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Modelling permeability and flow in siliceous shales of Danish North Sea

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The presence of siliceous shales in the Danish North Sea has raised concerns about well stability due to their propensity for inducing fractures during diagenesis (Ishii et al., 2011). This research project aims to develop a model for understanding fluid flow within siliceous shales, considering the presence or absence of fractures.

By interpreting seismic, well-logging and petrographic data, we have delineated the interval of the siliceous shales in multiple wells across the Danish North Sea (Fig. 1a). Our research encompasses measurements of specific surface area (S) in siliceous shale cuttings from these wells and complex conductivity measurements on siliceous Miocene core samples. These efforts are dedicated toward correlating the data with the frequency dispersion of resistivity logs, ultimately deriving matrix permeability (k) using the Kozeny equation $(k = c\emptyset^3/S^2)$ (Fig. 1b), where $\emptyset$ is porosity and c is Kozeny's factor.

By incorporating the impact of fractures, an improved understanding of the fluid dynamics within siliceous shales will offer a robust foundation for assessing well stability, risk mitigation, and reservoir management in this geologically complex region.

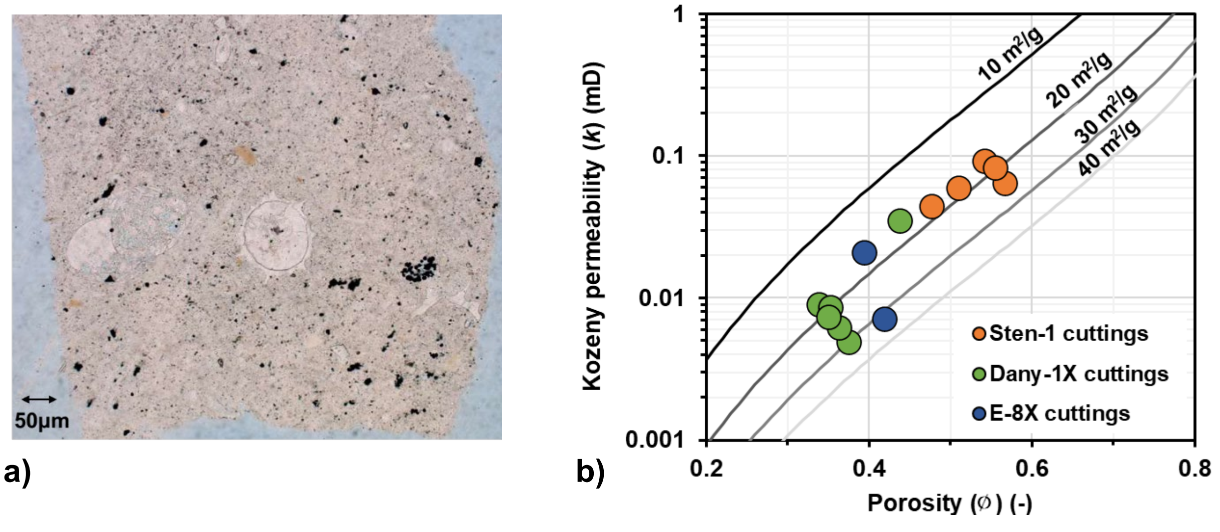

Figure 1 a) Petrographic image from cuttings in Sten-1 well, sampled at measured depth 1551 m, showing calcareous and siliceous microfossils. b) Kozeny permeability prediction from porosity and specific surface area of siliceous shale cuttings from Danish North Sea wells, with lines representing specific surface area values.

References

Ishii, E., Sanada, H., Iwatsuki, T., Sugita, Y., & Kurikami, H. (2011). Mechanical strength of the transition zone at the boundary between opal-A and opal-CT zones in siliceous rocks. *Engineering Geology*, *122*(3–4). https://doi.org/10.1016/j.enggeo.2011.05.007

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