

Reporting Summary

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Statistics

For all statistical analyses, confirm that the following items are present in the figure legend, table legend, main text, or Methods section.

- | n/a | Confirmed |
|-------------------------------------|--|
| ☐ | ☒ The exact sample size (n) for each experimental group/condition, given as a discrete number and unit of measurement |
| ☐ | ☒ A statement on whether measurements were taken from distinct samples or whether the same sample was measured repeatedly |
| ☐ | ☒ The statistical test(s) used AND whether they are one- or two-sided
<i>Only common tests should be described solely by name; describe more complex techniques in the Methods section.</i> |
| ☐ | ☒ A description of all covariates tested |
| ☐ | ☒ A description of any assumptions or corrections, such as tests of normality and adjustment for multiple comparisons |
| ☐ | ☒ A full description of the statistical parameters including central tendency (e.g. means) or other basic estimates (e.g. regression coefficient) AND variation (e.g. standard deviation) or associated estimates of uncertainty (e.g. confidence intervals) |
| ☐ | ☒ For null hypothesis testing, the test statistic (e.g. F , t , r) with confidence intervals, effect sizes, degrees of freedom and P value noted
<i>Give P values as exact values whenever suitable.</i> |
| ☒ | ☐ For Bayesian analysis, information on the choice of priors and Markov chain Monte Carlo settings |
| ☒ | ☐ For hierarchical and complex designs, identification of the appropriate level for tests and full reporting of outcomes |
| ☒ | ☐ Estimates of effect sizes (e.g. Cohen's d , Pearson's r), indicating how they were calculated |

Our web collection on [statistics for biologists](#) contains articles on many of the points above.

Software and code

Policy information about [availability of computer code](#)

- | | |
|-----------------|---|
| Data collection | '2G Enterprises Data Acquisition' software (versions 3.7 and 2.99.5) was used to collect the archaeomagnetic directional data. Rock magnetic data was collected using the Variable Field Translation Balance software. The three dimensional coordinates were recorded using a Sokkia® iM-50 Series and a Leica® FlexLine TS-02 total stations, and their standard software. |
| Data analysis | AGICOS's Remasoft software (version 3.0) was used for the interpretation of the directional data (Chadima and Hroudá, 2006). Rock magnetic analyses were interpreted with the Rock_Mag_Analyzer software 1.1 (Leonhardt 2006). Environmental Systems Research Institute® (ESRI) ArcGIS Desktop ArcMap and ArcScene (versions 10.2.2 and 10.5) were used for the archaeostratigraphic and spatial analyses. The custom code for the temporal calculations was created with Matlab is available at https://doi.org/10.5281/zenodo.10931465 and at http://pc213fis.fis.ucm.es/program.html |

For manuscripts utilizing custom algorithms or software that are central to the research but not yet described in published literature, software must be made available to editors and reviewers. We strongly encourage code deposition in a community repository (e.g. GitHub). See the Nature Portfolio [guidelines for submitting code & software](#) for further information.

Data

Policy information about [availability of data](#)

All manuscripts must include a [data availability statement](#). This statement should provide the following information, where applicable:

- Accession codes, unique identifiers, or web links for publicly available datasets
- A description of any restrictions on data availability
- For clinical datasets or third party data, please ensure that the statement adheres to our [policy](#)

Archaeomagnetic dataset is available at MagIC database (DOI: 10.7288/V4/MAGIC/20054). Archeostratigraphic data is included in the main figures, Extended Data figures and Supplementary Note 2

Human research participants

Policy information about [studies involving human research participants and Sex and Gender in Research](#).

Reporting on sex and gender

Population characteristics

Recruitment

Ethics oversight

Note that full information on the approval of the study protocol must also be provided in the manuscript.

Field-specific reporting

Please select the one below that is the best fit for your research. If you are not sure, read the appropriate sections before making your selection.

☐ Life sciences ☐ Behavioural & social sciences ☒ Ecological, evolutionary & environmental sciences

For a reference copy of the document with all sections, see nature.com/documents/nr-reporting-summary-flat.pdf

Ecological, evolutionary & environmental sciences study design

All studies must disclose on these points even when the disclosure is negative.

