QUATERNARY RESEARCH 38, 265–267 (1992)

LETTERS TO THE EDITOR

Comments on "Paleoclimatic Significance of the Mineral Magnetic Record of the Chinese Loess and Paleosols"

In a recent paper, Maher and Thompson (1992) compare their age model revision and paleoclimatic interpretation of the Luochuan loess magnetic susceptibility record with those of Clemens and Prell (1990). Maher and Thompson state that "Clemens and Prell (1990) matched the loess susceptibility record to lithogenic mass accumulation rate (MAR) in a sediment core from the northwest Arabian Sea" and that ". . . in attempting to match loess susceptibility with lithogenic mass accumulation rate, Clemens and Prell (1990) seek to link a concentration parameter (susceptibility) to an accumulation rate parameter (MAR), a mismatch of parameter types which is physically inappropriate." This synopsis of our previous work is incorrect, and hence their conclusions concerning the "mismatch" of parameters is misleading.

Clemens and Prell (1990) revised the Luochuan loess magnetic susceptibility age model not by correlation to lithogenic MAR but by correlation to the SPECMAP stacked $\delta^{18}O$ record (SPECMAP stack) (Imbrie *et al.*, 1984) using an inverse mapping technique (Martinson *et al.*, 1982). Clemens and Prell then spectrally compared the revised loess magnetic susceptibility record to the lithogenic MAR record from piston core RC27-61, finding statistically significant coherence and near-zero phase relationships over the 100,000-yr and 23,000-yr orbital frequency bands. From these comparisons Clemens and Prell concluded that both records were driven by environmental changes associated with relatively arid glacial and relatively humid interglacial periods.

This is the exact same approach employed by Maher and Thompson (1992) who use the sequence slotting algorithm of Thompson and Clark (1989) to correlate the Luochuan loess susceptibility record to the SPECMAP stack. They then visually compared the Luochuan susceptibility record to both the SPECMAP stack and the lithogenic MAR record from ODP Hole 722B (unreferenced; data is from Clemens and Prell (1991)). Based on these visual comparisons Maher and Thompson conclude that "in contrast to . . . Clemens and Prell (1990), we find only a general correspondence between the loess magnetic susceptibility and the rate of lithogenic mass accumulation. Instead, we find a very detailed match of loess susceptibility with the global $\delta^{18}O$ record."

Given that the loess susceptibility record was numerically mapped to the SPECMAP stack, reasonable correspondence between the two might be expected. Interpreting the resulting forced correlation between the loess and the SPECMAP stack in terms of environmental forcing factors is somewhat circular. A less circular comparison is between the loess susceptibility and the 722B lithogenic MAR for which the age model is independently derived by correlating the 722B $\delta^{18}O$ to the SPECMAP stack.[1] Thus,

[1] Maher and Thompson revised the published 722B age model (Clemens and Prell, 1991) by sequence slotting the 722B $\delta^{18}O$ record to the SPECMAP stack. This revised age model differs little from the Clemens and Prell (1991) age model with the exception of the large sedimentation rate "spike" (10–11.5 cm/1000 yr) generated at 145,000–146,000 yr. This sedimentation rate is ~130% greater than the mean linear sedimentation rate of this core (0 to 350,000 yr) and is not seen in other nearby cores. In addition, physical property measurements, which replicate fairly well the longer-term changes sedimentation rate and lithogenic MAR,

