DESCRIPTION

Earth and Planetary Science Letters (EPSL) is a leading journal for researchers across the entire Earth and planetary sciences community. It publishes concise, exciting, high-impact articles ("Letters") of broad interest. Its focus is on physical and chemical processes, the evolution and general properties of the Earth and planets - from their deep interiors to their atmospheres. EPSL also includes a Frontiers section, featuring invited high-profile synthesis articles by leading experts on timely topics to bring cutting-edge research to the wider community.

Benefits to authors
We also provide many author benefits, such as free PDFs, a liberal copyright policy, special discounts on Elsevier publications and much more. Please click here for more information on our author services.

Please see our Guide for Authors for information on article submission. If you require any further information or help, please visit our Support Center

AUDIENCE

All earth scientists.

IMPACT FACTOR

2016: 4.409 © Thomson Reuters Journal Citation Reports 2017
ABSTRACTING AND INDEXING

Aquatic Sciences and Fisheries Abstracts
Articles First (OCLC Database)
CAS
Compendex
Current Contents / Physical, Chemical & Earth Sciences
Meteorological and Geoastrophysical Abstracts
Engineering Index Monthly
GEOBASE
GeoRef
INSPEC
OCLC Contents Alert
Oceanic Abstracts
Petroleum Abstracts
Pollution Abstracts
Referativnyi Zhurnal VINTI-RAN (Russian Academy of Sciences)
Science Citation Index
Water Resources Abstracts
Web of Science
Arts & Humanities Search
Personal Alert
Astrophysics Data System
Scopus
Science Citation Index Expanded
Zoological Record
Environment Index
Academic Search (EBSCO)
Current Abstracts (EBSCO)
TOC Premier
Science & Technology Collection™
ProQuest
Science and Technology Collection

EDITORIAL BOARD

Co Editors-in-Chief:
Rebecca Bendick, University of Montana, Missoula, Montana, USA
Geodynamics, Geodesy, Continental Tectonics, Active Tectonics, Earthquake Mechanics, Numerical Simulation, Natural Hazard Communication
Mike Bickle, University of Cambridge, Cambridge, UK
Igneous Petrology, Metamorphic Petrology, Tectonics, High and Low Temperature Geochemistry, Archaean Geology, River Chemistry, Chemical Weathering, Geological Carbon Storage
John Brodholt, University College London (UCL), London, UK
Mineral Physics, Solid Earth Geophysics, Mantle and Core Processes, Impact Processes, Petrology, Rock and Mineral Deformation
Bruce Buffett, University of California at Berkeley, Berkeley, California, USA
Mantle and Core Dynamics, Subduction, Geomagnetism
Martin Frank, GEOMAR Helmholtz Centre for Ocean Research Kiel, Kiel, Germany
Oceanography/Paleoceanography, Paleoclimatology, Marine Chemistry, Low Temperature Isotope Geochemistry
Tamsin A. Mather, University of Oxford, Oxford, UK
Volcanology, Igneous Geochemistry, Atmospheric Chemistry
William B. McKinnon, Washington University in St. Louis, St. Louis, Missouri, USA
Planetary Science, Planetary Geology and Geophysics, Impact Cratering, Ice and and Ocean Worlds
Frederic Moynier, Institut de Physique du Globe de Paris, Paris, France
Cosmochemistry, Early Earth, Isotope Geochemistry, Non-traditional Stable Isotopes, High Temperature Geochemistry
Peter Shearer, University of California at San Diego (UCSD), La Jolla, California, USA
Seismology, Earth structure, Earthquake Physics, General Geophysics
Heather Stoll, ETH Zürich, Switzerland  
Paleoceanography, Paleoclimatology, Isotope Geochemistry  
Derek Vance, Eidgenössische Technische Hochschule (ETH) Zürich, Zürich, Switzerland  
Isotope Geochemistry, Marine Chemistry, Chemical Weathering, Biogeochemical Cycles  
An Yin, University of California at Los Angeles (UCLA), Los Angeles, California, USA  
Tectonics, Geochronology-Thermochronology, Surface Processes, Continental Petrology, Geochemistry  

