# Looking for Sweet Spots in Shale Gas, Making Good Use of an Existing Database - The Example of The Netherlands

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The Netherlands is the second largest gas producer in Europe and is producing gas mainly from conventional reservoirs. The Dutch government stated that the Netherlands will become a net importer of natural gas by 2025. As this gas province continues to mature and with field size inevitably decreasing, the attention shifted to the assessment of unconventional gas reservoirs in the last years.

A first assessment of possible unconventional gas reservoirs in the Netherlands was made examining the potential of e.g., shallow gas, tight gas, shale gas, basin centered gas and coal bed methane. From these resources shale gas is the least explored in the Netherlands.

Therefore we started a research topic to determine the possibilities to drill for shalegas and finding sweet spots in the Southern Netherlands onshore. This is done through the following steps: can it be there, will it be there, is it there and is it economical? By using well logs to determine total organic carbon content and geomechanical properties these sweet spots are identified.

The most promising formation in the Netherlands is the Posidonia Formation of Toarcian age (Figure 1). It is present in the West Netherlands Basin (WNB), onshore the Netherlands. By looking at different well logs (gamma ray, sonic, resistivity, density) and drilled cores focused on the Posidonia Formation first a general description of the formation was created. The logs were then used to calculate TOC and Young's Moduli. These can be used to determine whether a certain block containing the Posidonia Formation could have generated hydrocarbons as well as if the formation is suitable for fraccing. Actual TOC measurements were used to cross check the calculations. Available gas logs were added as well as 3D seismic to determine possible sweet spots and local faulting for an example area. Eventually this will lead to a volumetric calculation within these sweet spots.