0033-5894/92 $5.00

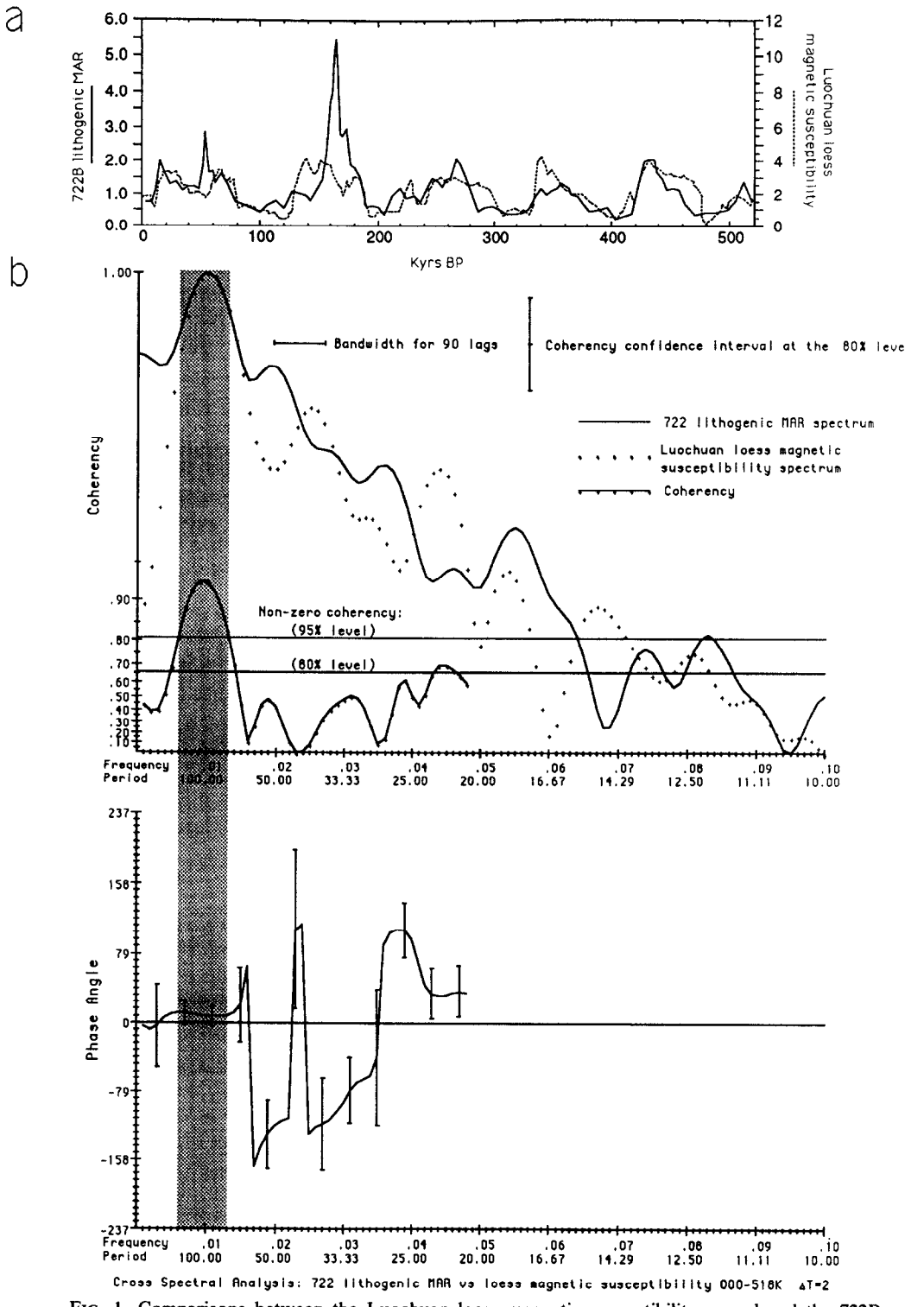

FIG. 1. Comparisons between the Luochuan loess magnetic susceptibility record and the 722B lithogenic MAR record. (a) Plots of the two records as digitized from Maher and Thompson (1992) (see footnote 2). (b) Cross-spectral coherence (upper) and phase (lower) relationships between the two records. Spectral densities (solid line and pluses) are normalized and plotted on log scales. The coherence spectrum (*y*-axis; solid line with pluses) is plotted on a hyperbolic arctangent scale. The solid horizontal lines indicate confidence at the 80 and 95% levels. The shaded bar highlights the statistically significant portion of the coherence spectrum centered on the 100,000 yr (ice-volume) frequency band.

https://doi.org/10.1016/0033-5894(92)90062-N Published online by Cambridge University Press

the lithogenic MAR and the loess susceptibility remain independent of one another and comparisons between the two are valid assuming that the forced zero-phase relationship between loess susceptibility and SPECMAP stack is valid and true in nature (Clemens and Prell, 1990). Cross-spectral comparison of the loess susceptibility record and the lithogenic MAR records as published in Figure 7 of Maher and Thompson [2] (1992) indicates that the correspondence they describe as "only general" is actually characterized very strong coherence (above the 95% confidence level) and a zero-phase relationship over the 100,000-yr frequency band which dominates the record of changes in late Quaternary ice volume (Fig. 1). This is the same result as in Clemens and Prell (1990) although they also found equally strong coherence over the 23,000 and 19,000-yr orbital frequency bands.

Maher and Thompson (1992) suggest that they have used a new approach toward age-model revision and paleoclimatic interpretation of the Luochuan loess magnetic susceptibility record. In reality, they used the exact same approach to age-model revision as in Clemens and Prell (1990). In doing so, they replicate the coherence and phase results of Clemens and Prell (1990) in terms of comparisons between the lithogenic MAR (from RC27-61) and the Luochuan loess magnetic susceptibility record. The only difference between the two studies is that Maher and Thompson used Clemens and Prell (1991) data from nearby ODP Hole 722B to "reinvent the wheel."

show no evidence of this sedimentation rate spike. This anomalous rate may be a function of overfitting the relatively low-resolution $\delta^{18}O$ record from 722B to the relatively high-resolution SPECMAP stack in an effort to achieve the best correlation coefficient possible out of the sequence slotting routine.

[2] Data digitized from Figure 7 in Maher and Thompson (1992) and corrected for the cartographic age-scale error on the *y*-axis. If plotted using the SPECMAP chronology (Imbrie *et al.*, 1984), this axis should span from 0 to ca. 526,000 yr (as shown correctly in Maher and Thompson's Fig. 6).

REFERENCES

Clemens, S., Prell, W. L. (1990). Late Pleistocene variability of Arabian Sea summer monsoon winds and continental aridity: Eolian records from the lithogenic component of deep-sea sediments. *Paleoceanography* 5, 109–145.

Clemens, S., and Prell, W. L. (1991). One-million year record of summer-monsoon winds and continental aridity from the Owen Ridge (Site 722B), northwest Arabian Sea, *Proc. ODP, Sci. Res.* 117, 365–388.

Imbrie, J., Hays, J. D., Martinson, D. G., McIntyre, A., Mix, A. C., Morley, J. J., Pisias, N. G., Prell, W. L.,Shackleton, N. J. (1984). The orbital theory of Pleistocene climate: Support from a revised chronology of the marine $d^{18}O$ record. *In* "Milankovitch and Climate, Part 1" (A. L. Berger *et al.*, Eds.), pp. 269–305. Riedel, Hingham/Dordrecht.

Maher, B. A., and Thompson, R. (1992). Paleoclimatic significane of the mineral magnetic record of the Chinese loess and paleosols. *Quaternary Research* 37, 155–170.

Martinson, D. G., Menke, W. and Stoffa, P. (1982). An inverse approach to signal correlation. *Journal of Geophysical Research* 87, 4807–4818.

Thompson, R., and Clark R. M. (1989). Sequence slotting for stratigraphic correlation between cores: Theory and practice. *Journal of Paleolimnology* 2, 173–184.

STEVEN C. CLEMENS
WARREN L. PRELL
Department of Geological Sciences
Brown University
Providence, Rhode Island 02912-1846