ostanin et al. (2013)



Vadakkepuliyambatta et al., 2013

MPOG / sea bed surveys



November 2014

23 - 26 November Shallow Anomalies Workshop
Indications of prospective petroleum systems?
Malta, Malta

EAGE

Technical Presentations

Monday 24 November 2014

Session	Starting time	Location
Geological Expressions of Hydrocarbon Leakage and Migration	09.00	Portomaso Suite
Sea Bed Samples and their Applications	13.30	Portomaso Suite
Remote Detection of Hydrocarbon Leakage	15.25	Portomaso Suite

Tuesday 25 November 2014

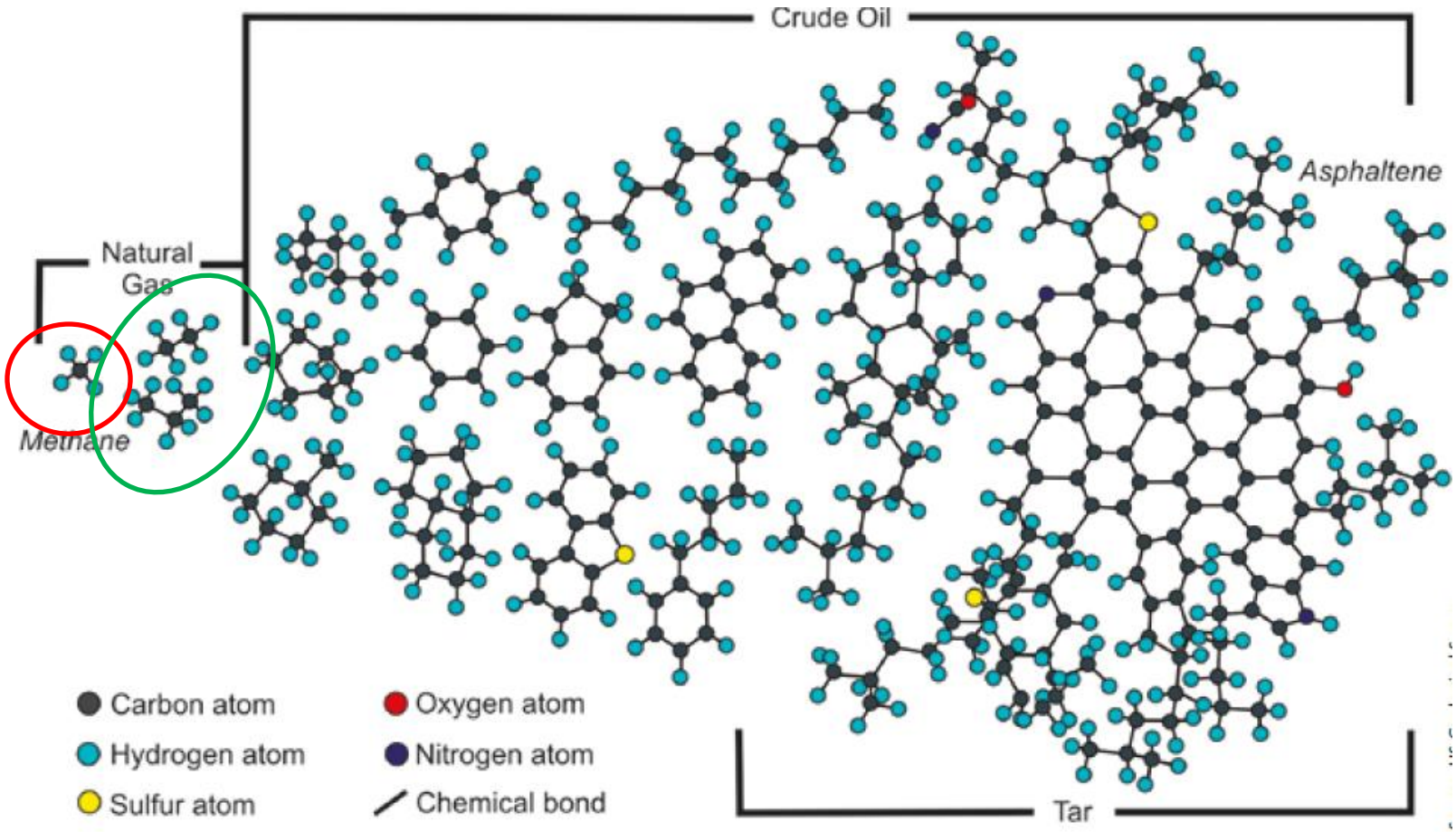
Session	Starting time	Location
Exploration Implications of Subsurface Hydrocarbon Migration Analysis	09.00	Portomaso Suite
Mapping Gas Migration and Hydrocarbon Seeps	13.30	Portomaso Suite