Advisory Board:  
Jean-Philippe Avouac, California Institute of Technology, Pasadena, California, USA  
Active Tectonics, Seismology, Geodynamics, Geomorphology, Structural Geology, Thermochronology, Rock Mechanics  
Pierre Beck, Université de Grenoble, Grenoble, France  
Mineralogy of Extra-Terrestrial Materials (Meteorites) And Surfaces (Rocky and Icy)  
George Bergantz, University of Washington, Seattle, Washington, USA  
Magmatic Processes, Fluid Dynamics, Multiphase Flow  
John Bridges, University of Leicester, Leicester, UK  
Mars, Martian Meteorites, Nakhlaite, Alteration of Mars Crust, Remote Sensing of Mars, Cometary Analyses, Chondrite Meteorites  
Roland Bürgmann, University of California at Berkeley, Berkeley, California, USA  
Active Tectonics, Space Geodesy, Crustal Deformation, Fault and Rock Rheology  
Jim Channell, University of Florida, Gainesville, Florida, USA  
Magnetic Stratigraphy, Timescales, Paleomagnetism, Alpine Paleogeography  
Kari Cooper, University of California, Davis, Davis, California, USA  
Magmatic Processes, Isotope Geochemistry, Uranium-Series Geochemistry, Geochronology  
Tibor Dunai, Universität zu Köln, Köln, Germany  
Geochronology  
Guillaume Fiquet, Université Pierre et Marie Curie, Sorbonne Universités, Paris, France  
Mineral Physics, Planetary Structure and Evolution, High-pressure Physics  
Jef Gee, University of California at San Diego (UCSD), San Diego, California, USA  
Paleomagnetism  
Ian Jackson, Australian National University, Canberra, Australian Capital Territory, Australia  
Mineral and Rock Physics with Applications to Earth Structure and Processes  
David Johnston, Harvard University, Cambridge, Massachusetts, USA  
Isotope Geochemistry and Historical Geobiology  
Brian Kennett, Australian National University, Canberra, Australian Capital Territory, Australia  
Seismology, Seismic Tomography, Geophysical Inversion, Deep Earth Processes  
Dennis Kent, Rutgers University, Piscataway, New Jersey, USA  
Paleomagnetism, Geomagnetism, Rock Magnetism, Polarity Time Scales, Plate Motions, Paleoclimate  
Cin-Ty Lee, Rice University, Houston, Texas, USA  
Solid-Earth Geochemistry, Igneous Petrology, General Geochemistry, Lithosphere Dynamics  
Timothy Lyons, University of California at Riverside, Riverside, California, USA  
Sedimentary Geochemistry, Biogeochemical Cycles, Astrobiology  
Hiroko Nagahara, University of Tokyo, Bunkyo-Ku, Japan  
Meteoritics  
Rich Pancost, University of Bristol, Bristol, UK  
Paleoclimate, Geomicrobiology, Preservation of Organic Matter  
Simon Poulton, University of Leeds, Leeds, England, UK  
Geochemical and Biogeochemical Processes in Modern Sediments and Waters with view to applying to understanding of Ancient Environments  
Louise Prockter, Lunar and Planetary Institute, Houston, Texas, USA  
Planetary Geology, Geophysics, Remote Sensing  
Liping Qin, University of Science and Technology of China (USTC), Hefei, China  
Cosmochemistry, Early Solar System Chronology, Nucleosynthetic Isotope Anomalies, Metal Isotope Geochemistry  
Stuart Robinson, University of Oxford, Oxford, UK  
Sedimentology and Stratigraphy  
Mathieu Roskosz, Université Pierre et Marie Curie, Sorbonne Universités, Paris, France  
Physicochemical Processes Responsible for the Mineralogical, Chemical and Isotopic Evolution of Solids in the Formation of the Solar System  
Alison Rust, University of Bristol, Bristol, England, UK  
Physical Volcanology  
Frederick Ryerson, Lawrence Livermore National Laboratory, Livermore, California, USA
Solid-Earth Geochemistry, Experimental Petrology, Mineral Physics, Cosmic-Ray Exposure Dating

**Heather Savage**, The Earth Institute at Columbia University, Palisades, New York, USA
Faulting, Structural Geology, Friction and Rock Mechanics

**Blair Schoene**, Princeton University, Princeton, New Jersey, USA
Geochronology, Thermochronology, Radiogenic Isotope Tracing, Field Geology, Structural Analysis, Geochemistry to processes of Lithospheric Evolution and Earth history

**Maria Schönbächler**, ETH Zürich, Zürich, Switzerland
Isotope Geochemistry and Cosmochemistry

**Barbara Sherwood Lollar**, University of Toronto, Toronto, Ontario, Canada
Environmental Mineral Physics

**Frederik Simons**, Princeton University, Princeton, New Jersey, USA
Solid-earth Geophysics, Seismology, Geodesy, Spectral Analysis, Wavelet Analysis, Inverse Problems

**William Ussler**, Monterey Bay Aquarium Research Inst., Moss Landing, California, USA
Biogeochemistry, Environmental Microbiology, Deep-sea Instrumentation, Marine Geology, Gas Hydrates

**Andrew Walker**, University of Leeds, Leeds, England, UK
Computational Geophysics and Mineral Physics

**Peter Zeitler**, Lehigh University, Bethlehem, Pennsylvania, USA
Geochronology, Noble-Gas Dating, Tectonics, Himalaya-Tibet-South Asia, Continental Geodynamics
GUIDE FOR AUTHORS

Your Paper Your Way
We now differentiate between the requirements for new and revised submissions. You may choose to submit your manuscript as a single Word or PDF file to be used in the refereeing process. Only when your paper is at the revision stage, will you be requested to put your paper in to a 'correct format' for acceptance and provide the items required for the publication of your article.
To find out more, please visit the Preparation section below.

INTRODUCTION
Earth and Planetary Science Letters uses an online, electronic submission system. By accessing the website http://ees.elsevier.com/epsl you will be guided stepwise through the creation and uploading of the various files. When submitting a manuscript to Elsevier Editorial System, authors need to provide an electronic version of their manuscript. The system automatically converts source files to a single Adobe Acrobat PDF version of the article, which is used in the peer-review process. Please note that even though manuscript source files are converted to PDF at submission for the review process, these source files are needed for further processing after acceptance.

Types of articles
The author should specify a category designation for the manuscript i.e. Letter, Comment and Reply, Erratum/Corrigendum, or Special Issue. The author should select the "Frontiers Paper" article type only if they have been invited by an editor to submit a Frontiers paper.

EPSL discourages the submission of companion papers since they are not in the spirit of short concise Letters. However, occasionally papers may benefit from being published back to back. EPSL will consider "companion"/linked papers on an individual basis (i.e., acceptance of one paper does not guarantee acceptance of the other).

Contact details for submission
Authors should submit their article via the Elsevier Editorial System (EES), at http://ees.elsevier.com/epsl, where they will be guided step-by-step through the creation and uploading of various files. Please use the following guidelines to prepare your article. For further information or assistance please visit our Support Center.

Submission checklist
You can use this list to carry out a final check of your submission before you send it to the journal for review. Please check the relevant section in this Guide for Authors for more details.

