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Patagonian and Southern African Dust input to Southern Indian Ocean

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The respective contributions of continental dust sources to the Southern Ocean are poorly defined. Such data is however of primary importance for constraining the increasingly sophisticated models developed nowadays. In the present study, total atmospheric deposition over the Southern Indian Ocean was measured continuously for two years, on both Crozet (46°S-53°W) and Kerguelen (49°S-69°W) Islands. REEs profiles, lead and neodymium isotopic ratios were found to differ between Crozet and Kerguelen, except during the austral winter, where higher lead enrichment factors have previously been measured. Dust aerosol concentrations were also simultaneously measured at the same place and during five years at an expected source region in dry Patagonia (Rio Gallegos, Argentina).

Using deposition flux (Df) and aerosol concentrations (C), calculated scavenging ratios (W) varies from 1000 to 46000 [1], far away than used by authors to compute Df from C measurements. Such high and variable scavenging ratio numbers are produced because C is measured near the surface, which is not the cloud scavenged aerosol. In the case of our experiment, the underestimation of F w using C and W reaches a factor of 50 compared to direct measurements for the whole observation duration. All atmospheric flux calculation based on dust concentration in air are subjected to this large underestimation and have to be not used in biogeochemical models.

Comparison with published lead isotopic composition data from continental sources in the Southern Hemisphere (South America, Southern Africa and Australia) suggests that lead on Crozet mainly originates from Southern Africa. On Kerguelen Islands, the situation is similar to Crozet during the austral winter, but for the rest of the year, South America is a more probable predominant source. There was no evidence of a notable contribution from Australia. REEs profiles were presented using compositional statistics and were found different at Crozet and at Kerguelen suggesting different origin for crustal elements. This is confirmed with the Neodymium isotope ratio which is characteristic of Patagonian soil for all seasons except winter at Kerguelen and shows a mixture of sources at Crozet and at Kerguelen during winter.

Aerosol concentration measured in the source Patagonian region clearly show a seasonal pattern supporting a seasonal deposition flux driven by a seasonal emission intensity in Patagonia.

[1] Heimburger, Losno, Triquet, Dulac & Mahowald, GBC, 26, 10.1029/2012GB004301