Supplementary Information for:
Increased sedimentation following the Neolithic Revolution in the Southern Levant
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Appendix A: Supplementary methods

Appendix A 1: Estimate of A during the four pre-postglacial periods

The A during the four pre-postglacial periods are estimated by assuming that: (1) average thickness of aragonite laminae during the last interglacial and penultimate interglacial periods are the same as in the Holocene (~11.60–0 ka; 1.18 mm); (2) average thickness of aragonite laminae during the last glacial and penultimate glacial periods are the same as during the late glacial period (~21.73–11.60 ka; 0.46 mm). In addition, the numbers of aragonite laminae (deformed and undeformed) were estimated to be: (1) 20,000 (representing roughly 20 kyr; one couple of aragonite-detritus laminae represent one varve year (Migowski et al., 2004; Prasad et al., 2004)) for the entire last glacial period, which yields \( A = 20,000 \times 0.46 \text{ mm} = 9.2 \text{ m} \); (2) 5,000 (representing roughly 5 kyr) for the last interglacial period, which yields \( A = 5,000 \times 1.18 \text{ mm} = 5.9 \text{ m} \); (3) 10,000 (representing roughly 10 kyr) for the penultimate glacial period, which yields \( A = 10,000 \times 0.46 \text{ mm} = 4.6 \text{ m} \); (4) 1,000 (representing roughly 1 kyr) for the penultimate interglacial period, which yields \( A = 1,000 \times 1.18 \text{ mm} = 1.18 \text{ m} \) (Table 3).

These assumptions are based on the thickness of aragonite and detritus laminae in the core interval ~110-0 m (~21.73-0 ka) and lithological (see Neugebauer et al., 2014, for details) studies of the core: (1) aragonite-detritus couplets are sparsely distributed during the interglacial periods and densely distributed during the glacial periods; (2) the average thickness of aragonite laminae during the postglacial and late glacial periods are comparable with the interglacial and glacial periods, respectively.

The above-mentioned quantities of aragonite laminae during the four pre-postglacial periods are conservative estimates, yielding slightly smaller A (in equation [4]) and, thus, were expected to yield slightly greater S (in equation [4]) for the four periods (Fig. 6). In addition, a comparison of the clastic SAR with or without deducting the A (in equation [4]) during the four pre-postglacial periods is also given (Appendix B Fig. B2). The maximum S (in equation [4]) of the four pre-postglacial periods will be reached by assuming the \( A = 0 \) (Appendix B Fig. B2B). The comparison corroborates the credibility of the conclusion that the average (estimated) clastic SAR during the Holocene is ~2-3 times higher than during the last two glacial cycles.

Appendix A 2: Calculations of observed number of large earthquake in the Dead Sea per ka

In the Dead Sea graben, intraclast breccias (mixed layers) have been firmly proven to be seismites (Agnon et al., 2006; Kagan et al., 2011; Ken-Tor et al., 2001; Marco and Agnon, 1995; Migowski et al., 2004). Based on 89 observed intraclast breccia layers (mixed layers) in the Dead Sea graben, a 60 kyr-long (~60-0 ka) record of past earthquakes was reconstructed (Agnon et al., 2006; Begin et al., 2005; Marco et al., 1996; Migowski et al., 2004). It is possibly the longest and most complete known paleoseismic record on Earth. Based on previous seismites research in the Dead Sea (Migowski et al., 2004) and its precursor Lake Lisan (Begin et al., 2005), the number of large earthquakes per kyr during different time periods was calculated (Fig. 5A). More than half of these paleoearthquakes had an epicenter outside the Dead Sea graben (Agnon et al., 2006; Migowski et al., 2004). The paleoseismic record in Fig. 5A, includes only earthquake intensities \( \geq V \) (Ken-Tor et al., 2001) in the Dead Sea graben. The paleoseismic record comes mainly from seismites in high stand lake sediments. Thus, we may have some gaps in the record when the lake level was at a low stand. Nevertheless, this is the most complete record that we can obtain at the moment.