Study description	The study comprises six hearths from the Neanderthal site of El Salt (Alcoy, SE Spain) to estimate quantitatively the minimum time elapsed between them. The hearths were ordered sequentially through archaeostratigraphic and spatial data and the minimum time between hearths has been calculated comparing the angular deviation between mean paleomagnetic directions with Earth's Magnetic Field Paleosecular Variation reconstructions.
Research sample	The samples are 13 magnetically oriented hand-blocks (105 specimens) and 11 loose samples from 6 archaeological hearths (used to perform paleomagnetic and rock-magnetic measurements) and the georeferenced in tridimensional coordinates of archaeological remains stratigraphically associated with the hearthplaces (1,411 faunal remains, 1,496 flint elements, 56 limestone flakes and pebbles, and 122 fragments of thermally altered travertine and tufa used for archaeostratigraphic and spatial analyses).
Sampling strategy	Sampling and fieldwork were carried out since 2014 as the excavation progressed, except the 2020 field season due to the pandemic. For archaeomagnetic analyses, we collected magnetically oriented blocks leaving the most heated surface at the top. Archaeomagnetic samples ideally came from well-heated and well-preserved (in situ) hearths, avoiding overlapped structures. Magnetically unoriented sample was directly collected from the ashy and subjacent black-layer facies of each hearth and saved in plastic bags. Archaeostratigraphic analyses implied the excavation and 3D recording of all flint, every limestone flake and pebble, faunal bones longer or wider than 1 cm and those shorter or narrower but displaying any recognizable anatomical part, and fragments of burnt travertine or tufa whose dimensions are greater than 5 cm.
Data collection	Archaeomagnetic directional data was obtained with a shielded ASC Model TD48 Thermal Demagnetizers (TD48-SC/TD48-DC) and a 2G-755 Superconducting cryogenic Rock magnetometer. Directional data was collected using the '2G Enterprises Data Acquisition' software (versions 3.7 and 2.99.5). Rock magnetic data was obtained with a Magnetic Measurements' Variable Field Translation Balance (MM_VFTB), using their standar software. The three dimensional coordinates were recorded using a Sokkia® iM-50 Series and a Leica® FlexLine TS-02 total stations.
Timing and spatial scale	The samples and georeferenced coordinates were collected/recorded during different excavation seasons since 2014. Analyses and interpretation of data were carried out during the subsequent years. The study focuses on Late Middle Palaeolithic (Neandertal) occupations associated with hearths in Mediterranean area of Iberian

Peninsula (Western Europe). Archaeological context of the studied materials is dated ca. 52 ky.

Data exclusions

Beyond standard quality control, we carried out a fully inclusive approach to all relevant data.

Two archaeomagnetic blocks were rejected due to evidences of mechanical alteration (e.g. visible cracks or displacement of some parts of the blocks). These blocks were damaged during (or just before) sampling. Once they were delimited in the field and just before pouring the plaster of Paris on them, it rained and both blocks got soaked.

The ash specimens from one of the hearths (H50) were excluded due to a possibly flattening effect caused by compaction

Apart from this, when calculating the mean archaeomagnetic directions, a double filtering for specimens selection was applied:

A) Specimens with $MAD > 5.0^\circ$ were rejected.

B) After applying the MAD filter, mean direction was calculated and specimens deviated more than 25° from the mean were rejected.

(More detailed explanations are given in the Supplementary Information of the manuscript)

Reproducibility

Thermal demagnetization of Natural Remanent Magnetization (NRM) is performed only once on each specimen due to the irreversible character of the experiment (it causes the progressive destruction of the original NRM). For this reason, a minimum of 8 specimens per hearth were analysed to obtain directional data. Thermomagnetic curves were performed on 11 different representative samples. Results and analysis are reproducible using standard available palaeomagnetic and archaeostratigraphic methods and data.

Randomization

n/a

Blinding

Blinding is not relevant in this study, because we did not identify any bias that could be avoided by blinding when calculating the mean archaeomagnetic directions and temporal estimations or when analysing the archaeostratigraphic data.

Did the study involve field work? ☒ Yes ☐ No

Field work, collection and transport

Field conditions

Field work was carried out in the archaeological site of El Salt. It is an open air place, but partially sheltered by a slightly tilted 40-meter-tall travertine wall. As explained in the Materials and Methods section of the article, a rainfall event partially damaged two of the samples.

Location

El Salt archaeological site (Alcoy, Spain): 38.6869° N, 0.5090° W. Altitude: 680 m.a.s.l.

Access & import/export

All the samples and georeferenced coordinates were collected/recorded during the excavation seasons of El Salt archaeological site. Excavation is carried out with formal permits issued by the regional government (Generalitat Valenciana). The samples were not taken out of the country in which they were collected (Spain) and no additional permits were required for their transport.

Disturbance

The archaeomagnetic samples are as small as possible, and additional intact sediment from each hearth was saved for their analysis using other techniques. The excavation process involved comprehensive documentation including systematic field notes, photography and photogrammetry, and facies description. All the field data was recorded digitally (text documents, spreadsheets and digital images).

Reporting for specific materials, systems and methods

We require information from authors about some types of materials, experimental systems and methods used in many studies. Here, indicate whether each material, system or method listed is relevant to your study. If you are not sure if a list item applies to your research, read the appropriate section before selecting a response.

Materials & experimental systems

n/a	Involved in the study
☒	☐ Antibodies
☒	☐ Eukaryotic cell lines
☐	☒ Palaeontology and archaeology
☒	☐ Animals and other organisms
☒	☐ Clinical data
☒	☐ Dual use research of concern

Methods

n/a	Involved in the study
☒	☐ ChIP-seq
☒	☐ Flow cytometry
☒	☐ MRI-based neuroimaging

Palaeontology and Archaeology

Specimen provenance	All the samples and georeferenced coordinates were collected/recorded during the excavation seasons of El Salt archaeological site. Excavation is carried out with formal permits issued by the regional government (Generalitat Valenciana).
Specimen deposition	The archaeomagnetic techniques used in this research are destructive and alter the properties of the samples. Thus, after their measurement, the samples cannot be used again. Furthermore, it must be said that they are sedimentary samples (not archaeological bone remains or lithic artifacts) and are no longer available.
Dating methods	No new dating is presented in this study.
☐ Tick this box to confirm that the raw and calibrated dates are available in the paper or in Supplementary Information.	
Ethics oversight	No ethical approval or guidance was required in this study, since we are not actually working with the archaeological artifacts.

Note that full information on the approval of the study protocol must also be provided in the manuscript.