Ensure that the following items are present:

One author has been designated as the corresponding author with contact details:
• E-mail address
• Full postal address

All necessary files have been uploaded:
Manuscript:
• Include keywords
• All figures (include relevant captions)
• All tables (including titles, description, footnotes)
• Ensure all figure and table citations in the text match the files provided
• Indicate clearly if color should be used for any figures in print
Graphical Abstracts / Highlights files (where applicable)
Supplemental files (where applicable)

Further considerations
• Manuscript has been 'spell checked' and 'grammar checked'
• All references mentioned in the Reference List are cited in the text, and vice versa
• Permission has been obtained for use of copyrighted material from other sources (including the Internet)
• A competing interests statement is provided, even if the authors have no competing interests to declare
• Journal policies detailed in this guide have been reviewed
• Referee suggestions and contact details provided, based on journal requirements

For further information, visit our Support Center.

*Cover letters should be directed to the editor and highlight the importance of the manuscript, its relevance to the field, and why it should be published in the journal. Requests for word or figure limit exceptions and indication of conflicts of interest are also appropriate to include. Including a copy of the abstract is not necessary since the abstract already appears in the manuscript itself.

BEFORE YOU BEGIN

Ethics in publishing
Please see our information pages on Ethics in publishing and Ethical guidelines for journal publication.

Human and animal rights
If the work involves the use of human subjects, the author should ensure that the work described has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for experiments involving humans; Uniform Requirements for manuscripts submitted to Biomedical journals. Authors should include a statement in the manuscript that informed consent was obtained for experimentation with human subjects. The privacy rights of human subjects must always be observed.

All animal experiments should comply with the ARRIVE guidelines and should be carried out in accordance with the U.K. Animals (Scientific Procedures) Act, 1986 and associated guidelines, EU Directive 2010/63/EU for animal experiments, or the National Institutes of Health guide for the care and use of Laboratory animals (NIH Publications No. 8023, revised 1978) and the authors should clearly indicate in the manuscript that such guidelines have been followed.

Conflict of Interest
Authors are expected to select an Editor and suggest reviewers with an area of expertise appropriate to the manuscript's content and with whom they or any of the co-authors have no conflict of interest. Conflicts of interest with Editors and reviewers include, but are not restricted to: being employed at the same institution; being a current or recent thesis advisor, student, or post-doctoral scholar; being a current or recent co-author or collaborator; or having business or financial relationships. Any such relationship that ended more than 3 years ago will not be considered a potential source of conflict.

If you have any questions about whether you have a conflict of interest with a particular editor or reviewer you are suggesting, please bring this to the attention of the editor at the initial submission stage.

All authors are requested to disclose any actual or potential conflict of interest including any financial, personal or other relationships with other people or organizations within three years of beginning the submitted work that could inappropriately influence, or be perceived to influence, their work. See also http://www.elsevier.com/conflictsofinterest.

Stratigraphic Names
Stratigraphic names should conform to the following chart produced by the Internal Commission on Stratigraphy: http://www.stratigraphy.org/column.php?id=Chart/Time%20Scale. Regarding general usage, early/late should be used for time and lower/upper should be used for rock units.

Submission declaration and verification
Submission of an article implies that the work described has not been published previously (except in the form of an abstract or as part of a published lecture or academic thesis or as an electronic preprint, see ‘Multiple, redundant or concurrent publication' section of our ethics policy for more information), that it is not under consideration for publication elsewhere, that its publication is approved by all authors and tacitly or explicitly by the responsible authorities where the work was carried out, and that, if accepted, it will not be published elsewhere in the same form, in English or in any other language, including electronically without the written consent of the copyright-holder. To verify originality, your article may be checked by the originality detection service CrossCheck.

Data policy
Data Access
All data discussed in the text and presented in figures must either be presented in tabulated form in the paper or its supplemental files; be contained in cited, readily available, persistent sources; or be available in an accessible, persistent depository such as a public database or data archive, if it exists for the specific data type. For appropriate types of data, making the data available in a format that can be downloaded into a spreadsheet from the supplemental files is recommended even if a similar table is presented in text form in the main text.

For chemical abundance data, elemental or oxide abundance data must be given unless a compelling reason exists why this is not possible. Derivative chemical parameters such as elemental abundance ratios or abundances normalized to some other parameter may be listed only in addition to the primary abundance data.

**Data Quality Information**

Authors must provide sufficient information (metadata) about the analytical process and reproducibility of measurements in order that the data quality can be evaluated. Correction procedures must be clearly presented.

For each measured chemical parameter, the analytical technique (e.g. ICPMS, XRF, EMP) and the laboratory where the measurement was performed should be provided, if possible in tabular format. If a parameter has been analyzed by more than one method or in more than one lab, each method must be documented separately. Analytical accuracy and reproducibility should be reported by providing name(s) and measured value(s) of internationally recognized reference samples measured as unknown samples with the estimated uncertainty of the reference standard measurement and the number of measurements.

**Sample Information**

Essential metadata about natural samples must be provided in order to allow for identification of their origin and type, and to trace their analytical history.

All natural samples for which data are reported require, if applicable, information about the sample location, including latitude and longitude (if these are unknown, coordinates obtained by using Google Earth would suffice); depth below sea level (for marine samples); position within a stratigraphic section or within a core (if applicable). Samples from scientific ocean drilling programs should include complete sample identifiers (e.g. leg, site/hole, core, section, interval) in the data tables. Samples should be classified (e.g. lithology for rocks and sediments, species for minerals and fossils, age). Samples for which previously published data exist should be referred to by the previously used identifiers or, if new sample identifiers are given, cross-referenced to the original identifiers.

**Citing Published Data**

When citing published data, or showing compilations of published data in figures, sources must be explicitly provided. On-line geochemical databases such as PetDB or GEOROC give full source references as part of their routine output. Because journal formats commonly limit the number references that can be listed in the main body of a publication, additional data sources should be explicitly listed in on-line electronic supplementary form. It is not sufficient to say: "Data shown were taken from PetDB or GEOROC."

**Contributors**

Each author is required to declare his or her individual contribution to the article: all authors must have materially participated in the research and/or article preparation, so roles for all authors should be described. The statement that all authors have approved the final article should be true and included in the disclosure.

