

# The Eemian in southern Europe: high-resolution age constraints from four Italian stalagmites

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The Last Interglacial in the marine record (Marine Isotope Stage 5e) was the last time that Earth's temperatures reached present levels. Its nearest terrestrial equivalent, the Eemian, has been identified in numerous pollen and other stratigraphic sequences from continental and offshore Europe. In spite of the Eemian being recognised in the geological record for more than 130 years, precisely when it started and how long it lasted remain controversial issues.

We provide the first precise ages for the duration of the Eemian in southern Europe based on high-resolution stable isotope and U/Th analysis of four Italian stalagmites. The composite stable isotope time series, based on over 2000 isotopic measurements, is anchored by over 60 MC-ICP-MS U/Th ages conducted mostly on 1-2 mg calcite powders.

The commencement of the Eemian post-dates a brief cold reversal during Termination II (the Kattégat Stadial) [1], which is preserved in three of the stalagmites as a distinctive step in their respective oxygen isotope time series. This step, which probably correlates with the Termination II 'pause' associated with Heinrich Event 11, is dated between  $131.5 \pm 1$  ka and  $129.0 \pm 1$  ka. Full Last Interglacial conditions were reached by  $128.5 \pm 1$  ka, when growth rates in each of the three stalagmites reached their highest values, confirming an earlier low-resolution study at our cave site [2].

Marine-based pollen records from the Iberian margin [3] directly tie the end of the Eemian forest phase to North Atlantic cold event C24, the first major ice-rafting episode of MIS5d. This event is clearly recorded in two of our stalagmites and starts at  $112 \pm 1$  ka. Many long pollen records from the southern half of Europe associate the end of the Eemian with this event, but the Iberian margin cores are the only ones that enable a direct land-sea comparison. Although a lack of firm ages for the end of the Eemian forest phase northern Europe precludes a transcontinental extrapolation of our findings, our chronology is the first to constrain the length of the Eemian in southern Europe.

## References

[1] Beets, D.J., Beets, C.J. and Cleveringa, A. (in press) *QSR*

[2] Drysdale, R.N., Zanchetta, G., Hellstrom, J.C., Fallick, A.E. and Zhao, J.X. (2005) *GRL* **32**, L24708, doi:10.1029/2005GL024658,

[3] Shackleton, N., Chapman, M., Sánchez Gōni, M., Pailler, D., and Lancelot, Y. (2002) *Quat. Res.* **58**, 14-16.