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High resolution biogenic sulphate record in the Holocene from EPICA-DML ice core

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Thanks to the relatively high annual accumulation rate (around 64 mm w.e.) and the high ice thickness (about 2750 m), the EPICA-DML ice core, drilled at at Kohnen Station (Dronning Maud Land - East Antarctica), provided highly resolved stratigraphies of chemical, isotopic and physical parameters able to reconstruct past atmospheres along the last glacial cycle.

High resolution total sulphate profile was obtained by on-site Fast Ion Chromatographic (FIC) measurements of ice core strips, continuously supplied by a melter device, with a 1-cm depth resolution. In the Holocene, such depth resolution corresponds to a sub-annual frequency, able to reveal, for a large part of the record, the seasonal oscillation of the biogenic source. Such variations are linked to changes in oceanic productivity which are assumed to play a key role in controlling the climate in clean marine environment by several processes (e.g. atmospheric CO2 uptake and albedo variation).

At this purpose, extra-biogenic contributions, such as crustal, sea spray and volcanic sources, were computed and subtracted from sulphate concentration. Crustal and marine inputs were calculated from Ca and Na high resolution (1 mm) data yielded by Continuous Flow Analysis (CFA).

The age scale has been taken from the EDML1 timescale, achieved transferring the dating of EPICA Dome C ice core (EDC3) to EDML ice core via volcanic signatures

synchronization.

As it can be observed from the high resolution profile and by the low relative standard deviation of biogenic sulphate concentrations, the contribution of the biogenic source appears to be quite constant along the late Holocene with small oscillations around the mean value.

The biogenic sulphate oscillation on centennial to millennial scale which can be detected in the profile needs to be confirmed from further investigation by spectral power analysis.

Due to the high resolution of the record, a stratigraphic dating was attempted for the late Holocene, using known sulphate spikes and isotopic features as tie points. The number of the years which were recognized in each interval of the biogenic sulphate record is generally close to the one calculated from the EDML1 timescale. As expected, the uncertainty increases as function of depth due to the decrease of temporal resolution.