Climatic control on variations of terrigenous particle provenance and transport in the Scotia Sea (Southern Ocean): evidence from Nd, Pb, and Sr isotopes

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Terrigenous matter constitutes a considerable proportion of total sediment accumulation in Late Quaternary deposits of the Atlantic sector of the Southern Ocean. Input of lithogenic debris from land to sea, mainly to the shelf, is driven by glaciogenic supply from Antarctica, the river systems of South America, and wind transport through the southern westerlies. Deep and bottom water circulation most effectively control the distribution of terrigenous particles in the pelagic realm (Petschick *et al.*, 1996). Variations of terrigenous sediment accumulation rates, grain size properties, and mineralogical composition, as inferred from sediment core studies, support the important role of ocean currents as major particle carriers throughout the late Quaternary (Diekmann *et al.*, 1996; Diekmann and Kuhn, 1997).

Clues exist for increased long-distance influxes of air-borne dust from Patagonia to both the Southern Ocean (Kumar *et al.*, 1995) and Antarctica (Petit *et al.*, 1990) during cold climatic stages. A Patagonian provenance of dust particles in ice cores from East Antarctica has been proposed from $^{143}Nd/^{144}Nd$ isotope data (Basile *et al.*, 1997). This finding documents the importance of an atmospheric pathway during glacial periods, which has also been inferred from deep-sea sediments of the South Atlantic (Kumar *et al.*, 1995). The authors postulated that the increase in primary productivity in the Southern Ocean during glacial periods has resulted from a relief of today's iron limitation by a greater supply of iron-rich aeolian dusts from dry areas of Patagonia. Nevertheless, their interpretation may be challenged because the aeolian dust component of the deep-sea sediments has not been isolated and analysed.

Significant dust deposition in deep-sea sediments probably occurred in the southern Scotia Sea (sediment core location PS2319), indicated by down-core fluctuations of grain size parameters and magnetic susceptibility (Fig. 1). The latter may be correlated with dust records in Antarctic ice cores (Hofmann, in press). Maxima of magnetic susceptibility correspond to dust peaks in ice cores. Similar variations of magnetic susceptibility appear in sediment core PS2515 from the northern Scotia Sea (Fig. 1). However, little is known about provenance and proportions of primary aeolian dust components deposited directly on the sea floor.

In order to investigate the hypothesis of an increased supply of aeolian dust into the Southern Ocean during glacial times, we have analysed the Nd, Pb, and Sr isotope compositions in bulk samples from sediment cores PS2515 and PS2319 of the Scotia Sea located at 53°S, 45°W and 60°S, 43°W, respectively. Both sediment cores span the climate cycles of the last 140 ka, representing marine isotope stages 1 through 6 (Figs. 1).

The isotope data of bulk sediments delineate systematic down-core variations in accordance with signatures of magnetic susceptibility (Fig. 1). In core intervals representing cold stages (marked by maxima of magnetic susceptibility) Nd and Sr isotopes exhibit a higher proportion of a mantle-

derived component possibly originating from rejuvenated crust of the continental margin of South America and/or the Antarctic Peninsula. The influence of the juvenile component is more pronounced in the northern sediment core (PS2515) than in the southern sediment core (PS2319), where contribution of an old crustal component from the Antarctic continent appears to be an important constituent.

The Pb isotope compositions in the cores indicate a complex situation concerning the source of the sediments. At a similar εNd-value, $^{206}Pb/^{204}Pb$ and $^{207}Pb/^{204}Pb$ isotopes may be highly variable indicating different source areas that cannot be distinguished by their Nd isotopes. The Pb isotopes may thus provide additional informations on the sources of the lithogenic components in deep Atlantic sediments. In order to elucidate the transport mechanisms of the isotopically distinct lithogenic components we are currently measuring the isotope compositions on clay and silt fractions.

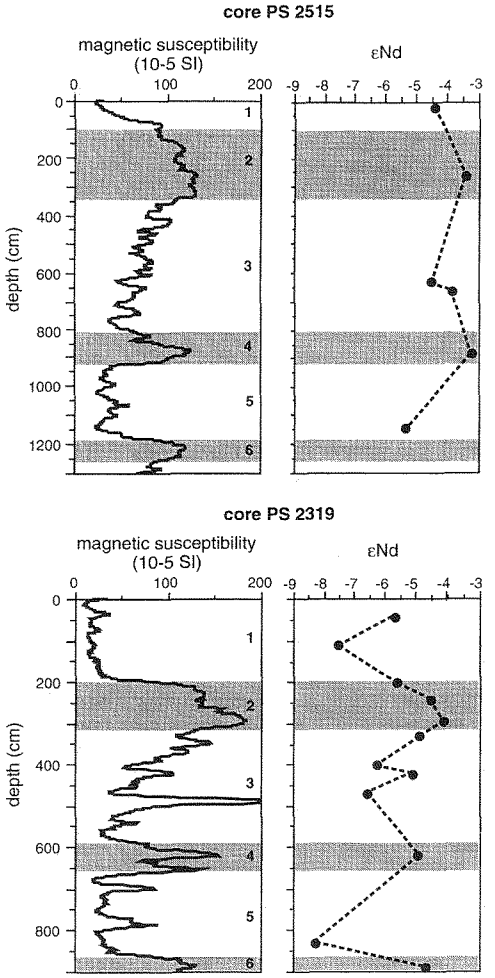

FIG. 1. Plots of magnetic susceptibility and εNd-values of sediment cores PS 2515 (53°S, 45°W, upper graph) and PS 2319 (60°S, 43°W; lower graph) from the Scotia Sea. Numbers indicate main marine isotope stages, glacial periods are shaded.

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