Detection of late Holocene $\Delta^{14}C$ anomalies and climate proxy response in a French stalagmite

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During the early Holocene, it is likely that variations in the North Atlantic thermohaline circulation played a significant role in determining climatic conditions in Europe [1]. Late Holocene climate, however, appears to have been affected by changes in solar irradiance, as indicated by centennial-scale variability in cosmogenic isotope fluxes recorded by ice cores [2].

At issue, therefore, is the nature of the amplification mechanisms responsible for transforming relatively weak fluctuations in solar irradiance into detectable changes in climatic conditions. Currently, two competing models have been proposed to explain this amplification process, each with a different pattern of regional climate change: an atmospheric and an oceanic model.

In order to test between these models, high resolution palaeoclimatic reconstructions are being undertaken at several cave sites in Europe. New ^{14}C and stable isotope data have been acquired for calcite in stalagmite CL26 from Grotte de Clamouse, France. In particular, we have focused on high amplitude atmospheric $\Delta^{14}C$ shifts at c. 2.7 ka, as modelling predicts this should be resolvable in speleothem calcite.

Stalagmite CL26 has been dated by U-series, and the atmospheric $\Delta^{14}C$ shift at 2.7 ka was located by radiocarbon analysis of the stalagmite calcite. $\delta^{18}O$, the climate proxy, and $\Delta^{14}C$, the solar proxy, were measured in the calcite, and isotopic signals were reconstructed before, during and after the 2.7 ka atmospheric $\Delta^{14}C$ shift.

Grotte de Clamouse was chosen because it lacks substantial soil or vegetation above the cave and the short carbon residence time allows the detection of $\Delta^{14}C$ signals in the stalagmite calcite. Calcite $\Delta^{14}C$ shifts at c. 2.7 ka have an amplitude (2.9 pMC), comparable with the contemporaneous atmosphere (3.73 pMC).

Unlike previous studies, the solar proxy, $\Delta^{14}C$ variations, has been detected in the same speleothem calcite as the climate proxy ($\delta^{18}O$) allowing us to avoid chronological inconsistencies between proxies, and providing us with a robust dataset for analysing the relationship between solar irradiance and climate change.

References

[1] Clark, P.U., Pisias, N.G., Stocker, T.F., and Weaver, A.J. (2002) *Nature* **415,** 863-869.

[2] Bard, E., Raisbeck, G.M., Yiou, F., and Jouzel, J. (1997) *Earth and Planetary Science Letters* **150,** 453-462.