**Authorship**

All authors should have made substantial contributions to all of the following: (1) the conception and design of the study, or acquisition of data, or analysis and interpretation of data, (2) drafting the article or revising it critically for important intellectual content, (3) final approval of the version to be submitted.

**Changes to authorship**

Authors are expected to consider carefully the list and order of authors before submitting their manuscript and provide the definitive list of authors at the time of the original submission. Any addition, deletion or rearrangement of author names in the authorship list should be made only before the manuscript has been accepted and only if approved by the journal Editor. To request such a change, the Editor must receive the following from the corresponding author: (a) the reason
for the change in author list and (b) written confirmation (e-mail, letter) from all authors that they agree with the addition, removal or rearrangement. In the case of addition or removal of authors, this includes confirmation from the author being added or removed.

Only in exceptional circumstances will the Editor consider the addition, deletion or rearrangement of authors after the manuscript has been accepted. While the Editor considers the request, publication of the manuscript will be suspended. If the manuscript has already been published in an online issue, any requests approved by the Editor will result in a corrigendum.

**Copyright**

Upon acceptance of an article, authors will be asked to complete a 'Journal Publishing Agreement' (see more information on this). An e-mail will be sent to the corresponding author confirming receipt of the manuscript together with a 'Journal Publishing Agreement' form or a link to the online version of this agreement.

Subscribers may reproduce tables of contents or prepare lists of articles including abstracts for internal circulation within their institutions. Permission of the Publisher is required for resale or distribution outside the institution and for all other derivative works, including compilations and translations. If excerpts from other copyrighted works are included, the author(s) must obtain written permission from the copyright owners and credit the source(s) in the article. Elsevier has preprinted forms for use by authors in these cases.

For open access articles: Upon acceptance of an article, authors will be asked to complete an 'Exclusive License Agreement' (more information). Permitted third party reuse of open access articles is determined by the author's choice of user license.

**Author rights**

As an author you (or your employer or institution) have certain rights to reuse your work. More information.

**Elsevier supports responsible sharing**

Find out how you can share your research published in Elsevier journals.

**Role of the funding source**

You are requested to identify who provided financial support for the conduct of the research and/or preparation of the article and to briefly describe the role of the sponsor(s), if any, in study design; in the collection, analysis and interpretation of data; in the writing of the report; and in the decision to submit the article for publication. If the funding source(s) had no such involvement then this should be stated.

**Funding body agreements and policies**

Elsevier has established a number of agreements with funding bodies which allow authors to comply with their funder's open access policies. Some funding bodies will reimburse the author for the Open Access Publication Fee. Details of existing agreements are available online.

**Open access**

This journal offers authors a choice in publishing their research:

**Open access**

- Articles are freely available to both subscribers and the wider public with permitted reuse.
- An open access publication fee is payable by authors or on their behalf, e.g. by their research funder or institution.

**Subscription**

- Articles are made available to subscribers as well as developing countries and patient groups through our universal access programs.
- No open access publication fee payable by authors.

Regardless of how you choose to publish your article, the journal will apply the same peer review criteria and acceptance standards.

For open access articles, permitted third party (re)use is defined by the following Creative Commons user licenses:
Creative Commons Attribution (CC BY)
Lets others distribute and copy the article, create extracts, abstracts, and other revised versions, adaptations or derivative works of or from an article (such as a translation), include in a collective work (such as an anthology), text or data mine the article, even for commercial purposes, as long as they credit the author(s), do not represent the author as endorsing their adaptation of the article, and do not modify the article in such a way as to damage the author's honor or reputation.

Creative Commons Attribution-NonCommercial-NoDerivs (CC BY-NC-ND)
For non-commercial purposes, lets others distribute and copy the article, and to include in a collective work (such as an anthology), as long as they credit the author(s) and provided they do not alter or modify the article.

The open access publication fee for this journal is USD 2800, excluding taxes. Learn more about Elsevier's pricing policy: https://www.elsevier.com/openaccesspricing.

Green open access
Authors can share their research in a variety of different ways and Elsevier has a number of green open access options available. We recommend authors see our green open access page for further information. Authors can also self-archive their manuscripts immediately and enable public access from their institution's repository after an embargo period. This is the version that has been accepted for publication and which typically includes author-incorporated changes suggested during submission, peer review and in editor-author communications. Embargo period: For subscription articles, an appropriate amount of time is needed for journals to deliver value to subscribing customers before an article becomes freely available to the public. This is the embargo period and it begins from the date the article is formally published online in its final and fully citable form. Find out more.

This journal has an embargo period of 24 months.

Elsevier Publishing Campus
The Elsevier Publishing Campus (www.publishingcampus.com) is an online platform offering free lectures, interactive training and professional advice to support you in publishing your research. The College of Skills training offers modules on how to prepare, write and structure your article and explains how editors will look at your paper when it is submitted for publication. Use these resources, and more, to ensure that your submission will be the best that you can make it.

Language (usage and editing services)
Please write your text in good English (American or British usage is accepted, but not a mixture of these). Authors who feel their English language manuscript may require editing to eliminate possible grammatical or spelling errors and to conform to correct scientific English may wish to use the English Language Editing service available from Elsevier's WebShop.

Submission
Our online submission system guides you stepwise through the process of entering your article details and uploading your files. The system converts your article files to a single PDF file used in the peer-review process. Editable files (e.g., Word, LaTeX) are required to typeset your article for final publication. All correspondence, including notification of the Editor's decision and requests for revision, is sent by e-mail.

Paper length
For regular Letter and invited "Frontiers" articles, EPSL has a restricted article length of no more than 6500 words in the main text (i.e., from introduction to conclusion). The word count will exclude the abstract, figures, tables, figure and table captions, acknowledgments, references, appendices, and supplementary files. Headings, citations, and equations within the main text are included in the word count. The total number of figures and tables (counted together) should not to exceed 10 and the number of reference should not exceed 50.

