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The timing of Mediterranean sapropel deposition relative to insolation, sea-level and African monsoon changes

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The periodic deposition of organic rich layers or 'sapropels' in eastern Mediterranean sediments can be linked to orbital-driven changes in the strength and location of (east) African monsoon precipitation. Sapropels are therefore an extremely useful tool for establishing orbital chronologies, and for providing insights about African monsoon variability on long timescales. However, the link between sapropel formation, insolation variations, and African monsoon 'maxima' is not straightforward because other processes (notably, sea-level rise) may have contributed to their deposition, and because there are uncertainties about monsoon−sapropel phase relationships. For example, different phasings are observed between Holocene and early Pleistocene sapropels, and between proxy records and model simulations. To address these issues, we have established geochemical and ice-volume-corrected planktonic foraminiferal stable isotope records for sapropels S1, S3, S4, and S5 in core LC21 from the southern Aegean Sea. The records have a radiometrically constrained chronology that has already been synchronised with the Red Sea relative sea-level record, and this allows us to examine in detail the timing of sapropel deposition relative to insolation, sea-level, and African monsoon changes.

Our records suggest that the onset of sapropel deposition and monsoon run-off was near synchronous, yet insolation-sapropel/monsoon phasings varied, whereby monsoon/sapropel onset was relatively delayed (with respect to insolation maxima) after glacial terminations. We suggest that large meltwater discharges into the North Atlantic modified the timing of sapropel deposition by delaying the timing of peak African monsoon run-off. Hence, the previous assumption of a systematic 3-kyr lag between insolation maxima and sapropel midpoints may lead to overestimated insolation-sapropel phasings. We also surmise that both monsoon run-off and sea-level rise were important buoyancy-forcing mechanisms for the studied sapropels, and their relative influences differed per sapropel case. For instance, sea-level rise was clearly important for sapropel S1, whereas monsoon forcing was likely more important for sapropel S5.