



## **The Werkendam natural CO<sub>2</sub> accumulation: An analogue for CO<sub>2</sub> storage in depleted oil reservoirs**

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The Werkendam natural CO<sub>2</sub> accumulation is hosted in the Röt (Early Triassic) sandstone of the West Netherlands Basin, at a depth of 2.8 km, about 20 km south-east of Rotterdam (NL). This reservoir, in a fault-bound structure, was oil-filled prior to charging with magmatic CO<sub>2</sub> in the early Cretaceous. It therefore offers a unique opportunity to study long-term CO<sub>2</sub>-water-rock interactions in the presence of oil.

This contribution will present the results of a detailed mineralogical and geochemical characterisation of core sections from the Werkendam CO<sub>2</sub> reservoir and an adjacent, stratigraphically equivalent aquifer.

X-ray diffraction combined with X-ray fluorescence spectrometry revealed that the reservoir samples contain substantially more feldspar and more barite and siderite than those from the aquifer, while the latter have higher hematite contents. These differences are attributed to the effects hydrocarbons and related fluids on diagenesis in the closed system of the CO<sub>2</sub> reservoir versus the open-system of the aquifer. Petrophysical analyses yielded overall higher and more anisotropic permeability for the reservoir samples, while the porosity is overall not significantly different from that of their aquifer equivalents. The differences are most pronounced in coarse-grained sandstones. These have low anhydrite contents and contain traces of calcite, while all other analyzed samples contain abundant anhydrite, dolomite/ankerite and siderite, but no calcite. Detailed petrography revealed mm-sized zones of excessive primary porosity. These are attributed to CO<sub>2</sub>-induced dissolution of precompactional, grain-replacive anhydrite cement. Diagenetic dolomite/ankerite crystals are covered by anhedral, epitaxial ankerite, separated from the crystals by bitumen coats. Since these carbonates were oil-wet before CO<sub>2</sub>-charging, the overgrowths are interpreted to have grown after CO<sub>2</sub>-charging. Their anhedral habit suggests growth in a 2-phase water-CO<sub>2</sub> system. Isotopic analysis yielded an internal source for all carbon, oxygen and sulphur, which implies that mineral trapping of CO<sub>2</sub> was insignificant.