Teleconnexions and environmental determinism: was there really a climate-driven collapse at Late Neolithic Çatalhöyük?

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Roffet-Salque *et al*. (1) present an innovative palaeoclimatic reconstruction using biomarkers to suggest δ^2H measurements on animal-fat residues from pottery vary through time at the important Neolithic site of Çatalhöyük. The interpretation of these changes in relation to a teleconnexion with the 8.2-kyBP climate event is problematic.

First, a t test is used to suggest that $\delta^2H_{18:0}$ values in level TP-O are significantly different from the values in the other archaeological levels, however the result of this test is insignificant (p=0.10). Analysis of variance of the samples from the different levels is a more appropriate test but suggests no significant variability between the levels (p=0.385). Temporal and measurement uncertainties suggest that variability within the data are more important than the mean values and that there is a clear overlap throughout the data series (Fig 1A).

[Figure 1 here]

Secondly, this apparent deviation in $\delta^2H_{18:0}$ is related to the 8.2-kyBP signal from Greenland (Fig. 1B). It is suggested that this signal is represented in both the on-site proxy and off-site proxy data from Nar Lake. Nar $\delta^{18}O$ does show a deviation of 1.5 ‰ at around 8.2-kyBP (2), but viewed longer-term, this signal is part of a set of oscillations starting at around 8.5-kyBP (Fig. 1C). Thus, there is no foundation for a teleconnexion between Greenland and Nar. Furthermore, using proxy estimates (2), this deviation at 8.2-kyBP at Nar would suggest a *warming* of summer maximum temperatures of about 0.22°C, rather than the cooling implied by the link to Greenland (Fig. 1D). However, this variability again – in the context of oscillations from c.8.5-kyBP and the error margins on the proxy – suggests that although marginally cooler, the summer maximum temperatures were not significantly different from the present day. Moreover, the pattern after 8.2-kyBP is one of lower maximum temperatures and thus lower water stress.

Thirdly, summer rainfall at Nar is only c.5% of the total annual rainfall, so to expect a significant deviation in $\delta^{18}O$ from the variation suggested by climate models (1: Fig. 3) is unrealistic. Fourthly, the extraction of one example from an ensemble of model results is questionable (3).

Thus not only is the attribution of the 8.2-kyBP event not supported by the data of (1), the regional palaeoclimate does not seem to be significantly linked to the event (Fig 1C-D). It is hard to justify a link to the purported social collapse. Our interpretation of the site's palaeoenvironment (4) suggests that there are no significant changes at this time, and there is now evidence for an overlap in settlement between the East and West Mounds at Çatalhöyük (5), which conflicts with the interpretation of a collapse (1).

Therefore, the environmental determinism that attempts to correlate "the apparent weakness of the climate signal" with "profound human responses are visible in the archaeological record" is unsupported. Reassessment of the new proxy data suggests no link to the 8.2-kyBP event, and that the regional palaeoclimate variability is also unrelated to the event. More nuanced approaches are needed to interpret human-climate interactions.

