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A NEW APPROACH TO INVESTIGATING PAST VEGETATION REGIMES USING HIGH RESOLUTION LIPID BIOMARKER RECORDS PRESERVED IN STALAGMITES

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Lipid biomarker records in stalagmites are a valuable new tool for palaeoenvironmental research: biomarkers are established proxies for environmental change, while stalagmites provide long, easily datable profiles, protected from post-depositional degradation and disturbance. Combining the two allows high resolution records of terrestrial environmental change to be obtained back to a minimum of 100,000 years BP. Here we present the first high resolution lipid records recovered from stalagmites, and demonstrate that they clearly reflect changes in the overlying vegetation.

PDS-5 is a stalagmite collected from Punta Degli Stretti, a cave on the Tuscan coast that is currently overlain by woodland vegetation. The sample contains a distinct band of heavily laminated calcite that, based upon calcite structure and trace element analyses, represents a major disturbance in the overlying environment. The lipid profile of this band differs distinctly from the rest of the stalagmite. In particular, there is a significant relative increase in vegetational biomarker input (as represented by the CPI2 and ratios of HMW/LMW *n*-fatty acids), and a substantial change in the C_{27}/C_{31} *n*-alkane ratio, and the C_{24}/C_{26} and C_{24}/C_{28} *n*-alkanol ratios. The C_{27}/C_{31} ratio has been proposed as a marker for arboreal vs. herbaceous plants (Marseille et al., 1999), and all three show a switch in chain length dominance from those compounds more associated with woodland vegetation (C_{27} *n*-alkane, C_{24} *n*-alkanol) to those more commonly dominant in grasslands or agricultural land (C_{31} *n*-alkane, C_{26} and C_{28} *n*-alkanols (ibid.; Bull et al., 2000)). We therefore propose that this band represents a decline in the overlying woodland and a period of vegetational clearance.

The hypothesis that these lipid signals are a coherent set of signatures relating to

specific environmental changes is strongly supported by samples from the Mechara karst in south-east Ethiopia. These stalagmites were deposited continuously over the past 100 years, a time period which saw considerable changes in the local vegetation regime as the native scrub was cleared to make way for agricultural crops. This change is clearly seen in the lipid signals preserved, with the clearances in the early 20th century being closely mirrored by significant variations in the C_{27}/C_{31} *n*-alkane ratio (changing in favour of C_{31} as agricultural activity increased), and supported by variations in the C_{24}/C_{28} *n*-alkanols, and in the increased input of vegetational material as reflected by relative abundances of HMW *n*-fatty acids. Significantly, while the lipid signal shows a close relationship to the known vegetational history of the area, it records events that are not apparent in established stalagmite proxies such as stable carbon isotopes, demonstrating the value of this new technique.

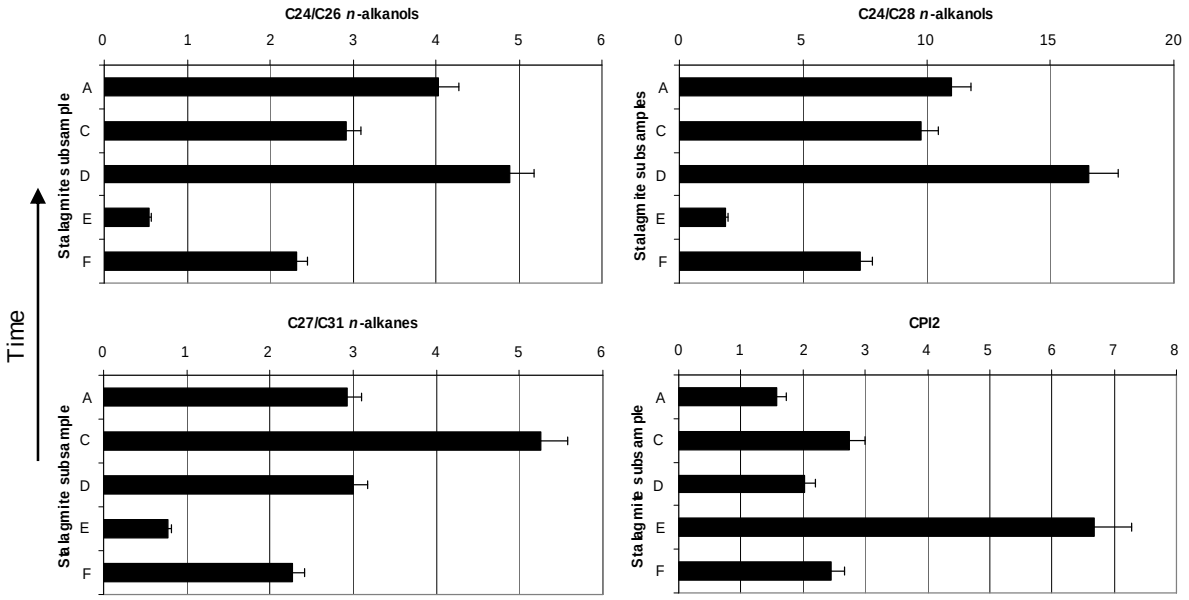

Figure 1. Changes in n-alkane and n-alkanol compositions through PDS-5. Note the significantly decreased ratios and increased CPI2 in band E.

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