Wednesday 26 November 2014

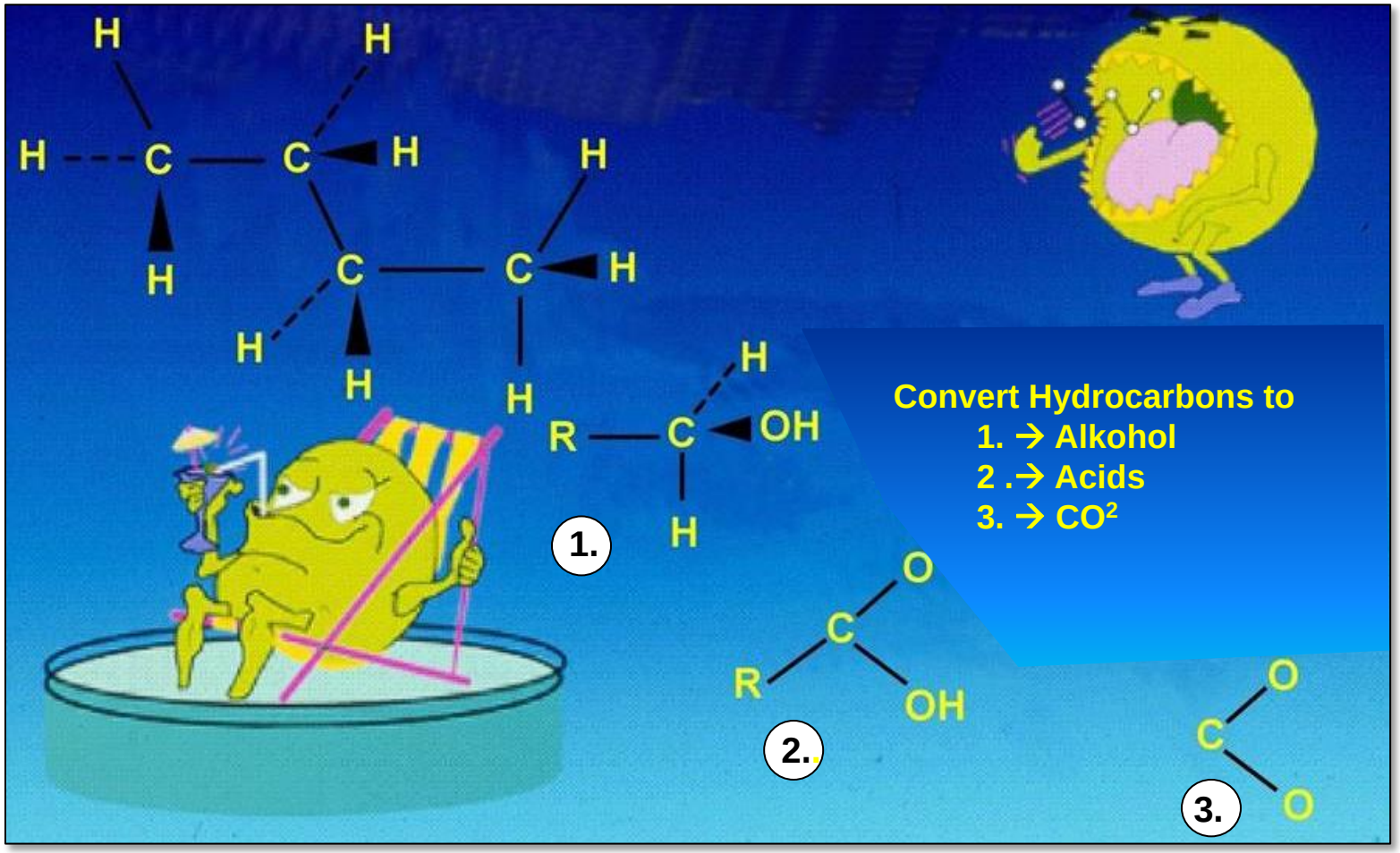
Session	Starting time	Location
Shallow Geophysical Anomalies, Hydrocarbon Migration and Seepage	09.00	Portomaso Suite

