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Dust record from the Scotia Sea during the last glacial cyle

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Dust records of Antarctic ice cores provide important information on past atmospheric circulation. They can be used to evaluate global circulation models and to infer the paleoenvironmental conditions of the surrounding continents. East Antarctic ice cores (e.g., EPICA-DML) indicate South America as a major source of dust during glacial stages of the last glacial cycle. There, the cold periods provided drier conditions with increased physical weathering and intensified glacial erosion in combination with a more persistent westerly circulation. We retrieved a deep-sea sediment core from the Scotia Sea, which lies between the presumed source area of the Patagonian loess and East Antarctica, to study the dust history along the trajectory to the Antarctic continent.

Core MD07-3134 was retrieved during cruise MD160 with RV Marion Dufresne II in March 2007 in the Scotia Sea. The core is 58,08 m long and originates from 3663 m water depth. We used core-logging techniques to measure a number of sediment-physical and –optical properties as well as relative paleointensity. Also, we determined biogenic opal, major and minor element concentration, and the amount of ice-rafted debris. Correlation of the dust (Ca2+) record from the EPICA-DML ice core to the magnetic susceptibility record (MS) of site MD07-3134 provides a one-to-one reproduction of virtually every single increase during the last glacial cycle. Therefore, there is sustained evidence that the MS record is a dust indicator. The oceanic record has, on average, higher amplitudes of variability with elevated contents during glacial stages because it is located closer to the Patagonian source area. Specifically during the Last Glacial Maximum, the upper part of Marine Isotopic Stage (MIS) 3, and MIS 4, the Scotia Sea record exhibits strong atmospheric dust signals that did not fully reach the Antarctic continent.

The one-to-one correlation provides a sound age model for the last 91 ka. Accordingly, the Scotia Sea site has relatively high average sedimentation rates of roughly 70 cm/ka. We established up to 20 confident age control points within the boundaries given by the relative paleointensity record and other stratigraphic indicators. The fact that we phase-locked Ca2+ and MS seems reasonable because both signals are atmospheric and, hence, we assume no major leads or lags. With the establishment of a high-resolution age model, upcoming studies will relate in detail the temperature record over East Antarctica to the paleoclimate proxies determined at site MD07-3134.