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The carbon isotopic signature of CO_2 in the current and penultimate interglacial period: ocean, peat or human influences?

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The current anthropogenic increase of CO_2 over the last 150 years raises the question in how far preindustrial changes in the carbon cycle led to long-term changes in atmospheric CO_2 during warm climate conditions. Antarctic ice core records show that past interglacials differ significantly in their temporal CO_2 evolution, but the reasons for this are still a matter of debate. E.g. the Holocene is characterized by a 20 ppmv increase in CO_2 over the last 7000 years (Indermühle et al., 1999), while the penultimate interglacial exhibits rather constant CO_2 concentrations after an initial CO_2 maximum. Moreover, CO_2 concentrations lag the temperature decline in the Southern Ocean region at the end of Marine Isotope Stage (MIS) 5.5 (Fischer et al., 1999; Petit et al., 1999).

Essentially two different ways to explain the Holocene CO_2 increase have been put forward: (i) changes in the terrestrial biosphere storage by natural (Indermühle et al., 1999) or early anthropogenic (Ruddiman, 2003) causes and (ii) changes in the ocean carbonate budget in the deep (carbonate compensation; Broecker et al., 2001) or surface (coral reef growth; Ridgwell et al., 2003) ocean. A reliable $\delta^{13}CO_2$ record from the EPICA Dome C ice core over the Holocene (Elsig et al., 2009) has recently shown that the isotopic signature of CO_2 is not in line with a significant net release of carbon from the terrestrial biosphere. However, opposing carbon fluxes by vegetation release and peat uptake may obliterate the picture.

Here we present latest $\delta^{13}CO_2$ data from MIS5.5, a time period certainly not influenced by an anthropogenic carbon release by deforestation or other land use changes. We compare both the overall level of the carbon isotopic signature between both interglacials and the long-term evolution within the two warm periods to draw conclusions on the potential reasons for CO_2 changes during both time periods.

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