

# **Ultrasensitive determination of lead isotopes at the sub-picogram per gram level in NEEM ice core from Greenland by thermal ionization mass spectrometry**

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Ultraclean analytical procedures and an improved decontamination method have been developed to minimize contamination problems and to accurately determine Pb isotopic compositions in North Greenland Eemian Ice Drilling (NEEM) deep ice core sections with concentrations at the sub-picogram per gram level. In the case of the analysis of Pb isotopes using thermal ionization mass spectrometry (TIMS), ionization efficiency can significantly vary depending on sample loading on the filament with silica-gel activator. A new silica-gel activator produced by PL-7 (Fuso Chemical) has replaced the previously used colloidal silica activator produced by Merck. A PL-7 silica-gel activator was then validated to provide sufficiently enhanced ion beam intensity for Pb isotope analysis with a very small amount (a few tens of picograms) of Pb. The blank contributions from reagents, laboratory materials and silica-gel activator were carefully evaluated. The results show that these blanks are negligible for the concentrations of Pb to be measured in the NEEM ice core. The decontamination and analysis of the artificial ice cores and selected NEEM ice core sections by means of an improved decontamination method confirmed the cleanliness and effectiveness of the entire analytical procedures.