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Iron sulfide minerals in Black Sea sediments

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This study presents an integrated geochemical, environmental magnetic, and electron microscopic approach to better understand the physicochemical processes in deep sea sediments from the northwestern Black Sea. The investigated gravity core GC 214 was retrieved in 2007 during RV Meteor cruise M72/1 west of the Crimean Peninsula in a water depth of 1686 mbsf.

Geochemical analyses of the pore water and solid phase indicate non-steady state sedimentation. The oxygen-depleted water column conditions, anaerobic oxidation of methane (AOM) and related microbially-driven sulfate reduction favor a highly complex iron sulfide mineral assemblage in the sediment column. The detailed magnetic susceptibility and remanence measurements indicate an irregularly stratified depth profile showing intervals of particularly high values. Further environmental magnetic analyses depict strongly elevated coercivities for those depth horizons, suggesting greigite as one of the main magnetic carrier minerals.

Automated chemical classification (ACC), using electron dispersive spectrometer (EDS) attached to a JEOL840 scanning electron microscope (SEM), on dispersed particle samples permitted the identification of greigite (Fe3S4) next to pyrrhotite (Fe7S8), pyrite (FeS2) and monosulfides (FeS), but also allowed for the absolute quantification of the various mineral phases. These analyses were carried out on magnetic extracts and density separates to be able to calculate budgets between the different present iron sulfides. We obtained excellent correlations between the different iron sulfide concentrations and the magnetic signal. Additional analyses on polished sections yield inside into the details of the sulfidization pathways along the depth profile of the sediment sequence and help to develop a more general process model for this particular geochemical (paleo-)environment.

Keywords: Black Sea, iron sulfides, environmental magnetism, anaerobic oxidation of methane (AOM), scanning electron microscopy (SEM), automated chemical classification (ACC), electron dispersive spectrometer (EDS)