

## Reporting Summary

Nature Research wishes to improve the reproducibility of the work that we publish. This form provides structure for consistency and transparency in reporting. For further information on Nature Research policies, see [Authors & Referees](#) and the [Editorial Policy Checklist](#).

### Statistical parameters

When statistical analyses are reported, confirm that the following items are present in the relevant location (e.g. 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
- An indication of 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 statistics 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
- Clearly defined error bars  
*State explicitly what error bars represent (e.g. SD, SE, CI)*

*Our web collection on [statistics for biologists](#) may be useful.*

### Software and code

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

Data collection

No software was used

Data analysis

No software was used

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/reviewers upon request. 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

There are no formal restrictions on data availability.

## Field-specific reporting

Please select 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/authors/policies/ReportingSummary-flat.pdf](https://www.nature.com/authors/policies/ReportingSummary-flat.pdf)

## Ecological, evolutionary & environmental sciences study design

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

Study description	Revealing the preservation mechanism of the Ediacara biota: description of fossils, study of thin sections, Scanning Electron Microscopy and laboratory simulations with sand and clay.
Research sample	Ediacaran fossils from the Lyamtza and Zimnie Gory localities of the Ediacara biota in the White Sea region (Russia) and from South Australia.
Sampling strategy	No sample-size calculation was performed
Data collection	Some fossils were collected by Ilya Bobrovskiy during field work 2015 to 2018. The rest were studied at the collections of Ediacaran macrofossils of the Borissiak Paleontological Institute RAS (Moscow, Russia). Ediacaran fossils from South Australia were studied at the South Australian Museum (Adelaide, Australia).
Timing and spatial scale	Samples stored in museum collections were collected from 1942 to 2018.
Data exclusions	Weathered samples were not studied for early diagenetic history.
Reproducibility	All attempts to repeat the experiment were successful.
Randomization	Samples were not allocated into groups.
Blinding	No statistical analyses were performed.
Did the study involve field work?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No

## Field work, collection and transport

Field conditions	Rock outcrops in the cliffs of the White Sea.
Location	Lyamtza Village and Zimnie Gory in the Arkhangelsk Region (Russia)
Access and import/export	Samples were collected under the license ARKH 01562 PD given to the Borissiak Paleontological Institute RAS for collecting palaeontological samples in the Arkhangelsk Region, Russia; no samples were imported/exported.
Disturbance	Only rock outcrops with no vegetation were explored.

## Reporting for specific materials, systems and methods

### Materials & experimental systems

n/a	Included in the study
<input checked="" type="checkbox"/>	<input type="checkbox"/> Unique biological materials
<input checked="" type="checkbox"/>	<input type="checkbox"/> Antibodies
<input checked="" type="checkbox"/>	<input type="checkbox"/> Eukaryotic cell lines
<input type="checkbox"/>	<input checked="" type="checkbox"/> Palaeontology
<input checked="" type="checkbox"/>	<input type="checkbox"/> Animals and other organisms
<input checked="" type="checkbox"/>	<input type="checkbox"/> Human research participants

### Methods

n/a	Included in the study
<input checked="" type="checkbox"/>	<input type="checkbox"/> ChIP-seq
<input checked="" type="checkbox"/>	<input type="checkbox"/> Flow cytometry
<input checked="" type="checkbox"/>	<input type="checkbox"/> MRI-based neuroimaging

## Palaeontology

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Specimen provenance

Samples were collected under the license ARKH 01562 PD from 12.07.2016 given by Rosnedra to the Borissiak Paleontological Institute RAS for collecting palaeontological samples in the Arkhangelsk Region, Russia

Specimen deposition

All specimens are located at the Borissiak Paleontological Institute RAS (Moscow, Russia) and the South Australian Museum (Adelaide, Australia).

Dating methods

No new dates are provided.

Tick this box to confirm that the raw and calibrated dates are available in the paper or in Supplementary Information.