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# Application of magnetic proxies in reservoir characterization: a case study from the North German Basin

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Porosity and permeability are key parameters for hydrocarbon reservoir characterization, but measurements are time consuming and expensive, and the demand for petrophysical proxies for these parameters is growing. In this study, the focus was laid on magnetic properties and their links with rock facies. Magnetic proxies can provide information about the concentration, grain size and type of magnetic minerals in soils and rocks. They are commonly used in environmental screening and mineral prospecting, but their potential for reservoir characterization is not yet fully understood.

Sandstone samples from two elder drill cores from the North German Basin (Rotliegend) were examined. Natural remanent magnetization, frequency dependent magnetic susceptibility and anisotropy of magnetic susceptibility were measured before and after salt extraction, and the results were correlated with porosity and permeability. Acquisition of isothermal remanent magnetization and Curie point determinations were used to characterize the magnetic mineralogy in respect of the rock facies.

Three ferr(o)magnetic minerals could be identified in the samples: magnetite, hematite and goethite. The occurrence of these three minerals was strongly dependant on the rock facies. Samples, which were characterised as aeolian mudflats, low energetic fluvial deposits and lake sediments typically yielded a significant magnetic anisotropy and relatively higher susceptibility values, whereas porosity and permeability was low. Hematite was found to be the most important magnetic mineral in these facies types. Contributions from goethite and a paramagnetic phase, probably illite, were also observable in most samples. In contrary, samples characterised as dry sandflats, damp sandflats and aeolian dunes showed elevated porosity and lower magnetic susceptibility values. Despite the lower bulk susceptibility values, the magnetic properties pointed towards magnetite as main magnetic mineral in these samples.

The relationship between the studied magnetic and reservoir parameters was strongly dependent from the facies types. In general, porosity and permeability showed best associations with bulk magnetic susceptibility, magnetic foliation and the magnetic anisotropy shape parameter.