Appendix A 3: Constraints of modern detritus flux in the depocenter of the Dead Sea

Modern offshore sedimentation monitoring in the Dead Sea by satellite observations (Nehorai et al., 2013) and sediment traps (Stiller et al., 1997), reveals that flash floods play a key role in supplying of offshore suspension particles. The sediment traps

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(Stiller et al., 1997) deployed at the depocenter of the Dead Sea, captured several floods, which induced the prominent detritus flux (dried allogetic particles) of 17.44 g/m²/day for the period of February 8-March 8, 1983. The detritus flux thus was estimated within 3.18-6.37 mm yr⁻¹ (assuming bulk density of the dried detritus within 1-2 g/cm³).

Appendix A 4: Constraints of basin external materials input for the postglacial period

Monitoring of dust deposition over the Dead Sea (Singer et al., 2003) during 1997-1999 AD yielded a deposition rate between 25.5 and 60.5 g m⁻² year⁻¹, and an average rate of 44.5 g m⁻² year⁻¹. This material is mainly from outside of the basin. We take it as a modern analog for the postglacial period (~11.5-0 ka). Thus, the dust deposition rate can be estimated at <0.0445 mm yr⁻¹ for the postglacial period (supposing a density ≥1.0 g/cm³), which is negligible relative to the very high clastic SAR obtained from Core 5017-1 during the postglacial.

Appendix B: Figures

Figure B1. Estimates of population growth in the Mediterranean climate of the Southern Levant, based on calculation of archaeological site densities per unit time. It is likely that the impact of human populations on their environment was dependent on population size, among other factors. However, reconstructing prehistoric population size is uncertain and debatable (Zimmermann et al., 2009). One method is to calculate site densities over time, in order to arrive at a reasonable proxy. Only one calculation is known to us for the Epipalaeolithic-Neolithic sequence that spans several zones in the Near East and provides data regarding site densities per kyr (Goring-Morris et al., 2009). In the Mediterranean Southern Levant, at the Early Epipalaeolithic, the density was ~20, by the onset of the PPNA it was ~30, by the Early PPNB it was ~60 and by the final PPNB it was ~80. This dramatic increase in the number of sites was accompanied by an increase in site size. Whereas in the Early Epipalaeolithic most sites were only several hundred square meters in area, in the Late Epipalaeolithic several sites were 1,000-2,000 m², in the PPNA. Jericho, for example, was 40,000 m², and by the PPNB several sites were even larger. The range of estimates for past village populations (Kramer, 1982; Naroll, 1962; Van Beek, 1982; Zimmermann et al., 2009) is mostly between 10-30 persons per 1,000 m². Accordingly, the population of many Neolithic villages may have been several hundred inhabitants, and in some cases maybe over 1,000. Thus, not only did human populations deplete their environment of vegetation due to the new economic and technological advances (e.g., construction, plaster for floors and walls), but the sheer population growth took its toll, too.
**Figure B2.** Comparison between the clastic SAR with (A) and without (B) deducting the estimated thickness of aragonite lamina during the four pre-postglacial periods. A: Clastic SAR after deducting the estimated thicknesses of aragonite laminae during the pre-postglacial periods (same with Fig. 6). B: Clastic SAR assuming no aragonite deposition during the pre-postglacial periods. This comparison corroborates the credibility of the conclusion that the average detrital accumulation rate during the Holocene is ~3-4 times that during the last two glacial cycles.

**Appendix C: Table**

Table C1. Periodization in the Levant (Savage and Levy, 2016) used in this study.

<table>
<thead>
<tr>
<th>Period</th>
<th>Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epipaleolithic</td>
<td>22000 BP-9500 BCE</td>
</tr>
<tr>
<td>Neolithic</td>
<td>9500 BCE-4500 BCE</td>
</tr>
<tr>
<td>Chalcolithic</td>
<td>4500 BCE-3900 BCE</td>
</tr>
<tr>
<td>Bronze Age</td>
<td>3900 BCE-1200 BCE</td>
</tr>
<tr>
<td>Iron Age</td>
<td>1200 BCE-539 BCE</td>
</tr>
<tr>
<td>Recent periods</td>
<td>539 BCE-present</td>
</tr>
</tbody>
</table>

**Appendix D: Author contributions**

Y.L. performed the detail analysis, interpretations and drafted the first draft of the manuscript. S.M. and N.W. participated in the ICDP project in the Dead Sea and in the associated sampling and logging party. D.N. provided input on the archaeological data and interpretations. All authors participated repeatedly in subsequent editing of the manuscript.

**Supplementary reference list**


