Figure S1: Comparison of $\delta^{18}O$ and $\delta^{13}C$ values along the central axis of MC-S2 (paler lines) and with shorter, off-axis transects (13 mm away). The high overall $\delta^{13}C$ values for MC-S2 (-2.5 to +1.5‰) indicate that its dripwaters have experienced isotopic enrichment (Dulinski and Rozanski, 1990). However i. low to moderate co-variation between $\delta^{18}O$ and $\delta^{13}C$ (r=0.7, 0.3 and 0.6 for phases I, II and III, respectively), and ii. good agreement between axial and off-axis transects (13 mm away) suggest that isotopic enrichment is not occurring across the drip impact zone of the stalagmite. The smoother variations and slight shift (~0.5 mm) of the off-axis transects relative to the central axis is due to the growth laminae thinning slightly towards the edges of the stalagmite.

Co-variation between $\delta^{18}O$ and $\delta^{13}C$ for MC-S1 is low, indicating that precipitation likely took place in quasi-isotopic equilibrium r=0.2 (Fig. 4a-c).
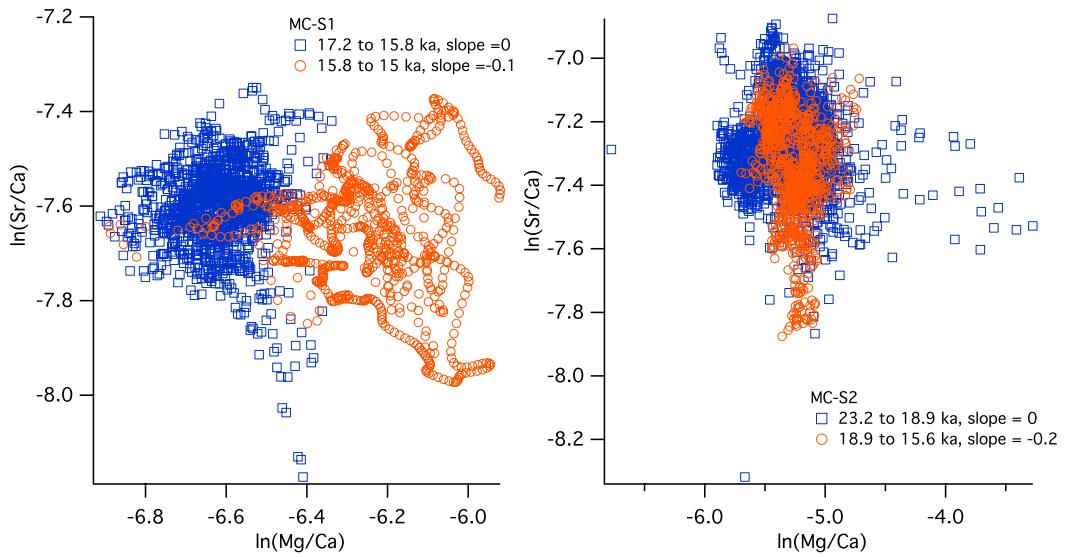
Figure S2: Cross-plots of ln(Sr/Ca) versus ln(Mg/Ca) (weight ratios) for speleothems MC-S1 (left panel) and MC-S2 (right panel). Slopes range from 0 to –0.2 for each speleothem. A slope of +0.88±0.13 is typically used to diagnose PCP (Sinclair et al., 2012). There appears to be no single common driver for Mg and Sr concentrations in these speleothems. Pearson's Product correlation values (calculated on non ln-transformed data) were: MC-S1 17.2 to 15.8 ka r=0, 15.8 to 15 ka r=0; MC-S2 23.2-18.9 ka r=-0.2, 18.9 to 15.6 ka r=-0.1 suggesting that PCP is not dominating these data.
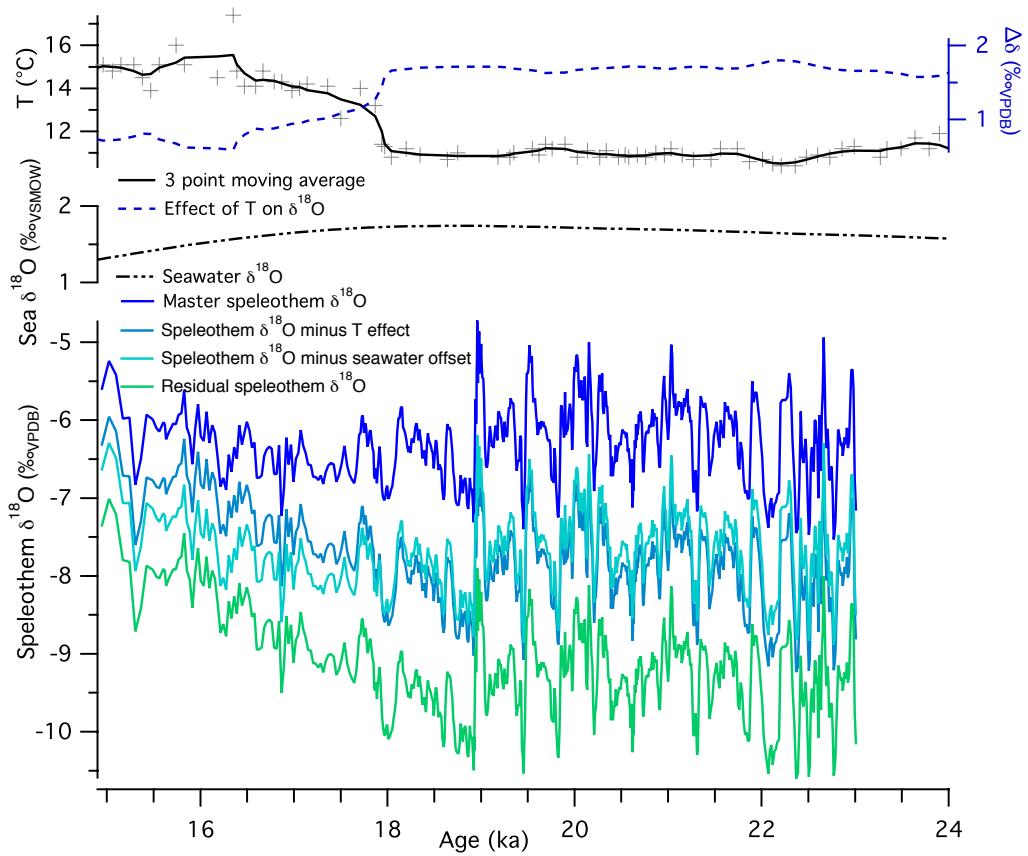
Figure S3: Sea surface temperature (bold unbroken line) from core MD03-2611 (DeDeckker et al., 2012) was twice smoothed with 3 point box smooth converted to the equivalent change in speleothem δ18O expected from mean annual cave air temperature variations using -0.24‰/°C (a); modelled seawater δ18O (Bintanja et al., 2008) impacted by enhanced storage of 18O in ice (b); estimated variation in speleothem δ18O owing to variation in cave temperature and seawater δ18O (c). Deconvolving both the cave temperature and seawater δ18O effects suggests that the residual δ18O values, approximating dripwater δ18O, were ~3‰ lower at the LGM (green curve) and that dripwater δ18O may have trended upwards by several per mil during the deglaciation. However, are a number of uncertainties need to be taken into account such as the 'precipitation effect' i.e. cooler LGM atmosphere promoting more 18O depleted vapour and hence rainfall δ18O, would counteract the ~3‰ modelled offset. An additional uncertainty is that the estimated impact of the temperature effect depends on the accuracy of the marine temperature reconstruction and its relationship to land temperatures.

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