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New ice core records on the glacial/interglacial change in atmospheric delta 13C of CO2

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The reconstruction of the carbon isotopic composition of CO_2 ($\delta^{13}C$) using Antarctic ice cores promises a deeper understanding on the causes of past atmospheric CO2 changes. Previous measurements on the Taylor Dome ice core over the last 30,000 years indicated marine processes to be dominating the significant $\delta^{13}C$ changes over the transition, whereas glacial $\delta^{13}C$ was only slightly depleted relative to the Holocene. However, significant uncertainty and the low temporal resolution of the Taylor Dome $\delta^{13}C$ data prevented a more detailed interpretation. Recently, substantial improvements have been made in the analysis and the resolution of ice core $\delta^{13}C$ records. With these and new measurements presented here, three independent $\delta^{13}C$ data sets over the last glacial/interglacial transition have now been derived from the two EPICA and the Talos Dome ice cores. Two of the methods use traditional dry extraction techniques with a reproducibility of 0.07-0.1‰ . The third method uses a novel sublimation technique with a reproducibility of 0.05‰ . Here we compare the data sets, their analytical setups and discuss their joint information as well as their differences. The three records provide a more detailed picture on the temporal evolution of $\delta^{13}C$ and confirm two pronounced isotope minima between 18-12,000 years BP in parallel to the two major phases of CO_2 increase as also reflected in marine sediments. Accordingly, a release of old carbon from the deep ocean is most likely responsible for a large part of the long-term increase in atmospheric CO_2 in this time interval. However, the fast CO_2 jumps at a round 12,000 and 14,000 years BP may be partly of terrestrial origin. The new sublimation data set provides also unambiguous $\delta^{13}C$ data for clathrate ice in the LGM. This shows a rather constant $\delta^{13}C$ level, which is only about 0.1‰ lower than the Holocene, despite significant changes in the terrestrial and marine carbon storage. Accordingly, during the LGM the changes in the different processes acting on the glacial carbon cycle largely compensate each other with respect to $\delta^{13}C$ as predicted by carbon cycle modeling.