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Isotopic composition of the air trapped in the EDML Ice Core (δ^{15}N, $\delta^{18}O_{atm}$, δ^{40}Ar, $\delta O_2/N_2$) over the last 140 kyrs

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The European Project for Ice Coring in Antarctica (EPICA) allowed the drilling of two deep ice cores on the East Antarctic Plateau. We focus on the 2755 m-depth ice core drilled at Kohnen Station (EDML – 75˚00'S, 00˚04'E, 2892 m a.s.l) and the isotopic composition of the air trapped in this ice over the last glacial-interglacial cycle. Due to the accumulation rate at Kohnen Station (6.7 cm.g^{-1}.an^{-1}) the EDML ice core provides a record which permits a study at millennial scale of climatic variations over the last 150 kyrs. We present continuous isotopic measurements of the air trapped in the ice (δ^{15}N, $\delta^{18}O_{atm}$, δ^{40}Ar, $\delta O_2/N_2$) over the 8-140 kyrs period with a 600 yr-resolution for the 8-40.5 kyrs and the 70-140 kyrs periods.

The $\delta^{18}O_{atm}$ profile confirms the integrity of the record back to 140 kyrs BP and provides new constraints for the EDML ice core dating.

Between 70 and 140 kyrs, we obtain a regular signal of $\delta O_2/N_2$ varying between 0 and -10 permil with very small analytical uncertainty ($\pm$1.2 permil). These variations are slightly smaller than those measured in Vostok and Dome F ice cores and the correlation between the profiles of $\delta O_2/N_2$ and of local insolation is less clear than in

these sites. We are therefore cautious in using such a signal for orbital dating of the EDML ice core.

The δ^{15}N and δ^{40}Ar signals are expected to give local information on the evolution of the firn structure, in close link with local temperature and accumulation rate. We confronted our measurements with δ^{15}N and δ^{40}Ar deduced from firn densification models. Since none of these models with different temperature / accumulation rate scenarios are able to reproduce the measured signals, we question the firn physic incorporated in the model and the possibility to include additional components into densification models (convective zone, eddy diffusivity and the nature of the snow). Knowledge about the mismatch between firn densification models and δ^{15}N measurements is important because the same firn densification models are used to determine the gas age/ice age difference, a parameter essential for ice cores dating and for analysing the sequence of events between atmospheric composition and polar temperature.