Comment and Reply submissions should be short, concise and not exceed 2000 words, with no more than 1 figure and 10 references.

Additional Notes: Large tables taking up more than one page should be submitted as part of Supplementary Material. Excessive use of multi-part figures is not permitted and the editor will make a decision on the suitability of such submissions. Additional figures can be included as part of Supplementary Material which would form part of the electronic version of the paper.
Line numbering and spacing

Please insert continuous line numbers in the text of the manuscript. In Word files, this can be found under File: Page Setup: Layout: Line numbers: Add line numbering: Continuous. In the LaTeX template, select \usepackage{lineno}.

Please double-space your manuscript before submission.

Figures over 10MB

Large files can be difficult for editors and reviewers to download. If the size of all of your figure adds up to over 10MB, please save a low resolution copy of your figures and: Upload your low-resolution figure files as type "Figure". These will be used for review. Upload your high-resolution figure files as type "Figure (high-resolution)". These will not be used for review, but will be sent to production if your article is accepted.

If you have any problems reducing the filesize, please see http://www.elsevier.com/author-schemas/artwork-and-media-instructions or visit our Support Center.

Reviewers

You are requested to provide 5 suggestions for reviewers. The editors request that you not only suggest well-established senior scientists working in your field, but also consider appropriate post-docs. Final decision on reviewers to be invited to assess a given paper is at the discretion of the handling editor.

PREPARATION

NEW SUBMISSIONS

Submission to this journal proceeds totally online and you will be guided stepwise through the creation and uploading of your files. The system automatically converts your files to a single PDF file, which is used in the peer-review process. As part of the Your Paper Your Way service, you may choose to submit your manuscript as a single file to be used in the refereeing process. This can be a PDF file or a Word document, in any format or layout that can be used by referees to evaluate your manuscript. It should contain high enough quality figures for refereeing. If you prefer to do so, you may still provide all or some of the source files at the initial submission. Please note that individual figure files larger than 10 MB must be uploaded separately.

References

There are no strict requirements on reference formatting at submission. References can be in any style or format as long as the style is consistent. Where applicable, author(s) name(s), journal title/book title, chapter title/article title, year of publication, volume number/book chapter and the pagination must be present. Use of DOI is highly encouraged. The reference style used by the journal will be applied to the accepted article by Elsevier at the proof stage. Note that missing data will be highlighted at proof stage for the author to correct.

Formatting requirements

There are no strict formatting requirements but all manuscripts must contain the essential elements needed to convey your manuscript, for example Abstract, Keywords, Introduction, Materials and Methods, Results, Conclusions, Artwork and Tables with Captions. If your article includes any Videos and/or other Supplementary material, this should be included in your initial submission for peer review purposes. Divide the article into clearly defined sections. Please note that the typesetter cannot implement corrections to supplementary files and must upload the file exactly as it is provided by the author. For this reason, please do not submit supplementary files with track changes or annotations enabled as the corrections will not be incorporated before publication.
Peer review
This journal operates a single blind review process. All contributions will be initially assessed by the editor for suitability for the journal. Papers deemed suitable are then typically sent to a minimum of two independent expert reviewers to assess the scientific quality of the paper. The Editor is responsible for the final decision regarding acceptance or rejection of articles. The Editor's decision is final. More information on types of peer review.

REVISED SUBMISSIONS
Use of word processing software
Regardless of the file format of the original submission, at revision you must provide us with an editable file of the entire article. Keep the layout of the text as simple as possible. Most formatting codes will be removed and replaced on processing the article. The electronic text should be prepared in a way very similar to that of conventional manuscripts (see also the Guide to Publishing with Elsevier). See also the section on Electronic artwork.
To avoid unnecessary errors you are strongly advised to use the 'spell-check' and 'grammar-check' functions of your word processor.

LaTeX
You are recommended to use the Elsevier article class elsarticle.cls to prepare your manuscript and BibTeX to generate your bibliography.
Our LaTeX site has detailed submission instructions, templates and other information.

Article structure
Subdivision - numbered sections
Divide your article into clearly defined and numbered sections. Subsections should be numbered 1.1 (then 1.1.1, 1.1.2, ...), 1.2, etc. (the abstract is not included in section numbering). Use this numbering also for internal cross-referencing: do not just refer to 'the text'. Any subsection may be given a brief heading. Each heading should appear on its own separate line.

Introduction
State the objectives of the work and provide an adequate background, avoiding a detailed literature survey or a summary of the results.

Material and methods
Provide sufficient detail to allow the work to be reproduced. Methods already published should be indicated by a reference: only relevant modifications should be described.

Experimental
Provide sufficient detail to allow the work to be reproduced. Methods already published should be indicated by a reference: only relevant modifications should be described.

Theory/calculation
A Theory section should extend, not repeat, the background to the article already dealt with in the Introduction and lay the foundation for further work. In contrast, a Calculation section represents a practical development from a theoretical basis.

Results
Results should be clear and concise.

Discussion
This should explore the significance of the results of the work, not repeat them. A combined Results and Discussion section is often appropriate. Avoid extensive citations and discussion of published literature.

Conclusions
The main conclusions of the study may be presented in a short Conclusions section, which may stand alone or form a subsection of a Discussion or Results and Discussion section.

Appendices
If there is more than one appendix, they should be identified as A, B, etc. Formulae and equations in appendices should be given separate numbering: Eq. (A.1), Eq. (A.2), etc.; in a subsequent appendix, Eq. (B.1) and so on. Similarly for tables and figures: Table A.1; Fig. A.1, etc.

