Meridional shifts of the South Westerly Winds over the Southern Atlantic Ocean over the last 40 ka

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The position and strength of the South Westerly Winds (SWW) play an important role in Earth's climate since they control both the Southern Ocean vertical stratification and dust inputs to the area. The latter regulate the biological carbon pump north of the Polar Front, being the primary source of iron, a limiting micronutrient. The observed variations in atmospheric CO2 during the Antarctic Isotopic Maximum (AIM) events could be linked to changes in the primary productivity in the Southern Ocean, as the result of SWW pattern modifications. However, meridional and intensity shifts of the SWW during the Quaternary abrupt events still remain largely debated.

We reconstruct the atmospheric circulation patterns over the last 40 ka using radiogenic isotopes (Pb, Nd and Sr) measured on the <10 µm detrital fraction of core MD07-3076Q (14°13.70'W, 44°9.20'S, 3,770m water depth) as tracers of dust sources to the Atlantic Southern Ocean. There are variations in the radiogenic isotopic compositions both at the Glacial/Interglacial and millennial (AIM8) time scales attesting changes in dust provenance. We also show that the dust flux is reduced during AIM 8.

Statistical analyses show that two main dust sources dominate the radiogenic isotopes variability. However, during AIM 8, a third source also contributes to core site MD07-3076Q. The radiogenic isotopes data show that the two main dust sources are Patagonia and the high altitude North Puna Plateau. North Central Western Argentina, another high altitude area, is likely to constitute the dust source contributing during AIM 8. During MIS 2, when the dust flux peaks, the main dust contributor is Patagonia. The North Puna Plateau relative contribution increases during the warm AIM 8 as well as during the Holocene. However, our results show that the atmospheric circulation patterns during AIM8 and the Holocene were different with a third source contributing during AIM 8. Finally, during AIM 8, our data support a southward shift of the SWW compared to their glacial position, *i.e.* over the Patagonian/Tierra del Fuego ice sheet. Such a shift would explain the greater relative contributions of the high altitude North Puna and North Central Western Argentina compared to Patagonia and the overall reduction of the dust flux. This southward shift of the SWW during AIM 8 is in agreement with a recent study [1] showing a positive coupling between an enhanced deep Southern Ocean ventilation and a decrease of the biological pump efficiency that explains the higher atmospheric CO2 concentrations observed during AIM events.

[1] Jaccard et al., 2016, doi:10.1038/nature16514

Mots-Clés : Dust; Southern Ocean; Antarctic Isotopic Maximum; South Westerly Winds; Radiogenic Isotopes

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