EGU General Assembly 2019 Abstract to be submitted to session HS8.1.9

Characterization of biogeochemical hot spots using induced polarization

Timea Katona[1], Jakob Gallistl[1], Sven Nordsiek[2], Matthias Bücker[3], Sven Frei[2], Stefan Durejka[2], Benjamin Gilfedder[2] and Adrian Flores-Orozco[1]

(1) Research Group Geophysics, Department of Geodesy and Geoinformation, TU-Wien, Austria

(2) Department of Hydrology, University of Bayreuth, Germany

(3) Institute for Geophysics and Extraterrestrial Physics, TU Braunschweig, Germany

Wetlands are considered as regions where biogeochemical active areas are common. Biogeochemical hot spots are spatially limited areas where processes such as nitrate or sulfate reduction take place in high reaction rates compared to the surrounding area. Biogeochemical hot spots are also of major interest on larger scales due to their possible emission of greenhouse gases and nutrient cycling. Thus, there is a growing demand to investigate the occurrence and spatial extension of hotspots in natural environments, such as wetlands. During sulphur cycling, sulfate reduction occurs and eventually leads to the precipitation of iron sulfides, such as pyrite (FeS_2). The induced polarization (IP) method has originally been developed for the characterization of disseminated sulfide ores for mining applications; hence, it also appears as a suitable method to delineate possible occurrences of hot spots in natural environments. Here, we present results from an IP characterization of hot spots in a wetland area located in the Lehstenbach catchment in southeast Germany. According to the hydrological analysis and modelling, the presumed hot spots in the area are located in the upper 60 cm of the subsurface. To delineate the extent of the hot spots with a high spatial resolution, 26 IP imaging data sets were collected with an electrode spacing of 20 cm and arrays of 64 electrodes. We also investigated the frequency dependence of the IP response using spectral induced polarization (SIP), which permitted us to discriminate between hot spots and the underlying granite bedrock. To evaluate the field-scale SIP signatures, additional SIP laboratory measurements were performed on synthetic iron-sulfide and oxides samples for a detailed analysis of the electrical response and its frequency dependence of iron-bearing minerals. Furthermore, geochemical analysis were performed on materials obtained from freeze-core drillings to examine the concentration of iron minerals as a function of depth. The field scale imaging results reveal an increase in the IP response within the upper 60 cm of the subsurface which correlates with the geochemical analysis i.e. variations in the iron concentration measured in the soil samples.