Essential title page information
• Title. Concise and informative. Titles are often used in information-retrieval systems. Avoid abbreviations and formulae where possible.
• **Author names and affiliations.** Please clearly indicate the given name(s) and family name(s) of each author and check that all names are accurately spelled. Present the authors' affiliation addresses (where the actual work was done) below the names. Indicate all affiliations with a lowercase superscript letter immediately after the author's name and in front of the appropriate address. Provide the full postal address of each affiliation, including the country name and, if available, the e-mail address of each author.

• **Corresponding author.** Clearly indicate who will handle correspondence at all stages of refereeing and publication, also post-publication. **Ensure that the e-mail address is given and that contact details are kept up to date by the corresponding author.**

• **Present/permanent address.** If an author has moved since the work described in the article was done, or was visiting at the time, a 'Present address' (or 'Permanent address') may be indicated as a footnote to that author's name. The address at which the author actually did the work must be retained as the main, affiliation address. Superscript Arabic numerals are used for such footnotes.

**Abstract**
A concise and factual abstract is required. The abstract should state briefly the purpose of the research, the principal results and major conclusions. An abstract is often presented separately from the article, so it must be able to stand alone. For this reason, References should be avoided, but if essential, then cite the author(s) and year(s). Also, non-standard or uncommon abbreviations should be avoided, but if essential they must be defined at their first mention in the abstract itself.

**Graphical abstract**
Although a graphical abstract is optional, its use is encouraged as it draws more attention to the online article. The graphical abstract should summarize the contents of the article in a concise, pictorial form designed to capture the attention of a wide readership. Graphical abstracts should be submitted as a separate file in the online submission system. Image size: Please provide an image with a minimum of 531 × 1328 pixels (h × w) or proportionally more. The image should be readable at a size of 5 × 13 cm using a regular screen resolution of 96 dpi. Preferred file types: TIFF, EPS, PDF or MS Office files. You can view Example Graphical Abstracts on our information site.

Authors can make use of Elsevier's Illustration Services to ensure the best presentation of their images and in accordance with all technical requirements.

**Highlights**
Highlights are mandatory for this journal. They consist of a short collection of bullet points that convey the core findings of the article and should be submitted in a separate editable file in the online submission system. Please use 'Highlights' in the file name and include 3 to 5 bullet points (maximum 85 characters, including spaces, per bullet point). You can view example Highlights on our information site.

**Keywords**
Immediately after the abstract, provide a maximum of 6 keywords, using American spelling and avoiding general and plural terms and multiple concepts (avoid, for example, 'and', 'of'). Be sparing with abbreviations: only abbreviations firmly established in the field may be eligible. These keywords will be used for indexing purposes.

**Abbreviations**
Define abbreviations that are not standard in this field in a footnote to be placed on the first page of the article. Such abbreviations that are unavoidable in the abstract must be defined at their first mention there, as well as in the footnote. Ensure consistency of abbreviations throughout the article.

**Acknowledgements**
Collate acknowledgements in a separate section at the end of the article before the references and do not, therefore, include them on the title page, as a footnote to the title or otherwise. List here those individuals who provided help during the research (e.g., providing language help, writing assistance or proof reading the article, etc.).

**Formatting of funding sources**
List funding sources in this standard way to facilitate compliance to funder's requirements:

Funding: This work was supported by the National Institutes of Health [grant numbers xxxx, yyyyy]; the Bill & Melinda Gates Foundation, Seattle, WA [grant number zzzz]; and the United States Institutes of Peace [grant number aaaa].
It is not necessary to include detailed descriptions on the program or type of grants and awards. When funding is from a block grant or other resources available to a university, college, or other research institution, submit the name of the institute or organization that provided the funding.

If no funding has been provided for the research, please include the following sentence:

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

**Math formulae**

Please submit math equations as editable text and not as images. Present simple formulae in line with normal text where possible and use the solidus (/) instead of a horizontal line for small fractional terms, e.g., X/Y. In principle, variables are to be presented in italics. Powers of e are often more conveniently denoted by exp. Number consecutively any equations that have to be displayed separately from the text (if referred to explicitly in the text).

**Footnotes**

Footnotes should be used sparingly. Number them consecutively throughout the article. Many word processors build footnotes into the text, and this feature may be used. Should this not be the case, indicate the position of footnotes in the text and present the footnotes themselves separately at the end of the article.

**Artwork**

**Electronic artwork**

**General points**

- Make sure you use uniform lettering and sizing of your original artwork.
- Preferred fonts: Arial (or Helvetica), Times New Roman (or Times), Symbol, Courier.
- Number the illustrations according to their sequence in the text.
- Use a logical naming convention for your artwork files.
- Indicate per figure if it is a single, 1.5 or 2-column fitting image.
- For Word submissions only, you may still provide figures and their captions, and tables within a single file at the revision stage.
- Please note that individual figure files larger than 10 MB must be provided in separate source files.

A detailed guide on electronic artwork is available.

**Formats**

Regardless of the application used, when your electronic artwork is finalized, please 'save as' or convert the images to one of the following formats (note the resolution requirements for line drawings, halftones, and line/halftone combinations given below):

- EPS (or PDF): Vector drawings. Embed the font or save the text as 'graphics'.
- TIFF (or JPEG): Color or grayscale photographs (halftones): always use a minimum of 300 dpi.
- TIFF (or JPEG): Bitmapped line drawings: use a minimum of 1000 dpi.
- TIFF (or JPEG): Combinations bitmapped line/half-tone (color or grayscale): a minimum of 500 dpi is required.

Please do not:

- Supply files that are optimized for screen use (e.g., GIF, BMP, PICT, WPG); the resolution is too low.
- Supply files that are too low in resolution.
- Submit graphics that are disproportionately large for the content.

**Color artwork**

Please make sure that artwork files are in an acceptable format (TIFF (or JPEG), EPS (or PDF), or MS Office files) and with the correct resolution. If, together with your accepted article, you submit usable color figures then Elsevier will ensure, at no additional charge, that these figures will appear in color online (e.g., ScienceDirect and other sites) regardless of whether or not these illustrations are reproduced in color in the printed version. **For color reproduction in print, you will receive information regarding the costs from Elsevier after receipt of your accepted article.** Please indicate your preference for color: in print or online only. Further information on the preparation of electronic artwork.

