Ocean circulation and carbon cycling during the last deglaciation: global synthesis

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IPODS-OC3 workshop, Cambridge, UK, 6-9 September 2018

The transition of Earth's climate from the cold Last Glacial Maximum (LGM) to the warm Holocene is still not fully understood. It is associated with a rise in atmospheric CO_2 acting as an important driver of the global warming. Although changing ocean circulation during the deglaciation has been linked to the rates of CO_2 increase, its exact mechanism remains unclear, and quantifying changes in the ocean circulation and carbon storage remain challenging tasks.

The overarching goal of PAGES' working group Ocean Circulation and Carbon Cycling (OC3) is to compile global foraminiferal carbon ($\delta^{13}C$) and oxygen ($\delta^{18}O$) isotope data and compare them with model simulations to better understand changes in ocean circulation and carbon cycling during the last deglaciation. INQUA's Investigating Past Ocean Dynamics (IPODS) focus group works towards the same scientific objective by synthesizing complementary global ocean circulation proxy data such as radiocarbon ($\Delta^{14}C$), ϵNd and Pa/Th. This joint IPODS-OC3 workshop aimed to make progress through new regional and global data syntheses and their combination with isotope-enabled model simulations.

The workshop brought together 40 international scientists – sea-going paleoceanographers and modelers – to report the progress within the working groups, to discuss potential overlaps between the communities and to identify potential joint aims.

On the first day of activities, OC3 regional syntheses group leaders gave updates of current activities and work progress from different ocean basins (North and South Atlantic, and Indian Ocean). Additionally, posters were presented on regional datasets and modeling approaches. $\delta^{13}C$ and $\delta^{18}O$ data were discussed with respect to the importance of deep and intermediate water distribution and circulation, and importance of the different ocean regions for CO_2 storage and deglacial CO_2 release.

The focus of the discussion was on new age-model and data-visualization software tools, including age-model approaches PARIS (Claire Waelbroeck), HMM-Match (Lorraine Lisiecki) and the age-model software and visualization tool PaleoDataView (Stefan Mulitza). Discussions included the differences of the approaches, age-model error assessments and uncertainties in reservoir age corrections.

Age models are an important backbone of OC3 and IPODs databases. As nearly all cores in the IPODS database are also included in the OC3 database (Fig. 1), the same age models will be used for the global synthesis to enable the direct comparison of different proxy records from the same cores.

The second day of the conference was designated to the IPODS working group. General summaries of the current knowledge in ϵNd, Pa/Th and $\Delta^{14}C$ were given by work-group leaders, followed by presentations of recent compilation studies (Pietrowski, Blaser; Ng et al. 2018).

The final day of the workshop was dedicated to future plans of OC3 and IPODS. The participants encouraged OC3 to proceed with the database effort and developed a strategy for the refinement of the data synthesis, including the development of quality-check guidelines and consistent age-model generation. Extensive labor is needed to generate consistent age models and to ensure data quality. A detailed work plan for the next year includes the release of the final database structure with already published regional synthesis datasets, publishing of the Atlantic Ocean synthesis in the beginning of 2019, and work on syntheses papers in the summer of 2019. The chair of OC3 was passed from Andreas Schmittner to Janne Repschläger. Juan Muglia will join the steering committee in the function of database manager.

The workshop added momentum to IPODS and OC3 activities such as the writing of an ϵNd review paper, the creation of a joint database including $\delta^{13}C$, $\delta^{18}O$, ϵNd, Pa/Th and $\Delta^{14}C$, and the exploration of common plans for the future.

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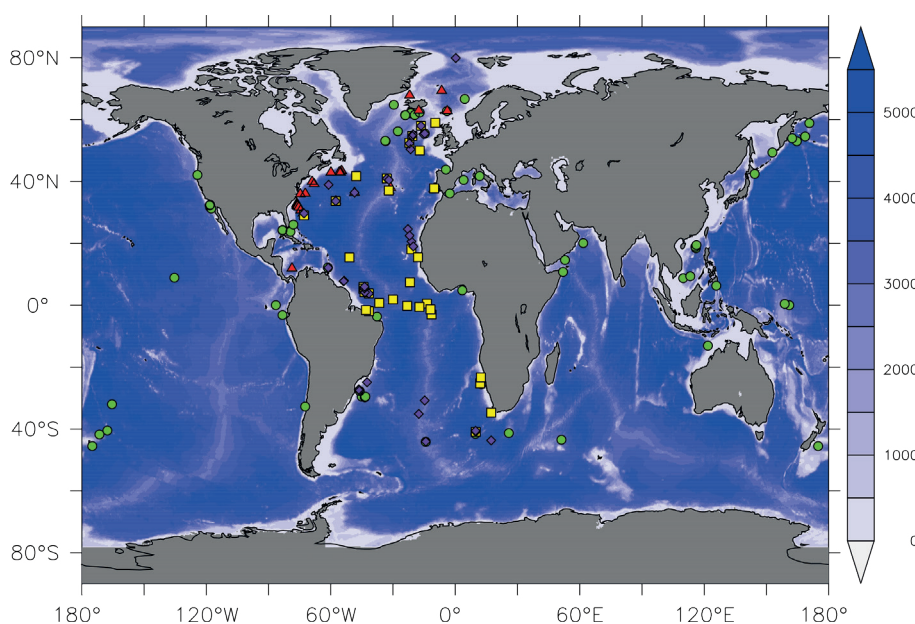Zhao N et al. (2018) Paleoceanogr Paleoclimatol 33: 128-151

Figure 1: Map showing cores included in the OC3 and IPODS databases covering the last deglaciation. Green circles show published high-resolution $\delta^{13}C$ data prioritized for quality control. Red triangles are radiocarbon data from Zhao et al. (2018). Yellow squares are Pa/Th data (Ng et al. 2018) and purple diamonds are ϵNd data.