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Using high-resolution radiocarbon, stable-isotope and trace-element variation in Bahamian speleothems to investigate the climate-system during the last glacial period

D. L. Hoffmann (1), D. A. Richards (1), P. L. Smart (1), J. W. Beck (2), B. A. Paterson (3), D. P. Mattey (4), C. J. Hawkesworth (3)

(1) School of Geographical Sciences, University of Bristol, UK

(2) NSF AMS Facility, University of Arizona, USA

(3) Department of Earth Sciences, University of Bristol, UK

(4) Department of Geology, Royal Holloway, University of London, UK

(Dirk.Hoffmann@bristol.ac.uk / Phone: +44 (0)117 9289111)

Significant fluctuations in the atmospheric concentration of radiocarbon (Δ^{14}C) have been observed at decadal to millennial timescales and attributed to changes in terrestrial or solar magnetic fields, and/or changes in the carbon cycle, particularly ocean circulation. Previously, we presented a continuous record of atmospheric radiocarbon from 45 to 11 ka B.P. based on TIMS U, Th and Pa measurements and AMS ^{14}C ages of a stalagmite (GB-89-24-1) from a cave on Grand Bahama (Beck et al., 2001). This record revealed elevated Δ^{14}C for the duration of growth and a general decline in Δ^{14}C between 26 and 11 ka B.P., from $\sim$ 700 to $\sim$ 100 ‰, which was considered too large to be solely a result of reduced production via increased shielding by the Earth's magnetic field and was probably related to redistribution of ^{14}C during a mode of ocean circulation much different to the present day.

Here, we focus on efforts to reproduce and explain the millennial and sub-millennial Δ^{14}C variations from 16 to 11 ka, including the Bolling transition and the Younger Dryas, using an additional Bahamas sample (GB89-25-3). We present new AMS ^{14}C ages that confirm the Δ^{14}C recorded in the stalagmite GB-89-24-1. We will also

present first results of the bottom section of GB89-25-3 that grew between 44 and 28 ka B.P. A robust chronology for the additional stalagmite has been obtained using MC-ICPMS U and Th isotope measurements with precisions comparable to AMS ^{14}C measurements for similar sample sizes. Comparison of high-resolution laser-ablation trace-element profiles between different samples has significantly improved our ability to constrain age models and, at the same time, provide climate information. The profiles of δ^{18}O, δ^{13}C, Sr, Mg, Ba and P variations are likely to be indicative of the changing climate and/or recharge. We observe that the Bahamian stalagmites show significant covariation of δ^{13}C and Mg-concentration. This indicates that a common mechanism exists which influences the variation of δ^{13}C and the Mg geochemistry. We also observe a correlation of Δ^{14}C and δ^{13}C over long periods. We investigate the question of the so called dead carbon fraction on the Δ^{14}C measurements in speleothems and we also explore the implications of the speleothem ^{14}C, stable-isotope and trace-element record by comparison with other existing palaeoclimate records.