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The Rock Magnetic Signature of the Neoproterozoic Glaciation's Aftermath

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Magnetic minerals are often strongly sensitive to environmental conditions. Because of that, rock magnetism may be used as a high-resolution tool to unravel the environmental changes held in sedimentary archives. Here we use rock magnetic measurements to investigate the environmental conditions prevailing during the aftermath of one of the Neoproterozoic glacial events (Marinoan). For that, we have acquired several rock magnetic parameters for samples from several locations, including South China, Mauritania, Volta Basin, Amazonia, Russia and Central Brazil. These parameters are derived from classical magnetic measurements (ARM, IRM, hysteresis, susceptibility) and from back scattered electron observations. Some samples have been studied additionally using low-temperature (LT) magnetic techniques. In all samples, low temperature measurements indicate the presence of fine-grained goethite in all samples. Magnetite and hematite are also present in various amounts and different grain sizes.

A detailed analysis was performed for three sections for which we have obtained both magnetic and isotopic data. These are: the Yangjiaping section in South China, the Araras section in Amazonia and the Sete Lagoas section in Central Brazil. The sections are post-Marinoan in age. In all samples, low temperature measurements indicate the presence of fine-grained goethite, while magnetite and hematite are present in various amounts and various grain sizes. Variations in concentration or grain size of the magnetic carriers seem to correlate with changes in the C-isotope signal. Strongly negative δ13C values, above the cap-carbonates, are associated with a loss of remanence intensity, which which probably results from the dissolution of magnetite to form pyrite.

In Amazonia, negative δ13C values found at the base of the cap carbonate succession are associated to hematite (and minor amounts of magnetite), whereas bitumen-rich levels found upsection, are systematically associated to the presence of sulphides, probably resulting from the interaction between organic matter and the primary magnetic minerals. Similarly, cap carbonates from the Sete Lagoas section (Brazil) display hematite at its base that disappears upsection mirroring the increase of δ13C values from –5‰ to +5‰The shape of the Verwey transition during low-temperature measurements also changes along the section, indicating an evolution in grain size.

A synthesis of the magnetic properties found at the different sections and their relation to the C-isotope signal will be shown that helps constrain the environmental significance. The influence of diagenesis on the magnetic and isotopic records will be discussed, as well as the role of methane release and continental weathering during the deglaciation.