ULTRA-SENSITIVE DIRECT DETERMINATION OF RARE EARTH ELEMENTS IN ANTARCTIC ICE CORE SAMPLES BY ICP-SFMS USING A DESOLVATION SYSTEM

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Rare Earth Elements (REE) have been widely adopted as excellent proxies for several geochemical processes. Their importance as a robust and powerful tracer is essentially due to two reasons. Firstly, REE are fractionated in the environment due to small but systematic differences in their chemical properties, resulting from their identical trivalent charge and the concomitant systematic decrease in ionic radius with increasing atomic number (the so-called lanthanide contraction). Secondly, REE show a conservative behaviour in the environment, due primarily to their low solubility and relative immobility in the terrestrial crust. As they are mostly transported in the atmosphere in the particulate phase, the REE content of atmospheric particulate matter will reflect the characteristics of the original site of provenance,

The successively dated snow and ice layers that are deposited in permanent glaciers in polar regions have proven to be valuable archives for studying the biogeochemical cycles of trace elements in the Earth's system. So far, REE determination has never been extensively attempted in glacial paleoclimatic archives such as polar ice cores, essentially because of the extremely low REE concentration and because of the limited volume of the samples.

Inductively Coupled Plasma Sector Field Mass Spectrometry (ICP-SFMS) is one of the most commonly used techniques for the determination of REE in natural waters because of the capability for a rapid multi-element detection over a wide concentration range with relatively low detection limits. Until now, complete REE determinations were never been performed in ice cores.

We present a new analytical methodology, based on ICP-SFMS coupled with a micro-flow nebulizer and a desolvation system, for the direct determination of Rare Earth Elements (REE) (La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu) down to the sub-ppt level (1 ppt = 1 pg g^{-1} = 10^{-12} g g^{-1}) in molten Antarctic ice.