

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
Only common tests should be described solely by name; describe more complex techniques in the Methods section.
- ☒ ☐ 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
Give P values as exact values whenever suitable.
- ☒ ☐ 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 Microsoft Access 2016, Microsoft Excel 2016, GEOSTAR, SurvCE, SurveyPro, E4

Data analysis Microsoft Excel 2016, ArcGIS 10.2, Kloninklijk Nederlands Meteorologisch Instituut (KNMI) climate explorer database (<https://climexp.knmi.nl>), Iolite, R (package Luminescence version 0.7.5), Riso Luminescence Analyst version 4.31.9

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 Research [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 list of figures that have associated raw data
- A description of any restrictions on data availability

The authors declare that the data supporting the findings of this study are available within the paper and its supplementary information files. The study utilized the Kloninklijk Nederlands Meteorologisch Instituut (KNMI) climate explorer database, available at <https://climexp.knmi.nl>.

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](https://www.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 presents qualitative and quantitative descriptions of artifacts recovered from archaeological excavation, OSL dating analysis of associated sediments, U-Th dating of nearby carbonate formations, and a rainfall attribution study based on published historical records.
Research sample	The research sample size for the artifact analysis was determined by what was recovered through excavation. The number of OSL samples was determined by the site stratigraphy. The number of U-Th samples was determined by the accessibility of suitable carbonate formations, further guided by trace element laser ablation mapping.
Sampling strategy	For artifact analysis, all plotted finds and 10 mm sieve material were classified to artifact type. All faunal plotted finds were analyzed for this study - the plotted finds are the largest and most informative. Small fragments in the 10 mm will not provide additional information relevant to this study. Likewise, all plotted OES finds were analyzed. All calcite crystals that were plotted, as well as from the 10 mm sieve were analyzed. The 10 mm sieve was included in this case because of the lower relative numbers of calcite crystals. For the lithic analysis, a sub-sample of the plotted finds was selected by using the Google Random Number generator to select Lots and then all lithic artefacts within those lots were analyzed. This provided us with a big enough sample size to address the relevant question for this study - are the lithic artefacts consistent with a Middle Stone Age designation. Carbonate sample strategy was based on an iterative cycle of field work and lab work. RP collected a number of initial carbonates based on prior field experience, these were U-Th dated and based on the dating success/failure more samples were collected by RP and JvdM. Laser ablation mapping of trace elements U and Th was used to visually select the layers most suitable for U-Th dating.
Data collection	JW, BJS, and KSB directed archaeological excavations at GHN. LG collected the OSL samples; LG and MCM conducted the OSL analysis. JW analyzed the archaeological crystals. JW and RP documented and collected geological crystals. BC analysed the faunal and OES assemblages with the assistance of AH. RP and JvdM collected and analysed the tufa samples. AFB, AH, and JW analysed the lithic assemblage.
Timing and spatial scale	Excavations and analyses at GHN began in 2016. A total of 4.75 square meters have been excavated, which has provided adequate material and information for analysis, but has also left a significant amount of intact witness deposits for any future analyses.
Data exclusions	Data were not excluded.
Reproducibility	The results presented here not from experiments and therefore reproducibility was not tested.
Randomization	Our study was not experimental, therefore randomization does not apply.
Blinding	Our study was not experimental, therefore blinding does not apply.
Did the study involve field work?	☒ Yes ☐ No

Field work, collection and transport

Field conditions	Most fieldwork was conducted during the dry winter months of June-Aug when the mean max temp tends to range between 15 and 25 degrees, and the monthly precipitation is generally less than 15 mm.
Location	GHN Rockshelter is located 12 km northwest of Kuruman at 27.384 (lat), 23.346 (long). The elevation is ~1420 masl.
Access & import/export	Excavation and analyses were conducted in accordance with local, national, and international laws and with the following permits granted by the South African Heritage Resource Agency; Permit IDs 2194 and 2446. Landowner permission was granted in writing by the Baga Motlhwane Traditional Council (14/01/2016).
Disturbance	Our work results in minimal disturbance. Following each excavation season, the excavation areas are completely backfilled with sandbags and covered with sediment so that there is almost no visible trace of our work. Our permanent control points are as inconspicuous as possible, with the only permanent marks being ~1 cm wide shallow divots. The smallest carbonate samples possible are collected for U-Th dating and in areas that are inconspicuous. We have not erected signage or significantly altered access paths to the site.

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
☒	☐ Human research participants
☒	☐ 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	Excavation and analyses at Ga-Mohana Hill North Rockshelter were conducted with the following permits granted by the South African Heritage Resource Agency; Permit ID 2194 (issued 8 March 2016) and Permit ID 2446 (issued 21 December 2016).
Specimen deposition	The specimens are currently housed in the Stone Age Laboratory in the Department of Archaeology at the University of Cape Town, South Africa. When all analyses at GHN are completed, all materials will be curated by the Archaeology Department at the McGregor Museum, Kimberley, South Africa as per a written agreement (Ref L 27.4.3.3.2) and in accordance the South African Heritage Resource Agency requirements.
Dating methods	Samples of tufa for U-Th dating were collected using a hammer, chisels and a modified cordless drill and diamond tipped core barrels. Carbonate samples were stored in sealed zip lock bags. No specific pretreatment protocols are used but prior to U-Th dating we did use laser ablation trace element mapping to investigate the concentration and distribution of U and Th, in order to pick the best possible layers for dating (low Th, high U). Sample preparation, measurement and age calculations were done in the Isotope and Trace Element Group in the School of Earth Sciences at the University of Melbourne and standard, published methods used (as detailed in the methods section). OSL samples were collected by hammering stainless steel tubes (5-cm diameter) into cleaned sections. OSL samples were prepared and measured at the University of Innsbruck Laboratory for OSL Dating. Standard preparation procedures were used to isolate quartz grains of 180–212µm diameter - Samples were wet sieved to recover grains of 180-212µm diameter, which were soaked in HCl (40%) and then H₂O₂ (50%). Grains were then density separated in Sodium Polytungstate solution of 2.70 g/cm³ to isolate quartz and feldspar from heavy minerals, then 2.62 g/cm³ to isolate quartz from feldspar. Quartz grains were then soaked in HF (40% for 40 minutes), followed by another HCl soak, and then sieved again (180µm). Quartz grains were measured using a Risø TL/OSL DA20 reader and stimulated for 2 s at 125 °C with a green laser (532 nm) and the ultraviolet OSL emission was measured using an Electron Tubes Ltd. 9635Q photomultiplier tube through 7.5 mm of Hoya U340 filter. Beta dose rates were measured using a Risø GM-25-5 low-level beta-counter, and alpha counting was performed using a Daybreak 583 thick-source alpha counter.
☒ Tick this box to confirm that the raw and calibrated dates are available in the paper or in Supplementary Information.	
Ethics oversight	Ethics oversight was not required because the study did not involve human or animal subjects, or vulnerable populations.

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