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## Dating monospecific and single-shell benthic foraminifera samples with a gas ion source: implications for the hypothetical release of <sup>14</sup>C-depleted CO<sub>2</sub> from ocean mid-waters into the atmosphere

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The evidence for very old intermediate waters during the glacial and deglaciation periods and their relationship with the evolution of atmospheric pCO<sub>2</sub> are still debated issues. The <sup>14</sup>C-depletion of intermediate waters may be linked to the Dansgaard-Oeschger (DO) and Heinrich (H) events abrupt climatic changes, which affected the stratification and dynamics of the global ocean during the last glacial period.

As shown by various proxies measured in ocean sediments, intermediate waters also experienced large variations of dissolved oxygen content, which may have affected the carriers of the geochemical signals, notably mixed benthic foraminifera used for <sup>14</sup>C reconstructions. A key aspect is therefore the ability to measure <sup>14</sup>C in high sedimentation rate cores and to analyze separately samples composed of monospecific benthic foraminifera adapted to oxic or suboxic conditions. Perturbing processes such as bioturbation should also vary with oxygen content, and it is also advisable to date single shells in order to evaluate their age spectrum at selected depths in the sediment.

We will present our progress in dating benthic foraminifera from a high sedimentation rate core from the northern Indian Ocean. The sediments located within the present oxygen minimum zone are partly laminated and we first measured several independent geochemical records to reconstruct hydrological and oxygen conditions over the last 50 kyr. Collectively, these proxies show marked variations that are in stratigraphic agreement and correlate precisely with DO and H events, independently dated in Greenland ice cores and in Chinese stalagmites.

For <sup>14</sup>C measurements of small samples we used the gas ion source of the AixMICADAS facility (Bard et al. 2015 NIMB) equipped with the gas interface system coupled to the carbonate handling system (CHS). Our method is based on the online leaching of ca. 30 % of the sample mass with HCl using the CHS, followed by complete hydrolysis of the residual carbonate with phosphoric acid. The precision, accuracy and blank levels have been tested extensively with IAEA C1 and C2 reference materials and internal standards, including old (>100 kyr BP) foraminifera.

We applied these techniques to the Indian Ocean core on 12 different species of benthic foraminifera adapted to various dissolved oxygen conditions. For sections corresponding to DO events, the <sup>14</sup>C age difference between benthic and planctonic foraminifera is broadly similar to that observed in the modern ocean (around 500 yr).

Surprisingly, large <sup>14</sup>C deviations are observed during the transition into the H1 period with all suboxic species systematically 2 kyr older than benthic foraminifera adapted to oxic conditions. The significant <sup>14</sup>C difference between benthic foraminifera picked at the same depth could be explained by bioturbation and migration in the sediment.

Our results suggest that care should be taken at the abundance variations of individual benthic foraminifera and that monospecific benthic samples should be used to reconstruct <sup>14</sup>C reservoir ages of intermediate waters. This will be crucial to settle the debate about the existence of large residence time in mid-ocean layers and on the hypothetical consequence of abrupt release of <sup>14</sup>C-depleted CO<sub>2</sub> into the atmosphere.