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# Diagenetic effects on porosity and permeability loss in sandstone reservoirs - a predictive approach using petrographic analysis combined with basin modelling

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## ABSTRACT

Cementational porosity/permeability loss can have a strong influence on the total reservoir quality reduction. Permo-Triassic sandstones are the main gas bearing intervals in the Netherlands. However, their reservoir quality is severely reduced in some intervals as the poroperm is diminished by secondary (diagenetic) pore-blocking cements. Different types of cements and their abundances are generally not equally distributed in sandstone reservoirs, hampering the prediction of good reservoir quality. Important factors driving the formation of these cements are the subsurface architecture, depositional environment, fluid flow and burial history. In this study we implement a novel approach aiming at understanding the processes that influence diagenesis-related poroperm losses.

A cement database was built upon data from thin section petrography and XRD analyses of core material. Petrography (optical, SEM and CL) was combined with basin modelling to determine the burial history of different fields. Sources and causes of cementation are determined to establish locally dominant mechanisms using basin modelling and fluid flow systematics with petrographic and geochemical analyses. We apply clumped isotopes, which is a new technique for defining crystallisation temperatures of the carbonate cement at high precision. Preliminary results from the petrographic and statistical study on the Rotliegend sandstone reservoirs reveal distinct correlations between reservoir quality and clay mineralogy, as well as a relation between cement composition and sub-unit. The different cement types are connected to the burial history and fluid flow pathways. In two Triassic Bunter sandstone reservoirs differences in $CO_2$ and $CH_4$ charge and temperature history, deducted from basin modelling, explained differences in cement composition within a reservoir layer. The WED field experienced much deeper burial during the Late Jurassic and Cretaceous rifting, as opposed to BRTS. The WED sandstones are richer in siderite cement and illite, whereas BRTS reservoir sandstones are kaolinite-rich.

This study aims to combine the local diagenetic models with knowledge of basin evolution, internal stratigraphy and depositional environment to develop a predictive 3D cement model, with the goal of process understanding and prediction of reservoir quality at unexplored locations. In addition, this can lead to a better approach for production/injection procedures.