Active hydrocarbon basins leak oil and/or gas causing local anomalies in the overburden, the sediment surface and even in the ocean and atmosphere. The anomalies can be geophysical or geochemical in nature but also biological. Recognizing and analyzing these anomalies yields an understanding of the hydrocarbon plumbing system that helps explorers assessing the prospectivity of potential hydrocarbon basins.

Crude: the light components leak



Measure Microbal activity as they…..



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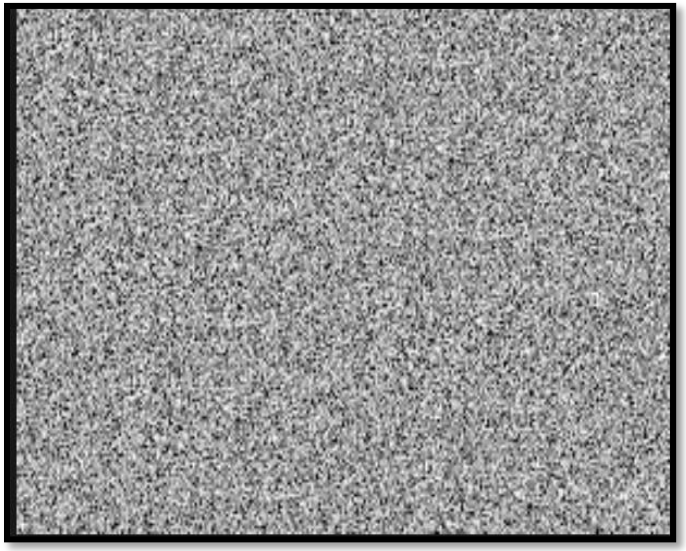
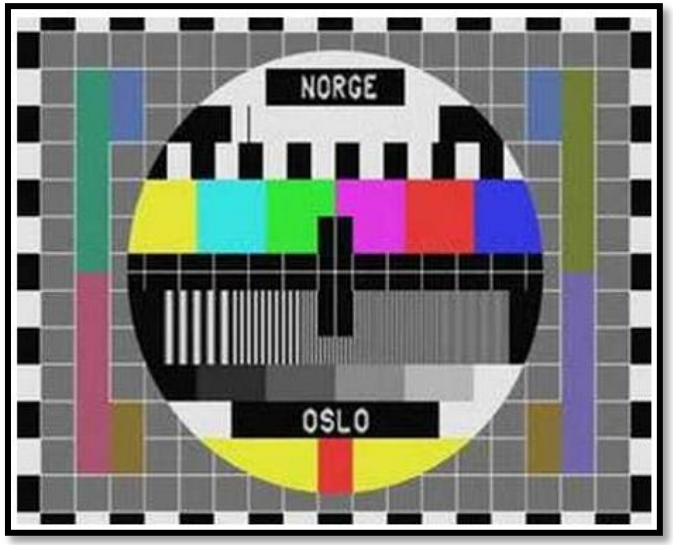
The signal and the Noise….

noise



signal



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Key conclusion from MPOG study

FIT data and study of geosections indicative of a component of lateral migration causing Hans and Fritz false oil anomalies.

While Ref area data are gas prone, Mister X samples are clearly more oil prone. This was applied in the source risk.

The key is that rather than utilizing them as direct HC indicators to de-risk Mister X, they are used to de-risk the petroleum system:

- Oil case
- Play on Source presence 1.0
- Access to charge changed from 0.7 to 0.9

Importance of good calibration wells is evident!

