Physico-chemical characterisation and tracing of dust deposition in snow from Dronning Maud Land, NE Antarctica

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Abstract

Mineral dust is a major source of micronutrients (e.g. Fe) in open oceans and "High Nutrient Low Chlorophyll" (HNLC) zones. The southern Ocean is by far the largest of all HNLC regions and thus has the potential to greatly enhance the biological CO2 pump at the global scale. As the aerosol fluxes in the southern ocean are not well constrained and the potential impact of anthropogenic airborne particles may be larger than expected, a multidisciplinary study is being carried out on dust-bearing snow samples collected in NE Antarctica.

Samples were collected at the coast and 200km inland, near the Sør Rondane Mountains. Particulate and dissolved phases were separated by filtration on 0.2µm poresize membranes. These samples were investigated to (i) characterize the size, morphology, chemistry and mineralogy of dust by single particle analyses (automated-FEG-SEM-EDS), (ii) trace the origin, the geographical variability and the relative contributions of natural and anthropogenic sources from particulate and dissolved phases, through trace element analysis (HR-ICP-MS), (iii) approach the iron bioavailability via the determination of the Fe(II)/Fe(III) speciation at the particle scale by synchrotron analysis.

Samples exhibit a fine particle-size distribution (> 98% of particles < 5µm, n=2500) and > 70% of the particles contain Fe, either in mineralogy, coating or both. Coastal samples indicate a finer grain size and a much higher Fe content in coatings. While the mineralogy suggests a substantial contribution from local Sør Rondane Mts., high Cr, Zn, Cu, Cd & Pb enrichment factors (x10 to x100 relative to upper continental crust) indicate an important

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anthropogenic contribution at the coast. Furthermore, the dissolved phase has much higher enrichments in transition metals, up to 10x the particulate phase. Finally, rare earth element profiles strongly suggest local (Sør Rondane Mts., Southern Ocean sea spray) and distant (Patagonia) sources.

**Keywords:** Dust, Antarctica, SEM, EDS, Sources tracing, Fe bioavailability