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Towards improved constraints on the timing of deep-water ventilation changes and the marine reservoir effect in the Southern Ocean between 40-10 kyr BP: A tephrochronological and radiocarbon approach

Peter Abbott (1,2), Samuel Jaccard (1), Steve Barker (2), Julia Gottschalk (1), Luke Skinner (3), and Clare Waelbroeck (4)

(1) Institute of Geological Sciences and Oeschger Center for Climate Change Research, University of Bern, Baltzerstrasse 1-3, Bern 3012, Switzerland , (2) School of Earth and Ocean Sciences, Cardiff University, Park Place, CF10 3AT, Cardiff, UK, (3) Godwin Laboratory for Palaeoclimate Research, Earth Sciences Department, University of Cambridge, Downing Street, Cambridge CB2 3EQ, UK, (4) Laboratoire des Sciences du Climat et de l'Environnement, LSCE/IPSL, CNRS-CEA-UVSQ, Université de Paris-Saclay, Domaine du CNRS, bât. 12, Gif-sur-Yvette 91198, France

Establishing tighter constraints on phase relationships between sedimentary evidence for deep-water ventilation and associated outgassing of carbon dioxide (CO_2), and ice-core evidence for past atmospheric CO_2 variations can help in testing models of past relationships between climate and CO_2. The rate and timing of deep-water ventilation can be determined through paired 14C dating of planktonic and benthic foraminifera in marine sequences, however, uncertainty still exists regarding the temporally variable marine reservoir effect, the age offset between the atmosphere and surface waters. Providing independent age control for marine sequences and/or directly synchronising the marine and ice-core records can provide constraints on the reservoir effect and aid comparisons between these records. This can be achieved using tephrochronology, with common horizons of volcanic ash traced between palaeoclimatic sequences acting as time-synchronous tie-lines due to their rapid deposition. This allows ages unaffected by the reservoir effect (e.g. terrestrial 14C, Ar/Ar, ice-core) to be transferred into the marine chronologies.

We are applying this approach within the Atlantic sector of the Southern Ocean, a key area for the release of CO_2 via deep-water ventilation during the deglaciation that has several upwind volcanic systems known to have deposited volcanic ash over the region. Two marine cores with pre-existing ventilation age estimates (MD07-3076Q and TN057-21) are currently under investigation using recently developed methods for the identification of marine cryptotephras, ash horizons not visible upon core inspection. Here we report on the initial results of these investigations and discuss the future potential for the tephrochronological correlation of these records to Antarctic ice-core records and/or proximal sequences and further constraining marine reservoir estimates and ventilation age reconstructions from these sequences.