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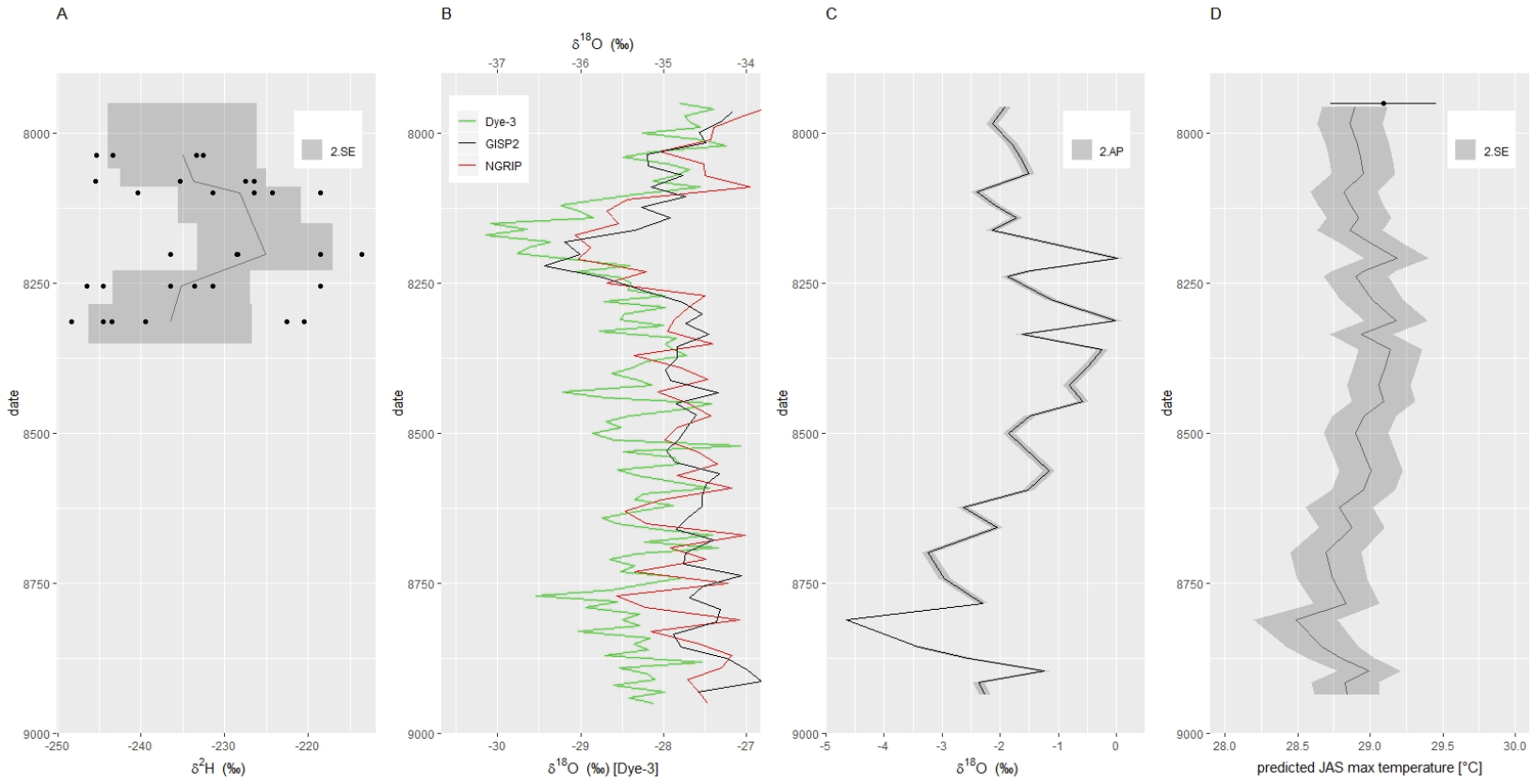
Caption

Fig. 1 Comparison of the $\delta^2H_{18:0}$ proxy of (1) with global and regional climate records. Note that this plot uses a 1-ky window from 8950 cal BP in order to place the archaeozoological data in a longer-term context. (A) replots the data of (1: their Fig 1D) using shading to show the 2 standard error variation of data around the mean (solid line); original data points are plotted at the midpoint of the archaeological phase, but shading is shown vertically to demonstrate the full uncertainty of the Bayesian estimates of these phases. There is clear overlap between the phases, and variability is more important than mean values. (B) shows the water $\delta^{18}O$ values of three Greenland ice cores (6-9) used to demonstrate the onset and duration of the 8.2-kyBP event. (C) is the $\delta^{18}O$ record from the sediments in Nar Lake (2), c.150 km from Çatalhöyük, which provides the best available regional information for climate proxies. Shaded area shows 2 x analytical precision of the measurements. (D) is an estimate of summer maximum temperature for Nar Lake, based on the proxy derived by (2) from modern climate measurements. The shaded area is 2 standard errors, using a RMS combination of the uncertainties from the measurement analytical precision and the standard error from the proxy model. The point and error bar at the top of the plot show the mean and 2 standard error range for the 1961-1990 climatic observations.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