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Soluble/insoluble fractionation of elements in mineral dust from Antarctic samples

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Deposition of dust on the Antarctic continent is controlled by many factors, such as the primary supply of dust particles from the continents [1], the long range transport, the hydrological cycle and the snow accumulation rate [2, 3]. Thus, the study of mineral dust in ice cores gives the possibility to reconstruct past climatic and environmental conditions.

Generally, when an ice core sample is melted, soluble elements dissolve in water, while insoluble elements remain in the solid phase. Other elements, such as iron, calcium, potassium and sulfur, typically partition between the soluble and the insoluble fractions. However recent studies have shown how the dust record may be chemically and physically altered in deep ice cores [4, 5], posing a challenge in the interpretation of the climatic signal that may lie within such samples. In particular, relative abundance of specific elements was shown to be different when comparing shallow and deep dust samples, suggesting that post depositional processes are taking place.

In this study we present a comparison between samples belonging to the Talos Dome ice core analyzed through two different techniques: instrumental neutron activation analysis (INAA) and inductively coupled plasma mass spectrometry (ICP-MS). 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 determined 45 elements through ICP-MS and 39 through INAA, with a good overlapping of the elements between the two techniques. Besides the determination of major elements, 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 [6]. We here present depth profiles for each analysed element, covering discrete portions of the entire ice core.

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