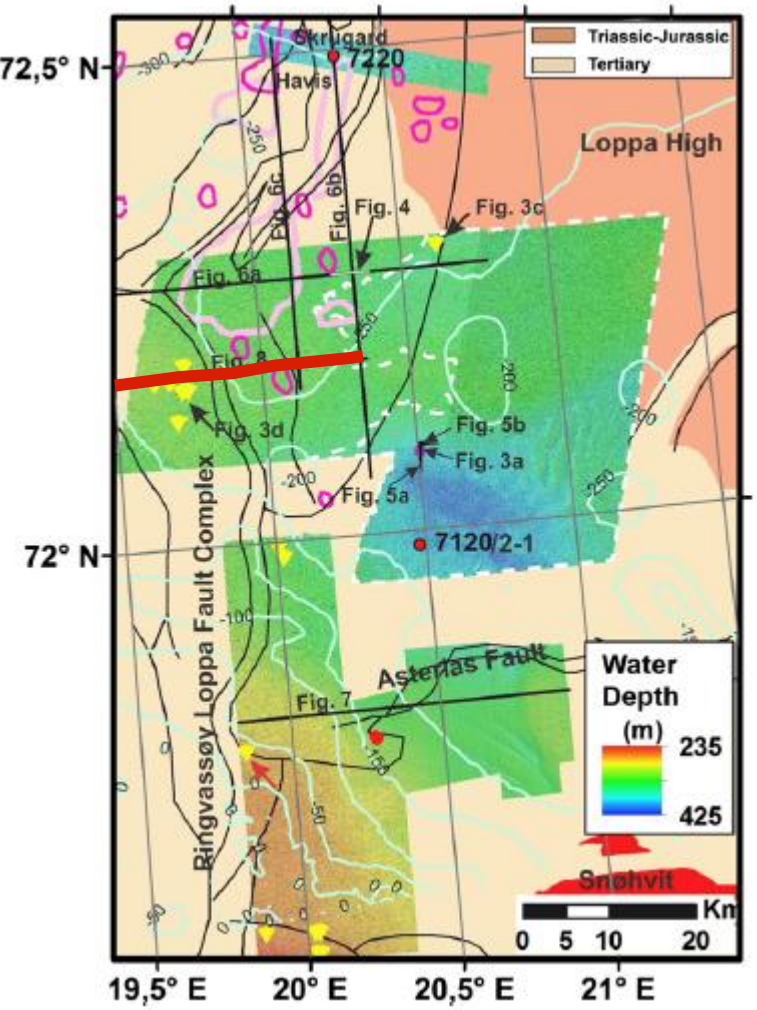
Conclusions

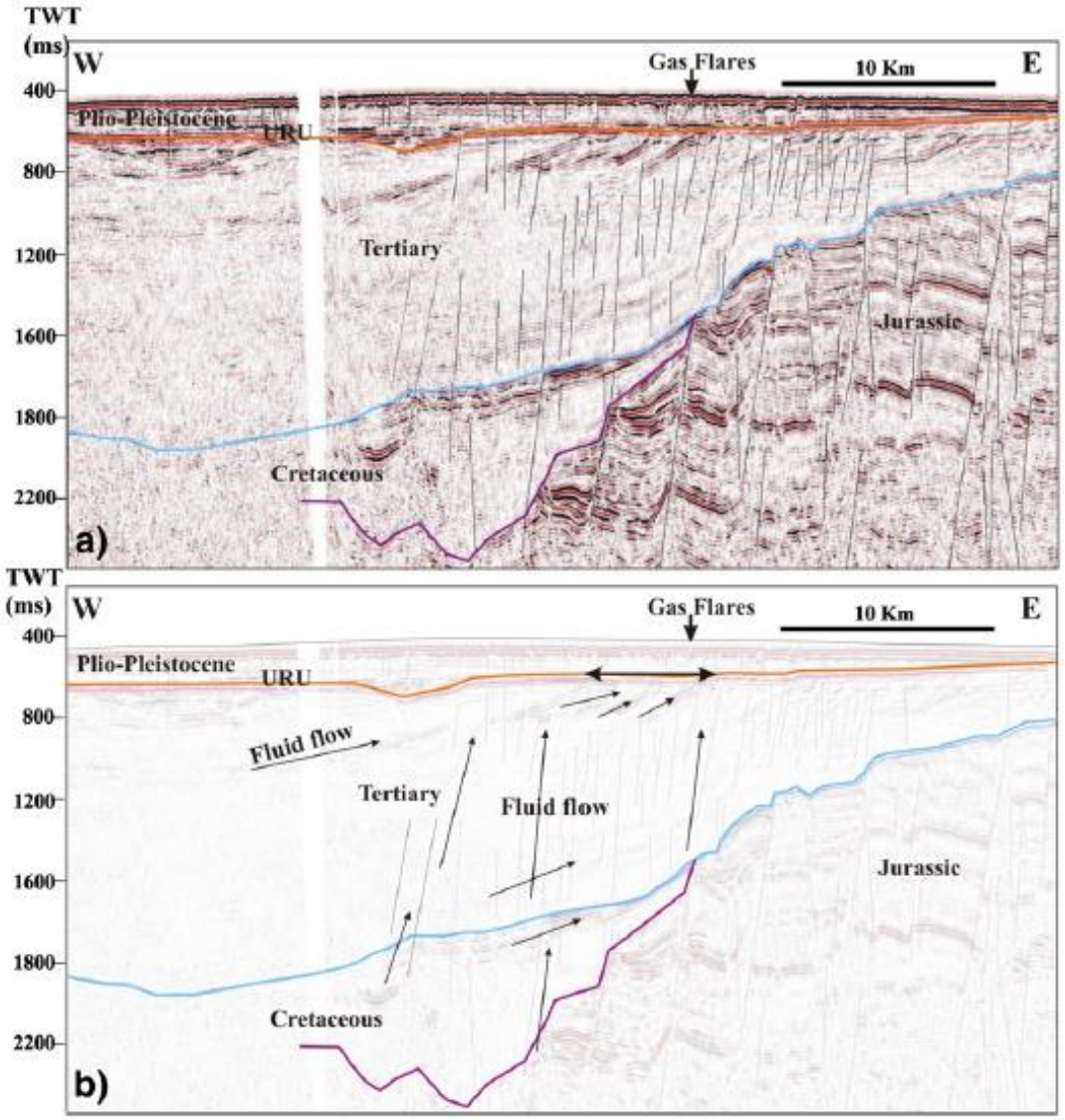
- A major learning was that it proved to be important to utilize reference data from exploration wells to calibrate data collected over prospects to establish the relevance and reliability of the observed anomalies.
- Careful study of the subsurface (faults and sub crops) and integration of seismic with geochemical data from wellbores is necessary to establish an understanding of the fluid pathways, linking subsurface and surface anomalies.
- A common observation was that in most cases “the signal” (e.g. hydrocarbons) is transported both:

    1. laterally by dipping conductive layers in the overburden
    2. vertically by faults/seal leakage

- In terms of risking the learning so far was that it is very difficult to differentiate the two. The art of de-risking a prospect is to differentiate between the vertical seepage (prospect specific signal) and a more regional lateral transport (“play component”).
- So, despite no substitute for prospect specific fluid indicators suitable for a direct prospect ranking, employment of surface sampling can help to de-risk the petroleum system. Referencing sea floor samples with geochemical data from well bores and sufficient dense sea floor samples of reference wells, the HC phase risk can be de-risked.

Chand et al., 2012





Spectrum of Seepage Styles Thaesher et al. 1996(Thrasher/BP)

