

Corresponding author(s): Xiaotong Peng

Last updated by author(s): Apr 2, 2026

Reporting Summary

Nature Portfolio 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 Portfolio policies, see our [Editorial Policies](#) and the [Editorial Policy Checklist](#).

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 Photomicrographs (Leica LAS v4.9 software, Leica LAS X software, StrangeView v1.1 software)

Data analysis Global Mapper 26.1; PAUP 4.0a169; Fastp v0.23.2; trimAl v1.4.1; MEGAHIT v1.2.95; BLASTn v2.5.0; MetaWRAP v1.2; CheckM v1.2.2; rRNA_HMM; GTDB-tk v2.4.0; GTDB database R220

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](#)

The original in situ images for the whale fossils and whale falls, and microbial MAGs for the dominant bivalve symbionts are available on Science Data Bank (<https://doi.org/10.57760/sciencedb.28830>). The original images of 35 investigated whale fall species are available on MorphoBank (<https://morphobank.org/permalink/>)

P6064). Sixty-seven DNA barcoding gene sequences and one mitochondrial genome were deposited in GenBank (PX673207–PX673224; PX684580–PX684631; PX519993). All these data have been released, and are openly accessible with the provided web-links.

Research involving human participants, their data, or biological material

Policy information about studies with [human participants or human data](#). See also policy information about [sex, gender \(identity/presentation\), and sexual orientation](#) and [race, ethnicity and racism](#).

Reporting on sex and gender n/a

Reporting on race, ethnicity, or other socially relevant groupings n/a

Population characteristics n/a

Recruitment n/a

Ethics oversight n/a

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](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 We used human occupied vehicle to discover the whale falls and whale fossils in the Diamantina Zone.

Research sample All samples were obtained during 32 dives carried out in the Diamantina Zone.

Sampling strategy We used the manipulators and slurp of the submersible to recover the investigated samples.

Data collection In situ images and videos were taken with pan-tilt still and video cameras. Biodiversity and geochemistry data were collected on-land laboratory. Cruise participants collected onboard data.

Timing and spatial scale Dives were conducted during February 7–March 18, 2023.

Data exclusions No data was excluded.

Reproducibility All in situ images and videos were recorded. All analyses were conducted based on duplicate materials.

Randomization No randomization was used.

Blinding Blinding is inapplicable and irrelevant.

Did the study involve field work? ☒ Yes ☐ No

Field work, collection and transport

Field conditions Water depth, 4616m –7001 m.

Location Dives were conducted in the Diamantina Zone along the trench axis.

Access & import/export The cruise, conducted on the high seas, was approved by the Chinese government.

Disturbance No disturbance to the environment.

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
☒	☐ Plants

Methods

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

Animals and other research organisms

Policy information about [studies involving animals](#); [ARRIVE guidelines](#) recommended for reporting animal research, and [Sex and Gender in Research](#)

Laboratory animals	No laboratory animals were used in the study.
Wild animals	Whale-fall fossil samples were collected using the submersible's two hydraulically powered manipulator arms, operated by submersible pilots, and stored in the geological baskets. The whale falls investigated are remains of naturally dead whales. Details of the invertebrate whale-fall species are provided in Extended Data Table 1. Only a small number of invertebrate specimens associated with whale bones were collected and fixed for taxonomic and molecular studies. Several whale-fall bones in the sulfophilic stage were collected using the manipulator arms and kept in the biobox. Some associated free-living whale-fall fauna species like gastropods, squat lobsters and brittle stars were collected using the slurp sampler mounted on the submersible. Upon retrieval of the submersible, all whale-fall fauna died due to the water pressure changes. All investigated whale fossils and whale-fall specimens are deposited at room temperature, -20 °C, or -80 °C during on board. Now they are kept in the same method in the Hadal Museum, Institute of Deep-sea Science and Engineering, Chinese Academy of Sciences.
Reporting on sex	Sex is inapplicable for the investigated animals and irrelevant.
Field-collected samples	Whale-fall fossil samples were sorted and registered in the ship's laboratory, then deposited in the cold room under -20 °C during the cruise. The whale bones and associated invertebrate specimens were immediately sorted, fixed, and registered in the ship's laboratory. For taxonomic purposes, these whale fall specimens were preserved using either 10% formalin or 75% ethanol solution. Specimen tissues for molecular analysis were preserved directly in -80 °C freezers. Now all investigated whale fossils and whale-fall specimens are deposited at room temperature, -20 °C, or -80 °C, in the Hadal Museum, Institute of Deep-sea Science and Engineering, Chinese Academy of Sciences.
Ethics oversight	The study did not require an ethical approval.

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

Plants

Seed stocks	n/a
Novel plant genotypes	n/a
Authentication	n/a