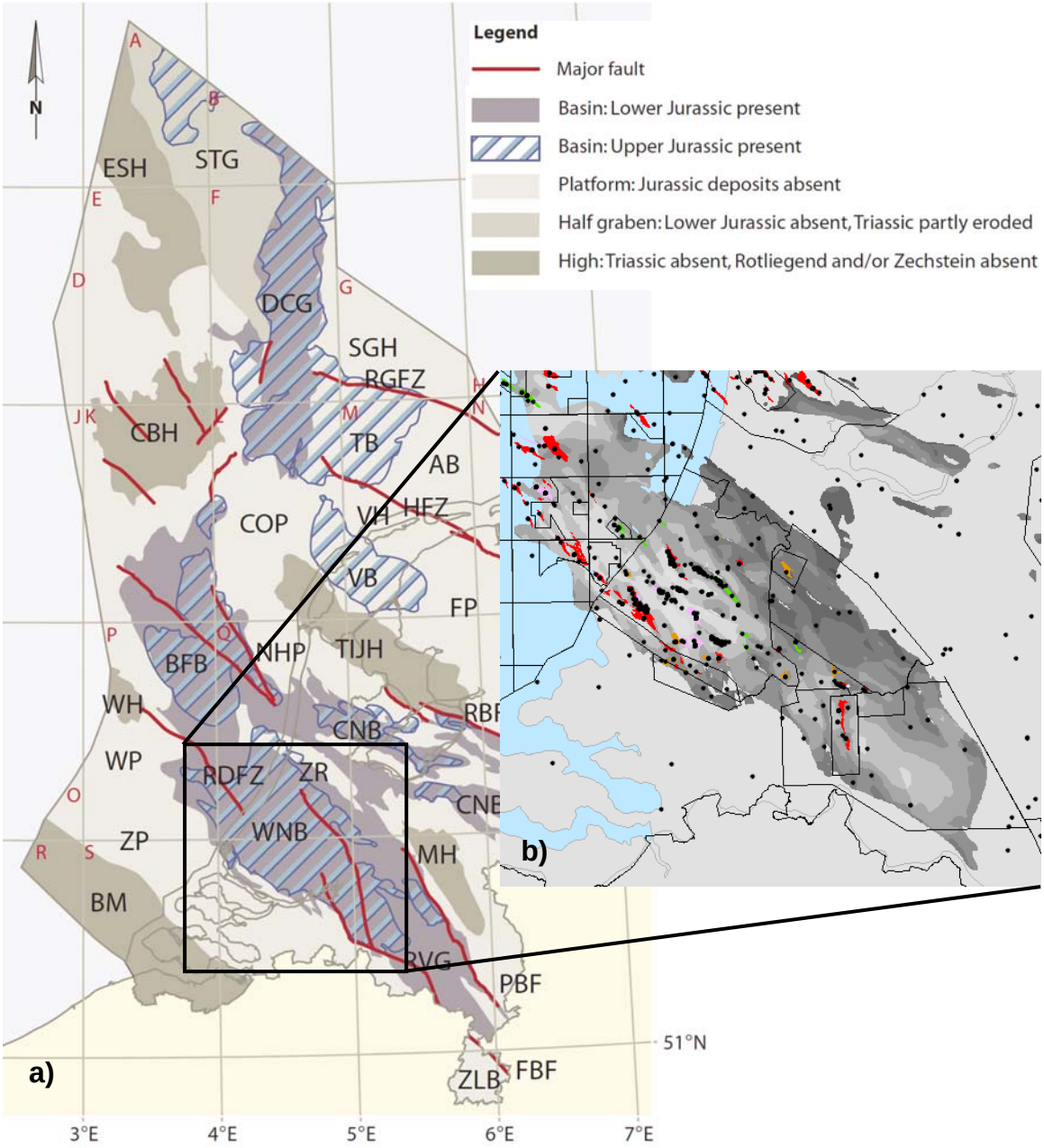


*Figure 1 Overview over the structural elements in the Late Jurassic (a) and distribution map of the Posidonia Shale Formation (b) WNB – West Netherlands Basin*

A detailed geochemical study was conducted on a cored Posidonia Shale section and underlying sediments derived from a well located in the southern North Sea offshore the Netherlands. Samples were subjected to a variety of analytical techniques including CS analysis, Rock Eval pyrolysis, GC-MS and carbon and sulfur isotope analysis. Furthermore, detailed organic geochemical studies have revealed the presence of biomarkers that derive from green sulfur bacteria, organisms that required both light and free hydrogen sulfide ($H_2S$), illustrating those anoxic conditions extended high into the upper water column

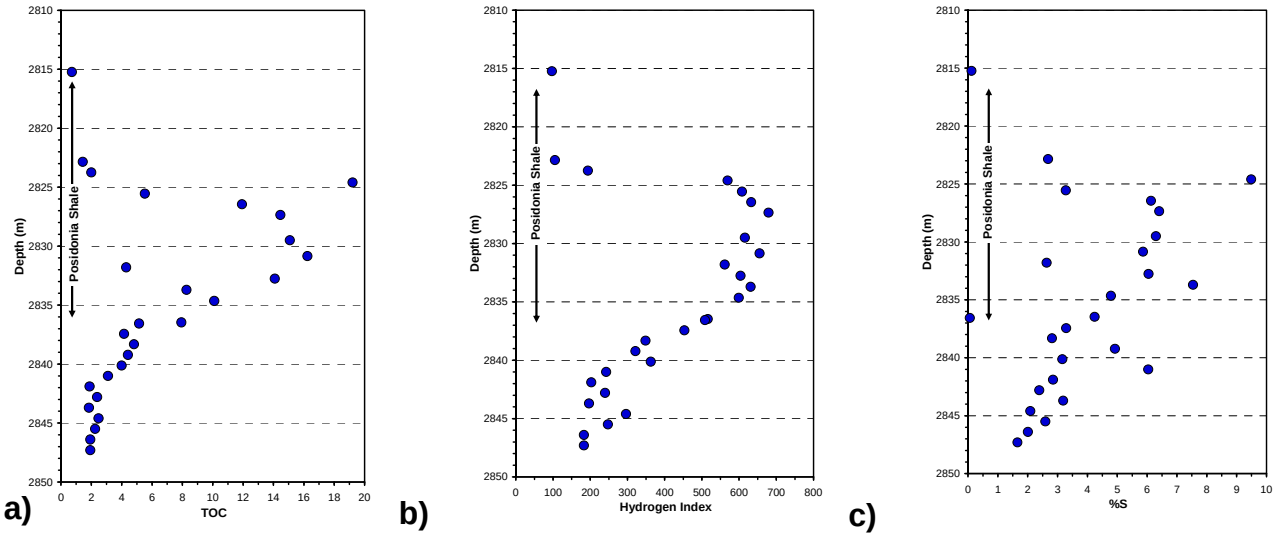


*Figure 2 TOC (a) Hydrogen Index (b) and %Sulphur content (c) for the Posidonia Shale Formation in the Netherlands (Veld et al. in prep.)*

Existing datasets (e.g., Donders et al., 2007) suggest there is a direct relation between biofacies (microfossil composition) and sediment characteristics such as grain size. Therefore it is very well conceivable that a relationship exists between biofacies and e.g. porosity, permeability and TOC, and consequently gas production in unconventional shale gas fields. When this relationship is quantified, it can be used to help explain and predict the sweet spots in the field.

Biofacies analysis is capable to detect intra-shale variability and provides an explanation for the observed changes in grain size. By combining a detailed study of biofacies with geochemical analyses, this correlation can be used to make predictions about the surrounding area.

## References

Donders, T.H., Kloosterboer-van Hoeve, M.L., Westerhoff, W., Verreussel, R.M.C.H., Lotter, A.F. (2007) Late Neogene continental stages in NW Europe revisited, Earth-Science Reviews, 85, 161-186.