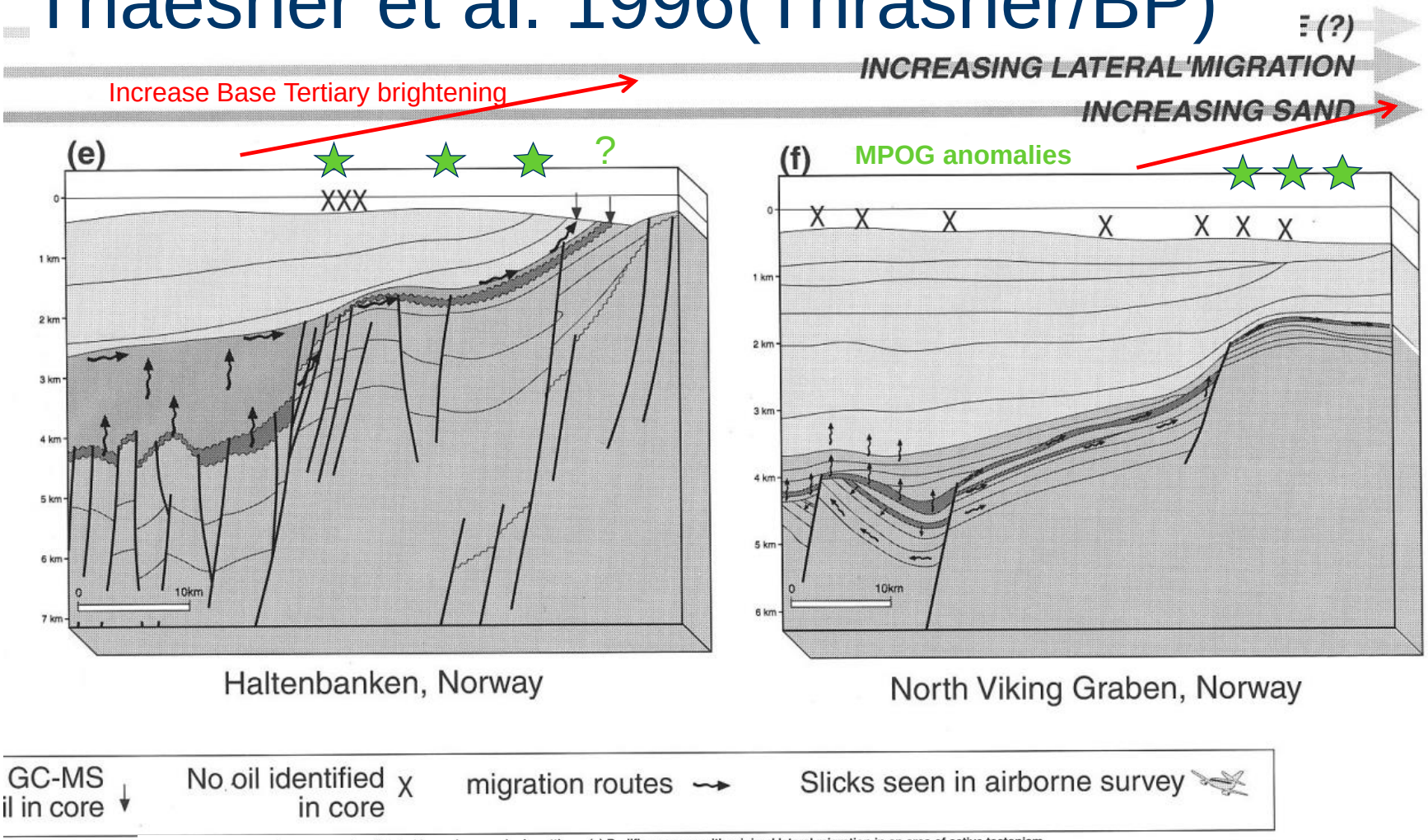


Figure 18—Spectrum of seepage styles dictated by various geologic settings. (a) Prolific seepage with minimal lateral migration in an area of active tectonism—offshore California (no vertical exaggeration) (adapted from Hovland and Judd, 1988). (b) High depositional rate and muddy sedimentation leading to near-vertical migration, with focusing of petroleum up salt walls and active faults leading to major point-source seeps—deep-water Gulf of Mexico (3× vertical exaggeration). (c) More localized seepage associated with mud diapirism—offshore Colombia (3.5× vertical exaggeration) (see Thrasher, Strait et al., this volume). (d) Laterally migrating petroleum focused upward over salt diapirs—Central North Sea (no vertical exaggeration). (e) Lateral displacement of seepage up dipping carrier beds—Haltenbanken (5.5× vertical exaggeration). (f) No leakage to surface detected but significant lateral migration seen in tectonically quiescent basin—North Viking Graben (7× vertical exaggeration).