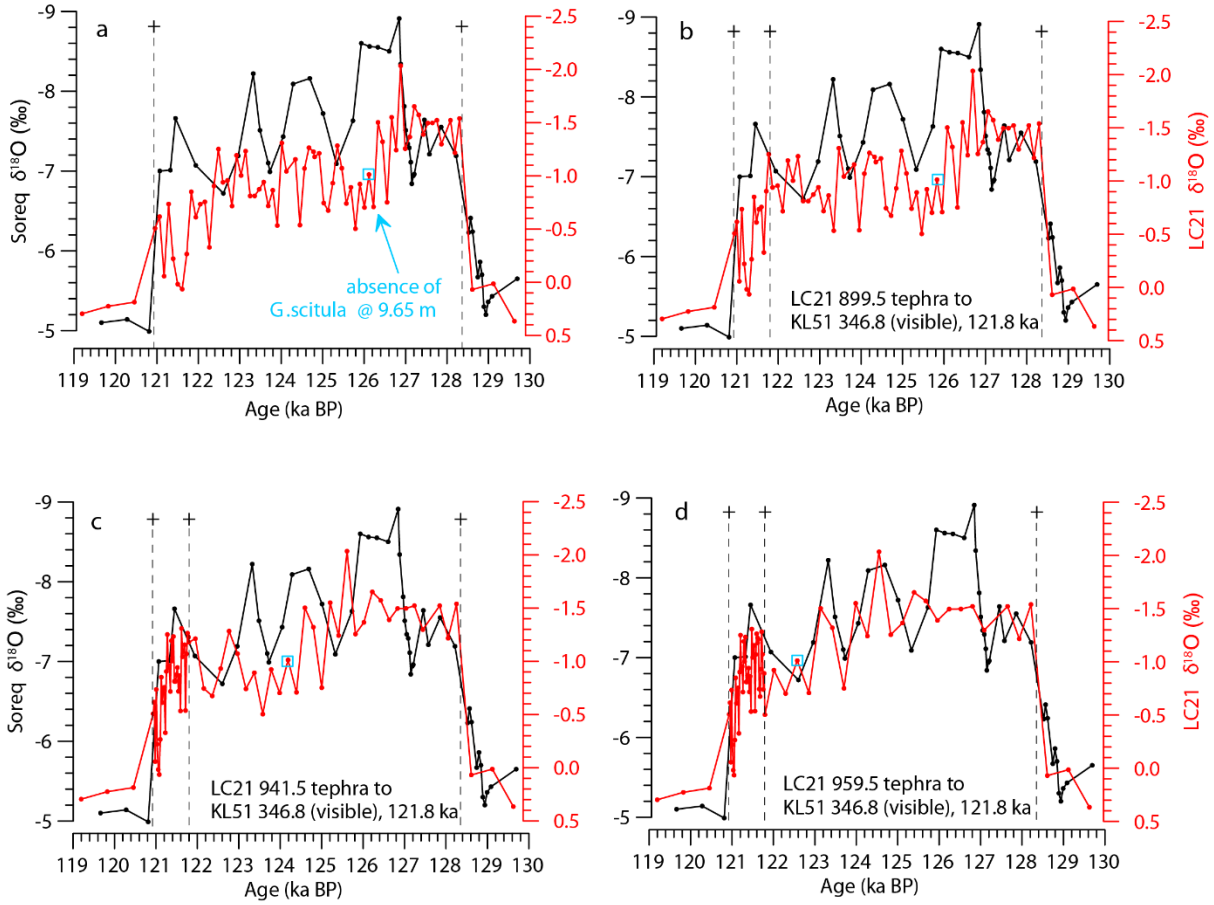
Supplementary Information 4: Implications for the proxy records of the possible tephra correlations between cores LC21 and KL51.



Supplementary Figure 1. Implications for the known bio and oxygen isotope stratigraphies of LC21 of using alternative depths to correlation the uppermost tephra layers in S5 to the KL51 346.8 visible tephra layer: a) existing alignment of LC21 isotope stratigraphy with the Soreq Cave speleothem isotope stratigraphy, with tie points only at the top and bottom of sapropel S5 (from [54]); b) same as a) but with the additional tie point resulting from the correlation of sample KL51 346.8 (visible) to the cryptotephra sample LC21 899.5 cm; c) as a) but with an additional tie point resulting from the correlation of KL51 346.8 (visible) to the cryptotephra sample at LC21 941.5 and d) as a) but with additional tie point from the correlation of KL51 346.8 (visible) to the cryptotephra at LC21 959.5 cm. The resulting position of the *G. scitula* disappearance in each alternative correlation is shown by the cyan square; this biostratigraphic event has been observed approximately half way through sapropel 5 in records across the Mediterranean [55].

Discussion of possible correlations of tephra in the upper part of sapropel 5 (cores LC21 and KL51).

