Monitoring Saharan dust chemical variability on the West African margin

Aloys Bory*†[1], Charlotte Skonieczny[2], Viviane Bout-Roumazeilles[1], Sylvie Philippe[1], Quentin Louis[1], Déborah Ponlevé[1], Aboubacry Diallo[3], and Thierno Ndiaye[3]

[1]Laboratoire d'Océanologie et de Géosciences (LOG) – CNRS : UMR8187 – 28 avenue Foch, BP 80 62930 Wimereux, France, France

[2]Massachusetts Institute of Technology, Department of Earth, Atmospheric and Planetary Sciences (MIT) – 45 Carleton St., E25-629, Cambridge, MA 02142, USA, United States

[3]Institut de Recherche pour le Développement (IRD) – IRD, US191 IMAGO – Dakar, Senegal, France

Abstract

Improving our understanding of the spatial and temporal variability of Saharan dust composition is essential to assess the influence of the dust on atmospheric and oceanic realms, and also to enable reconstructing past changes in the dust cycle (modifications in the contributing sources for instance) as recorded in environmental archives. For this purpose, we have been collecting dust deposits on the Senegalese margin (at Mbour, ∼80km south of Dakar) for nearly a decade at a weekly (or better) resolution. Pilot investigations, carried out on the $< 30\mu$m calcium carbonate-free fraction, reveal a marked seasonal variability in the dust elemental composition (measured by ICP-OES/ICP-MS). Ca/Al and Ti/Al ratios, for example, are higher during the dry winter-spring season, which is when most of the dust is deposited at our site, while K/Al and Na/Al, among other ratios, increase during the wet summer monsoon season. This variability reveals changes in dust provenance linked to the seasonal migration of the ITCZ and associated shift in wind patterns over West Africa. The observed geochemical variations likely reflect, to a large extent, the higher degree of chemical alteration of the Sahelian source terrains (activated only during the winter, when the ITCZ lies at lower latitudes) compared to the northern Saharan dust sources. This is supported by earlier investigations based on clay mineralogy measurements [Skonieczny et al., EPSL, 2013]. Part of the observed chemical variability, however, reflects the contrasting original lithology of the various contributing sources: dust derived from the Atlantic coastal region of the Western Sahara, for instance, is enriched in phosphorus. The extent to which data obtained so far (including trace elements concentrations and a few Sr-Nd isotopic ratios) enables us to typify the mineralogical and geochemical signatures of the other major dust source regions impacting the tropical Atlantic region will be discussed.

Keywords: mineral dust, Sahara, Sahel, West Africa, major and trace elements, clay mineralogy, Sr and Nd isotopes

*Speaker

†Corresponding author: aloys.bory@univ-lille1.fr