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Application of geoelectric and electromagnetic methods for the detection of failing zones and brine rising zones in the vicinity of a potential CO_2-storage site

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Within the framework of the project "brine - CO_2 storage in eastern Brandenburg" geophysical investigations are conducted by the German Research Center for Geoscience (GFZ), Potsdam and the Brandenburg University of Technology (BTU), Cottbus on different scales in order to investigate underground situations and evaluate methods suitable for a salinization early warning system. The research of BTU is focused on the distribution of underground structures up to a maximum depth of 200m. Of prevalent interest are the detection capabilities for near surface failing zones which might serve as favored pathways for brine migration and the status-quo of the freshwater-saltwater boundary.

Geophysical investigations with the frequency domain electromagnetic (FDEM) and direct current (DC) geoelectric methods are qualified for the identification and monitoring of brine displacement as the measuring parameter is the resistivity/conductivity of the subsurface.

In eastern Brandenburg the Oligocene Rupelian clay represents the barrier horizon separating the freshwater and saline aquifers. Due to postglacial processes this layer is locally reduced or totally eroded and might enhance upward brine migration during pressure increase.

The areas of investigation were selected by known high fluid conductivity values (hydro chemical indication) and the potential presence of quaternary erosion channels in the Rupelian clay (geological indication).

The geophysical results yield a vertical and horizontal resistivity/conductivity distribution. The interpretation is done by lithology profiles of nearby boreholes and correlation with fluid conductivities in groundwater wells. The results of FDEM and DC on coincident profiles are generally in accordance and show that both methods are suitable with DC geoelectrics supplementing a higher resolution close to the surface (max. 80m depth) and the electromagnetics adding coarser/less detailed conductivity information of the deeper underground (down to 200m depth).