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Analysis of impurities from Talos Dome ice core to assess the solubility of different elements using INAA and ICP-SFMS

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Antarctic ice cores play a central role in paleoclimatic reconstructions, as they provide a high resolution archive of past climatic and environmental processes. This study focuses on the TALDICE ice core drilled at Talos Dome (East Antarctica, 72°49'S, 159°11'E), which covers more than 343k years of climate history. A comparison is presented between samples analyzed through two different techniques: low background instrumental neutron activation analysis (INAA) and inductively coupled plasma mass spectrometry (ICP-SFMS). While the former is used to investigate only the insoluble fraction of dust, as it can only be applied to solid samples, the latter is used to assess the elemental composition of both the total and the soluble fraction of dust. We thus observe how different elements partition between soluble and insoluble phase at different depths of the ice core and link the geochemical patterns of the considered elements to the main climatic oscillations covered in the Talos Dome ice core.

We determined 45 elements through ICP-SFMS and 39 through INAA, with a good overlapping of the elements between the two techniques. Besides the determination of major elements (Na, Mg, Al, Si, K, Ca, Ti, Mn, Fe), which is important in the assessment of the impact of dust on the ecosystem (e.g. source of nutrients in the Southern Ocean), the high sensibility of both techniques also permitted the determination of trace elements. Among these, rare earth elements (REE) are of particular importance as they have been widely used as a geochemical tracer of aeolian dust sources.

We present enrichment factors and correlation matrices to assess the crustal or non-crustal origin of the considered elements. The high correlations and low enrichment factors found among insoluble elements confirm a prevalent crustal composition for mineral dust. Regarding solubility, the majority of elements exhibits a minimum in solubility during the last glacial maximum. This is the result of higher fluxes of mineral dust transported to the Antarctic continent during cold climate periods and is consistent with the crustal origin we documented for most of the elements considered.