Goldschmidt 2021 Abstract
https://doi.org/10.7185/gold2021.7013

Meridional shifts of the South Westerly Winds over the Southern Atlantic Ocean during abrupt climate events

SYLVAIN PICHAT[1], BLAISE GRAVIER[1], OPHÉLIE LODYGA[1] AND VALENTINE SCHAAFF[1,2]

[1]Laboratoire de Géologie de Lyon, Univ Lyon
[2]Max Planck Institute for Chemistry
Presenting Author: spichat@ens-lyon.fr

The position and strength of the South Westerly Winds (SWW) play a major role in Earth's climate as they control both the Southern Ocean vertical stratification and dust inputs to the area. The latter regulates 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 primary productivity in the Southern Ocean, as the result of SWW modifications. However, meridional and intensity shifts of the SWW during the Quaternary abrupt climate events remain largely debated.

We reconstruct the SWW patterns over the last 40 ka using radiogenic isotopes measured on the <63µm detrital fraction of core MD07-3076Q (14°13.70'W, 44°9.20'S, 3770m bsl) as tracers of dust provenance to the Atlantic Southern Ocean. At the end of AIM1 and beginning of the Holocene we observe variations in the isotopic compositions attesting changes in dust sources. During high dust flux periods (LGM and AIM1) we interpret the radiogenic isotopes compositions as reflecting a mixing between two main dust sources: the Argentinian Pampas and the Puna Plateau, a high-altitude area located further north. The Puna Plateau contribution is higher during AIM1 than during the LGM. We interpreted these provenance variations as a southward shift of the SWW during AIM1, thereby deflating less material from the Pampas to the Southern Ocean as well as more intense/frequent dust storms over the Puna Plateau. During the Holocene, the dust flux is low compared to the previous 30 ka. It is associated with a change of dust sources with two main contributors: the North Puna Plateau and Patagonia.

These results indicate that the mechanisms that generate dust and its transport during AIM1 are different from that of the Holocene. A southward shift of the SWW during AIM1 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