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Evidence for an Abrupt, High-Amplitude Climate Fluctuation c. 8,300 Years Ago in a New Laser Ablation $\delta^{18}O$ Record for a Holocene Speleothem from S.W. Ireland

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A well defined decrease in $\delta^{18}O$ reflecting the so-called 8,200 year cooling event (Alley et al., 1997) has been detected in a Holocene stalagmite from S.W. Ireland using a new laser ablation gas-chromatography technique with a spatial resolution of 250 microns. The exceptionally high resolution of the new record (1,645 $\delta^{18}O$ measurements for the Holocene) has enabled us to reconstruct in detail the structure of this event. Over the critical time interval between 8,000 and 9,000 years ago, each $\delta^{18}O$ analysis represents between about 12 months and 3 years. Importantly, we have detected a short-lived (c. 45 year), very high amplitude (>8 per mil) shift to lower $\delta^{18}O$ at 8,380 calendar years B.P., superimposed on a longer-lived cold episode between about 8,500 and 8,150 years ago. The c. 8 per mil magnitude of the short-lived high-amplitude event is too large to attribute solely to cooling. Instead we interpret this event as reflecting a sudden change in oceanic moisture-source area and/or storm tracks, reflecting an abrupt short-lived atmospheric reorganisation in response to cooling of the N. Atlantic surface waters. Significantly, the onset of cooling 8,470 years ago was synchronous with the catastrophic deglacial release of large volumes of melt-waters from ice-dammed glacial lakes Agassiz and Ojibway in N.E. Canada (Barber et al., 1999). None of the mid to late-Holocene ice-rafting events identified in two N. Atlantic cores (Bond et al., 1997) have any expression in the new high-resolution $\delta^{18}O$ record, implying that their influence on air temperatures on the E. Atlantic margin were minimal and that they did not cause a detectable atmospheric reorganisation. Our data indicate that the inferred early Holocene (c. 8,300 years ago) atmospheric cooling and reorganisation resulted from exceptionally strong external forcing, and not from a weak quasi-periodic forcing internal to the climate system. The rapid recovery of the climate system following the early Holocene cooling event may reflect boundary conditions (strongly increasing N. Hemisphere insolation) quite unlike those of the present-day, implying that it might not be a good analogue for recovery following any future episode of anthropogenic climate cooling.

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