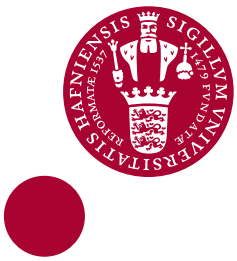

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Global biosphere primary productivity over the last 800,000 years reconstructed from the triple-isotope composition of dioxygen trapped in polar ice cores

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The primary production, or oxygenic photosynthesis of the global biosphere, is one of the main source and sink of atmospheric oxygen (O_2) and carbon dioxide (CO_2), respectively. There has been a growing number of evidence that global gross primary productivity (GPP) varies in response to climate change. It is therefore important to understand the climate- and/or environment controls of the global biosphere primary productivity for better predicting the future evolution of biosphere carbon uptake. The triple-isotope composition of O_2 ($\Delta^{17}O$ of O_2) trapped in polar ice cores allows us to trace the past changes of global biosphere primary productivity as far back as 800,000 years before present (800 ka). Previously available $\Delta^{17}O$ of O_2 records over the last ca. 450 ka show relatively low and high global biosphere productivity over the last five glacial and interglacial intervals respectively, with a unique pattern over Termination V (TV) - Marine Isotopic Stage (MIS) 11, as biosphere productivity at the end of TV is ~ 20 % higher than the four younger ones (Blunier et al., 2012; Brandon et al., 2020). However, questions remain on (1) whether the concomitant changes of global biosphere productivity and CO_2 were the pervasive feature of glacial periods over the last 800 ka, and (2) whether the global biosphere productivity during the “lukewarm” interglacials before the Mid-Brunhes Event (MBE) were lower than those after the MBE.
Here, we present an extended composite record of $\Delta^{17}O$ of O_2 covering the last 800 ka, based on new $\Delta^{17}O$ of O_2 results from the EPICA Dome C and reconstruct the evolution of global biosphere productivity over that time interval using the independent box models of Landais et al. (2007) and Blunier et al. (2012). We find that the glacial productivity minima occurred nearly synchronously with the glacial CO_2 minima at mid-glacial stage; interestingly millennia before the sea level reaches their minima. Following the mid-glacial minima, we also show slight productivity increases at the full-glacial stages, before deglacial productivity rises. Comparison of reconstructed interglacial productivity demonstrates a slightly higher productivity over the post-MBE (MISs 1, 5, 7, 9, and 11) than pre-MBE ones (MISs 13, 15, 17, and 19). However, the mean difference between post- and pre-MBE interglacials largely depends on the box model used for productivity reconstruction.