Monitoring the transformation of iron oxide intoiron sulphide with the method of spectral induced polarization

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Biogeochemical processes in wetlands are related to the availability of oxygen in the subsurface, leading to a separation into an oxic and an anoxic zone. Spatial variations between regimes of high and low oxygen content result in the transformation of iron com pounds that are present naturally in the soil. The SIP method has demonstrated to be a suitable method to delineate in-situ biogeochemical processes, such as changes in the redox-status of soils or the accumulation of biominerals. However, the parameters underlying the IP response are still not fully understood. Hence, in this study, we investigate the changes in the SIP response during the transition from iron oxides into iron sulphides. A column filled with goethite grains was flushed with a sulphide solution (pH 10 – 11) for one month. Daily SIP measurements at frequencies between 5 mHz and 10 kHz yield detailed information about the temporal changes in the complex electrical conductivity caused by the reaction with goethite to form sulphides. We evaluate the complex conductivity spectra with a Debye decomposition. Two parameters resulting from this approach are identified to exhibit a strong correlation with the amount of sulphide retained by the sample: the normalized chargeability mn, which can be considered as a measure for the magnitude of the polarization effect, and the mean relaxation time τ mean. Both observations can be attributed to a progressing transformation of goethite into iron sulphide and thus to an increasing volume of polarizable material in the sample holder.