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Detrital and authigenic magnetic micro- and nanoparticles in pelagic sediments of the Equatorial Atlantic

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Magnetic paleofield and paleoenvironmental information of marine sediments is mostly carried by submicron magnetic particles from various sources. Most existing studies make plausible, but largely unconfirmed assumptions about the origin, mineralogy and grain size of the magnetic mineral assemblages of pelagic sediments. This study intends to provide a detailed characterization of magnetic micro- and nanoparticles in oxic to mildly suboxic sedimentary environments of the Equatorial Atlantic and compares three sites (Ceará Rise, Mid Atlantic Ridge (MAR), Sierra Leone Rise) along a W-E transect. This region offers magnetic particle sources such as continental dust, fluvial discharge and weathering of ocean ridge basalts. Remanence, hysteresis, low- and high-temperature rock magnetic investigations were performed on bulk sediments, magnetic extracts and heavy liquid separates and were combined with analytic scanning (SEM) and transmission (TEM) electron microscopy.

Curie temperatures between 580 and 600°C indicate oxidized magnetite as the major low coercivity component in all samples. The Verwey transition (∼110 K) is weakly expressed in the samples from the Ceará Rise and the MAR and disappears at the Sierra Leone Rise. SEM studies on the magnetic extracts show that the quantitative main components are detrital titanomagnetite particles with increasing Ti-content throughout the transect towards the East. Magnetite particles with very low to zero Ti-content provide about one third of the detrital component. They often show shrinking cracks indicating external maghemitization. Further components are octahedral

titanomagnetite crystals, silicates with (titano-) magnetite inclusions and spherules with low Ti-content. An important high coercive component, most likely goethite, is unsaturated at 2.5 T and missing in the magnetic extracts. It is manifested by a large discrepancy of the slopes in field cooling and the zero field cooling low-T curves, which disappear after heating to 340˚C.

Shape, grain size, roundness as well as the degree of preservation of the magnetic grains give insight into the transport mechanisms and regional provenances of the various components. The close coupling of ARM and IRM signals hints at a single source mechanism, eolian dust input, for micro- and nanoparticle fractions in the East of the transect. Therefore, the ARM/IRM ratio indicates mainly grain size variations related to varying wind intensity. In the western Equatorial Atlantic, the accumulation rates of the micro- and nanoparticles are much more weakly coupled. The coarser fraction is reflecting sea level controlled Amazon discharge while the fine fraction is yet to be identified by TEM. In contrary to the eastern part, the ARM/IRM signal of this region expresses rather a grain size mixing than sorting regime.