The tephra sample KL51 346.8 (visible) shares the same andesitic to dacitic glass composition (Fig. 5) as three cryptotephra samples from LC21; at 899.5, 941.5 and 959.5 cm. It is therefore

not possible to define an unambiguous correlation between the two cores. However, as much previous work has been undertaken on the biostratigraphy, isotope stratigraphy, and chronology of S5, we are able assess the implications of correlating the sample KL51 346.8 (visible) to each of the geochemically indistinguishable samples at 899.5, 941.5 and 959.5 cm in LC21, and therefore determine which correlation is consistent with existing evidence.

Implications of correlating the KL51 tephra with sample LC21 899.5cm (Supplementary Fig. 1b)

This correlation would imply an increase in sedimentation rate at the very top of S5 in LC21 (above 899.5 cm), and in turn a slight compression of the known faunal and isotopic stratigraphy for LC21 at the top of S5 with a slight stretching of the rest of S5, below 899.5cm (Fig. 9a and 9b). [55] established that one of the key markers in S5 across multiple Eastern Mediterranean Sea cores is the consistent disappearance of *G. scitula* about a third of the way up S5. In contrast to [55], [94] included also core LC21 in their study, reporting that *G. scitula* disappears at 9.65 m depth in core LC21 (figure 8b), which is consistent with the biostratigraphy of other Eastern Mediterranean cores [55]. This correlation of the KL51 and LC21 cores through the tephra layers (Fig. 8b) therefore preserves the coherence of the existing faunal and isotope stratigraphy of LC21 with other cores from across the Mediterranean. It does, however, raise the question of the origin of the geochemically identical cryptotephra underneath sample 899.5 cm in LC21 (Fig. 2), which could not in this case be attributed to simple reworking as it was deposited before LC21 899.5 cm, not after. This leaves the possibility that the tephra between 899.5 and 959.5 cm in LC21 represents a near continuous, geochemically homogenous series of eruptions over several thousand years. Given the geographical proximity of KL51 to LC21 (Fig. 1), evidence of such eruptive activity would be expected to be duplicated in KL51. However, unlike cores LC21

and ODP967, no cryptotephra study has yet been conducted on core KL51 so we are unable to test this idea at present.

Implications of correlating the KL51 tephra with sample LC21 941.5cm (Supplementary Fig. 1c)

Cryptotephra LC21 941.5 cm represents the level with the highest glass shard counts in this section. A correlation with KL51 Intra S5 would imply an increase in the sedimentation rate at the top of S5 in LC21, compressing the proxy stratigraphic record. The increase in sediment accumulation could, at least in part, be attributed to the high tephra shard counts in this part of the core (Fig. 2), and may explain the exaggerated thickness of S5 in LC21 ([60]. The correlation would place the disappearance of *G.scitula* approximately half way through the duration of S5 at around 124 -125 ka, which would be consistent with this event in other sediment cores from across the Mediterranean [55]. The correlation also produces a good alignment of the LC21 isotope stratigraphy with that of Soreq Cave (Fig. 8c) with which there is a physical link [54]. Assigning this level to the primary eruption event demands an explanation of the significant numbers of geochemically identical tephra shards (Figs. 5, 6 and 7) recorded both above and below this level (Fig. 2). The 18 cm of low tephra counts below 941.5 cm may be attributed to reworking through bioturbation or possibly coring artefacts, while the comparatively high shard counts above this level may be due to the remobilisation and re-deposition processes described by [81].

Implications of correlating the KL51 tephra with sample LC21 959.5 cm (Supplementary Fig. 1d)

This correlation would dramatically increase the calculated sedimentation rate above 959.5 cm at the top of S5 in LC21. Such an increase could conceivably be attributed to the input of

the tephra itself (possibly from reworking through the processes described by [81] and might explain the unusual thickness of S5 in LC21 [60]. It would greatly compress the known isotope stratigraphy [94] in the upper part of S5 when plotted against time (Fig. 8d), and stretch the known stratigraphy below 959.5 cm, implying that *G. scitula* would be present throughout most of S5 (Fig. 9 c). This would be inconsistent with many other Eastern and Western Mediterranean sediment cores [55,94] where this species is consistently present only in the lower half of S5. With respect to the Soreq cave isotope stratigraphy from which the LC21 age model is derived (through correlation of the two sets of isotopes; [54]) this correlation does mean that two out of three isotope peaks fit well between the Soreq and LC21 isotope curves (Fig. 8d), which, as there is a physical mechanism linking these two records [54] would appear to support the correlation.

In summary, the correlation between LC21 941.5 cm and the KL51 346.8 (visible) sample (Fig. 8c) aligns the disappearance of *G. scitula* in LC21 with the position of this event in other S5 sequences from across the Mediterranean [55] (b) leads to a close agreement of the isotope stratigraphy with the Soreq Cave isotope stratigraphy with which there is a physical link [54] and (c) allows the plausible interpretation of the tephra below and above this level as the result of reworking by burrowing or re-deposition [81] respectively. However, undertaking cryptotephra studies on S5 in KL51 and other nearby cores would test this interpretation.