siderable time to cool. The cooling time of a sheet can be estimated from the calculations of Jaeger[6] on the conductive cooling of igneous rock bodies. The outer margins of such a sheet, including the basal Plinian deposit, would cool quickly and would acquire their magnetic properties over a short time period at an early stage. The interior of the sheet will be insulated and take much longer to cool, and acquire the magnetic properties.

The time scale, t, for conductive cooling is related to the thermal diffusivity, k, and the sheet thickness, $2a$, through a non-dimensional parameter, τ by $\tau = kt/a^2$. Jaeger[6] gives profiles of temperature for different values of τ through a sheet. For $a = 20$ m and $k = 8 \times 10^{-7}$ m^2 s^{-1}, the centre of the sheet would remain at the initial emplacement temperature (~400 °C) for just over a year. The centre of such a sheet would take 80 yr to cool down to 125 °C and the time over which its magnetic properties were acquired would be much greater than the basal Plinian deposit lying directly on top of cold country rock. Cooling rates would be greater if convective processes (for example, rainfall) affected the porous pyroclastic sheet, but different parts of the deposit would still acquire their magnetic properties at substantially different cooling rates. The differences in magnetism could thus be explained by a prolonged and complicated cooling history rather than by a time gap.

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DOWNEY AND TARLING REPLY—Our results are an example of scientific serendipity, that is, the collection was undertaken assuming the volcanological consensus of a single eruption and the archaeological views of a single late Minoan IB (LMIB) destruction. We originally accepted Bond and Sparks' conclusion[1] that most of the tephra were of mud-flow origin, now known to be an ash flow, and hence W.S.D. sampled the tephra more than was strictly necessary. Our object had been simply to test whether these two catastrophes were synchronous and hence causally related. The evidence for a 10-20 yr gap necessarily came after the fieldwork and we have no finance to reinvestigate the field evidence. Nonetheless, we are surprised that Sparks should exclude all possibility of a gap. The main evidence cited is (1) the absence of erosion between the two, and (2) a Plinian ash band that is traced into a base surge deposit. We agree that paroxysmal eruptions are of short duration, probably a few hours or days, but this does not exclude a time gap between the Plinian and later explosive eruptions. However, the short duration, combined with the magnitude of the eruption, implies that the paroxysmal blast was of high velocity so would readily move the light, unconsolidated Plinian pellets, leaving a 'sand-blasted' surface which could be difficult to distinguish from a pristine surface, particularly as the base surge probably eroded, as well as redeposited, earlier pumice in a way similar to that of Mt St Helens[2] (some 20 times smaller magnitude), so local, redeposited Plinian ash should be expected. We agree that the distal deep-sea 'Minoan' tephra is probably Plinian[3]. Nearer to the source, paroxysmal ashes must overlie Plinian, but seismic activity probably disrupted local layering and enhanced slumping at greater distances. Sparks' thermal model predicts that the magnetization would be 'frozen' in at different depths at different times. We do not find this. The directions are identical throughout the upper 60 m of upper tephra, which also has emplacement temperatures of some 400 °C near the caldera, decreasing to 300 °C on the flanks. Only a superficial few millimetres of large lava ejecta have been heated by contact with the tephra, suggesting rapid cooling—presumably by penecontemporaneous rainfall. We consider that our findings are consistent with the available evidence although further study and evaluation are desirable. In particular, analyses of the quantities of LMIB pottery at Cretan sites may be particularly informative.

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Table 1 Archaeointensity data

Site and sample	Refs 2, 4	Ref. 1
H. Triada kiln, central Crete	60.6±7.3*	68.1±2, n=6†
Phaistos 1 kiln, central Crete	37.8±6.4 89.6±15	67.3±6.6, n=4
K. Zakro 1 kiln, eastern Crete	61.7±3.8, n=3 [1, 2]‡	
K. Zakro 3 tile brick, eastern Crete	57.8±2.5, n=2 [1, 2, 3] 60.2±2.5, n=1 [1, 2] (by Thellier technique) 55.3±0.8, n=1 [1, 2] (by ARM technique)	60.7±2.4, n=6 (61.9±5.7 for Makrygialos)
K. Zakro 1+3	60.1±3.9, n=5 [1, 2] 57.1±5.2, n=12 [1, 2]	

* Standard error of the averaged results.
† n, Number of samples.
‡ Numbers in brackets indicate reliability: 1, very good; 2, moderately good; 3, dubious, combining Thellier and ARM (anhysteric remanent magnetization) techniques as stated.

DOWNEY AND TARLING assert[1] that the Plinian ash found in late Minoan (LM) Akrotiri is contemporary with the LMIA destruction on central Crete and that the ashes overlying these deposits in Akrotiri are, in turn, contemporaneous with the LMIB destruction in eastern Crete.

It is interesting to see the archaeomagnetic method applied to mud bricks and that such good results could be obtained. However, there is insufficient evidence, and the determination of a time gap between the above events has been over-optimistically stated by Downey and Tarling.

It is worth comparing the data in Downey and Tarling's Table 1 with other intensity and directional measurements which have been made[2-4] on fired kiln clays from Phaistos (Ph), Hagia Triada (HT) and Kato Zakros (KZ) (see our Table 1). The apparent difference in magnetic intensity between HT and KZ is emphasized by Downey and Tarling more than it ought to have been, when the associated errors and techniques used in their case and in refs 2 and 4 are considered (incorporating the data in their Table 2).

Regarding the intensity variations of single measurements, the upper and lower error limits of 50-68 μT for eastern Crete (55-63 for ref. 2) and 55-73 μT for central Crete (53-68 for ref. 2) compared with 57-67 μT for Plinian ashfall, do not allow us to assess positively the two eruptive phases of the volcano.

The archaeodirectional data[1,4] are compared in Table 2. Although barely discernible differences are noted in inclination ($I°$) data for HT and KZ from refs 1, 3 and 4 (which agree to within $\pm 1\sigma$ error), a difference in $I°$ and $D°$ (declination) observed for Phaistos, which is also noted in the intensity data (Table 1), may be explained by the use of measuring apparatus *in situ* as reported in Table 3.

The errors for the directional data of our Table 2 and Downey and Tarling's Table 2, and the degree of variation between them, indicate that this time