**Figure captions**

Ensure that each illustration has a caption. A caption should comprise a brief title (not on the figure itself) and a description of the illustration. Keep text in the illustrations themselves to a minimum but explain all symbols and abbreviations used.
**Tables**

Please submit tables as editable text and not as images. Tables can be placed either next to the relevant text in the article, or on separate page(s) at the end. Number tables consecutively in accordance with their appearance in the text and place any table notes below the table body. Be sparing in the use of tables and ensure that the data presented in them do not duplicate results described elsewhere in the article. Please avoid using vertical rules and shading in table cells.

Each table may only take up **one page**. If the table is larger than one page, please upload as supplementary material for online publication only.

**References**

*Citation in text*

Please ensure that every reference cited in the text is also present in the reference list (and vice versa). Any references cited in the abstract must be given in full.

Unpublished results and personal communications are not recommended in the reference list, but may be mentioned in the text. All references included in the reference list must have been accepted for publication and should have a DOI. For references that are accepted, but not yet published, please cite as in press. For references that are accepted, but have not yet been assigned a DOI, please upload a copy of the accepted reference with your submission as a supplementary for review only file. Please update the reference to include the DOI as soon as it is available.

If there are references cited only in supplementary material, please remove them from the main reference list and add them to the bottom of the supplementary material file as a separate supplemental reference list to keep the supplementary file self-contained. References not cited in the main text will be deleted or moved to a Further Reading list appearing immediately above the main articles references.

The total number of references should not exceed **50**.

*Reference links*

Increased discoverability of research and high quality peer review are ensured by online links to the sources cited. In order to allow us to create links to abstracting and indexing services, such as Scopus, CrossRef and PubMed, please ensure that data provided in the references are correct. Please note that incorrect surnames, journal/book titles, publication year and pagination may prevent link creation. When copying references, please be careful as they may already contain errors. Use of the DOI is encouraged.

A DOI can be used to cite and link to electronic articles where an article is in-press and full citation details are not yet known, but the article is available online. A DOI is guaranteed never to change, so you can use it as a permanent link to any electronic article. An example of a citation using DOI for an article not yet in an issue is: VanDecar J.C., Russo R.M., James D.E., Ambeh W.B., Franke M. (2003). Aseismic continuation of the Lesser Antilles slab beneath northeastern Venezuela. Journal of Geophysical Research, https://doi.org/10.1029/2001JB000884. Please note the format of such citations should be in the same style as all other references in the paper.

*Web references*

As a minimum, the full URL should be given and the date when the reference was last accessed. Any further information, if known (DOI, author names, dates, reference to a source publication, etc.), should also be given. Web references can be listed separately (e.g., after the reference list) under a different heading if desired, or can be included in the reference list.

*Data references*

This journal encourages you to cite underlying or relevant datasets in your manuscript by citing them in your text and including a data reference in your Reference List. Data references should include the following elements: author name(s), dataset title, data repository, version (where available), year, and global persistent identifier. Add [dataset] immediately before the reference so we can properly identify it as a data reference. The [dataset] identifier will not appear in your published article.

*Reference management software*

Most Elsevier journals have their reference template available in many of the most popular reference management software products. These include all products that support Citation Style Language styles, such as Mendeley and Zotero, as well as EndNote. Using the word processor plug-ins from...
these products, authors only need to select the appropriate journal template when preparing their article, after which citations and bibliographies will be automatically formatted in the journal's style. If no template is yet available for this journal, please follow the format of the sample references and citations as shown in this Guide.

Users of Mendeley Desktop can easily install the reference style for this journal by clicking the following link:
http://open.mendeley.com/use-citation-style/earth-and-planetary-science-letters
When preparing your manuscript, you will then be able to select this style using the Mendeley plugins for Microsoft Word or LibreOffice.

Reference formatting
There are no strict requirements on reference formatting at submission. References can be in any style or format as long as the style is consistent. Where applicable, author(s) name(s), journal title/book title, chapter title/article title, year of publication, volume number/book chapter and the pagination must be present. Use of DOI is highly encouraged. The reference style used by the journal will be applied to the accepted article by Elsevier at the proof stage. Note that missing data will be highlighted at proof stage for the author to correct. If you do wish to format the references yourself they should be arranged according to the following examples:

Reference style

Text: All citations in the text should refer to:
1. Single author: the author's name (without initials, unless there is ambiguity) and the year of publication;
2. Two authors: both authors' names and the year of publication;
3. Three or more authors: first author's name followed by 'et al.' and the year of publication.

Citations may be made directly (or parenthetically). Groups of references should be listed first alphabetically, then chronologically.

Examples: 'as demonstrated (Allan, 2000a, 2000b, 1999; Allan and Jones, 1999). Kramer et al. (2010) have recently shown ....'

List: References should be arranged first alphabetically and then further sorted chronologically if necessary. More than one reference from the same author(s) in the same year must be identified by the letters 'a', 'b', 'c', etc., placed after the year of publication.

Examples:
Reference to a journal publication:
Reference to a book:
Reference to a chapter in an edited book:
Reference to a website:
Reference to a dataset:

Journal abbreviations source
Journal names should be abbreviated according to the List of Title Word Abbreviations.

Video
Elsevier accepts video material and animation sequences to support and enhance your scientific research. Authors who have video or animation files that they wish to submit with their article are strongly encouraged to include links to these within the body of the article. This can be done in the same way as a figure or table by referring to the video or animation content and noting in the body text where it should be placed. All submitted files should be properly labeled so that they directly relate to the video file’s content. In order to ensure that your video or animation material is directly usable, please provide the files in one of our recommended file formats with a preferred maximum size of 150 MB in total. Any single file should not exceed 50 MB. Video and animation files supplied will be published online in the electronic version of your article in Elsevier Web products, including
ScienceDirect. Please supply 'stills' with your files: you can choose any frame from the video or animation or make a separate image. These will be used instead of standard icons and will personalize the link to your video data. For more detailed instructions please visit our video instruction pages.

