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Tracing Extraterrestrial Dust in Polar Ice by Helium Isotopes – New Results from the EPICA Dronning Maud Land Ice Core

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Interplanetary dust particles (IDP) fall to the Earth at a rate of $\sim$ 40.000 tons per year. A fraction of the cosmic dust is archived in the polar ice sheets, together with the much more common terrestrial dust. Helium isotope analysis of ice core samples can be used to trace the flux of interplanetary dust particles as ^{3}He is highly enriched in IDPs compared to any terrestrial source and is well retained in the record.

Detailed analysis of the helium isotopic composition of particulate matter in ice cores has so far been impossible because of limited access to the large sample sizes needed ($>$1kg). Here, we present a new method to analyze helium isotopes in particles from ice. This technique samples the excess water stream from the melt-head of a continuous flow analysis for aerosol chemistry. The particulate material is collected on silver filters which are subsequently analyzed in a noble gas sector field mass spectrometer. This technique allows in principle to analyze continuous or quasi-continuous ice core records of any age.

We present the first high-resolution glacial-interglacial record of cosmic dust flux from the EPICA ice core drilled in Dronning Maud Land (EDML). The samples analyzed cover the transition from the last glacial maximum to the Holocene. Sample size was approximately 5kg representing time intervals varying between of 300-600yr for the glacial and 150-200yr for the interglacial.

The ^{3}He/^{4}He ratios vary from $4{\cdot}10^{-5}$ to $2.7{\cdot}10^{-4}$ (i.e., from 30 to 200 times the

atmospheric helium isotope ratio) indicating that virtually all the ^{3}He is of extraterrestrial origin. Using the well-constrained snow accumulation rate of the EDML core, extraterrestrial ^{3}He fluxes can be determined. Most importantly, we do not observe significantly different ^{3}He fluxes between the glacial and interglacial. The ^{3}He fluxes are in good agreement with previous estimates from marine sediments thus strongly supporting the use of ^{3}He as a ‘constant flux proxy’ in paleoclimatology. These results are promising and reveal the huge potential to use the IDP-derived information for improving interpretations of ice core records particularly in the older parts of the ice core where chronologies rely on modeling and related uncertainties are significant.