Note: since video and animation cannot be embedded in the print version of the journal, please provide text for both the electronic and the print version for the portions of the article that refer to this content.

RESEARCH DATA
This journal encourages and enables you to share data that supports your research publication where appropriate, and enables you to interlink the data with your published articles. Research data refers to the results of observations or experimentation that validate research findings. To facilitate reproducibility and data reuse, this journal also encourages you to share your software, code, models, algorithms, protocols, methods and other useful materials related to the project.

Below are a number of ways in which you can associate data with your article or make a statement about the availability of your data when submitting your manuscript. If you are sharing data in one of these ways, you are encouraged to cite the data in your manuscript and reference list. Please refer to the "References" section for more information about data citation. For more information on depositing, sharing and using research data and other relevant research materials, visit the research data page.

Data linking
If you have made your research data available in a data repository, you can link your article directly to the dataset. Elsevier collaborates with a number of repositories to link articles on ScienceDirect with relevant repositories, giving readers access to underlying data that gives them a better understanding of the research described.

There are different ways to link your datasets to your article. When available, you can directly link your dataset to your article by providing the relevant information in the submission system. For more information, visit the database linking page.

For supported data repositories a repository banner will automatically appear next to your published article on ScienceDirect.

In addition, you can link to relevant data or entities through identifiers within the text of your manuscript, using the following format: Database: xxxx (e.g., TAIR: AT1G01020; CCDC: 734053; PDB: 1XFN).

Open data
This journal supports Open data, enabling authors to submit any raw (unprocessed) research data with their article for open access publication under the CC BY license. More information.

Mendeley Data
This journal supports Mendeley Data, enabling you to deposit any research data (including raw and processed data, video, code, software, algorithms, protocols, and methods) associated with your manuscript in a free-to-use, open access repository. Before submitting your article, you can deposit the relevant datasets to Mendeley Data. Please include the DOI of the deposited dataset(s) in your main manuscript file. The datasets will be listed and directly accessible to readers next to your published article online.

For more information, visit the Mendeley Data for journals page.

Data statement
To foster transparency, we encourage you to state the availability of your data in your submission. This may be a requirement of your funding body or institution. If your data is unavailable to access or unsuitable to post, you will have the opportunity to indicate why during the submission process, for example by stating that the research data is confidential. The statement will appear with your published article on ScienceDirect. For more information, visit the Data Statement page.
**International Geo Sample Number (IGSN)**

If you have registered your sample with the SESAR database and have received an IGSN for this sample, please tag your IGSNs in your manuscript. This will enable Elsevier to link the IGSN number to the sample in SESAR if your paper is published online. To tag an IGSN, please use the syntax "IGSN: IGSN number" (e.g., IGSN: HRV0035F0). For more information on SESAR and how to register your samples please visit [http://www.geosamples.org/](http://www.geosamples.org/)

**AudioSlides**

The journal encourages authors to create an AudioSlides presentation with their published article. AudioSlides are brief, webinar-style presentations that are shown next to the online article on ScienceDirect. This gives authors the opportunity to summarize their research in their own words and to help readers understand what the paper is about. More information and examples are available. Authors of this journal will automatically receive an invitation e-mail to create an AudioSlides presentation after acceptance of their paper.

**Google Maps and KML files**

KML (Keyhole Markup Language) files (optional): You can enrich your online articles by providing KML or KMZ files which will be visualized using Google maps. The KML or KMZ files can be uploaded in our online submission system. KML is an XML schema for expressing geographic annotation and visualization within Internet-based Earth browsers. Elsevier will generate Google Maps from the submitted KML files and include these in the article when published online. Submitted KML files will also be available for downloading from your online article on ScienceDirect. More information.

**Interactive plots**

This journal enables you to show an Interactive Plot with your article by simply submitting a data file. Full instructions.

**AFTER ACCEPTANCE**

**Online proof correction**

Corresponding authors will receive an e-mail with a link to our online proofing system, allowing annotation and correction of proofs online. The environment is similar to MS Word: in addition to editing text, you can also comment on figures/tables and answer questions from the Copy Editor. Web-based proofing provides a faster and less error-prone process by allowing you to directly type your corrections, eliminating the potential introduction of errors.

If preferred, you can still choose to annotate and upload your edits on the PDF version. All instructions for proofing will be given in the e-mail we send to authors, including alternative methods to the online version and PDF. We will do everything possible to get your article published quickly and accurately. Please use this proof only for checking the typesetting, editing, completeness and correctness of the text, tables and figures. Significant changes to the article as accepted for publication will only be considered at this stage with permission from the Editor. It is important to ensure that all corrections are sent back to us in one communication. Please check carefully before replying, as inclusion of any subsequent corrections cannot be guaranteed. Proofreading is solely your responsibility.

**Offprints**

The corresponding author will, at no cost, receive a customized Share Link providing 50 days free access to the final published version of the article on ScienceDirect. The Share Link can be used for sharing the article via any communication channel, including email and social media. For an extra charge, paper offprints can be ordered via the offprint order form which is sent once the article is accepted for publication. Both corresponding and co-authors may order offprints at any time via Elsevier's Webshop. Corresponding authors who have published their article open access do not receive a Share Link as their final published version of the article is available open access on ScienceDirect and can be shared through the article DOI link.

**AUTHOR INQUIRIES**

Visit the Elsevier Support Center to find the answers you need. Here you will find everything from Frequently Asked Questions to ways to get in touch.

You can also check the status of your submitted article or find out when your accepted article will be published.