Physics of the Earth

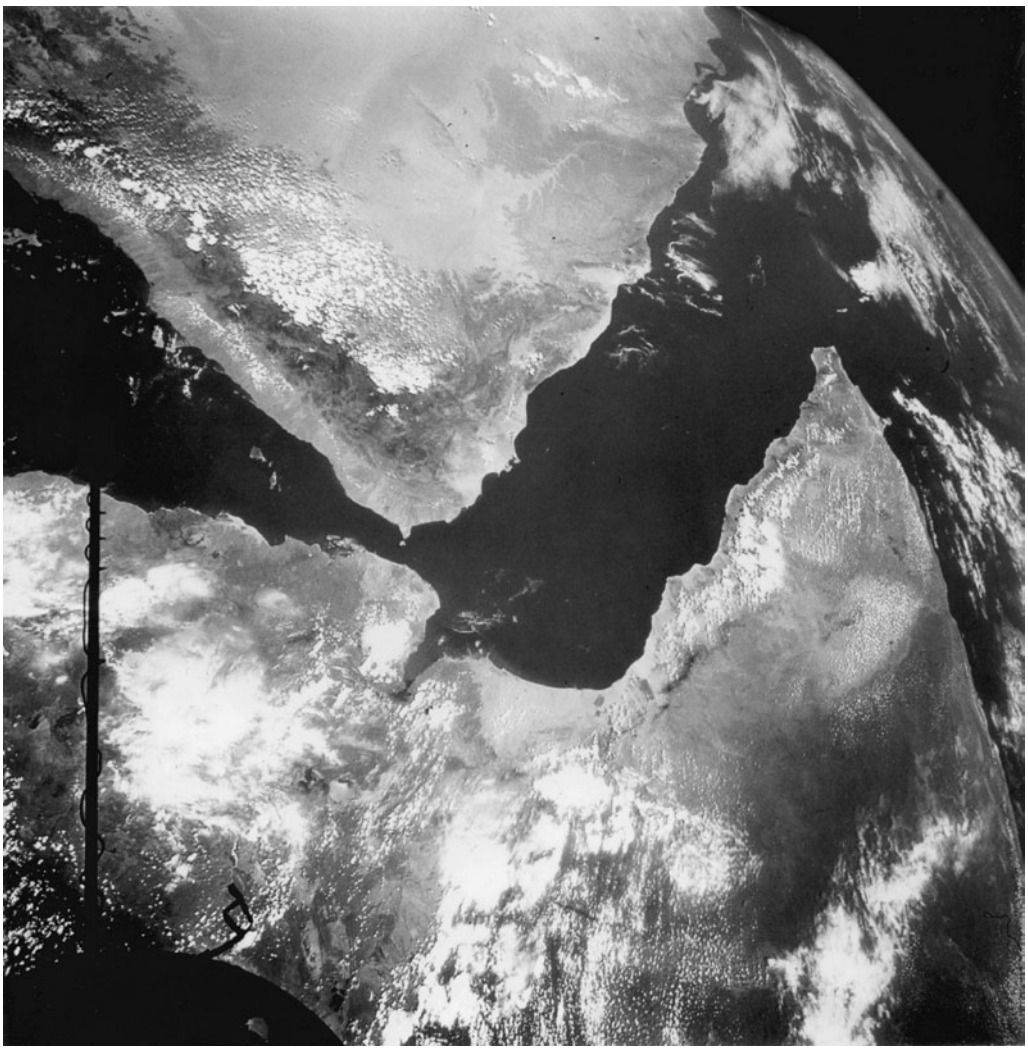
The fourth edition of Physics of the Earth maintains the original philosophy of this classic textbook on fundamental solid Earth geophysics, while being completely revised and up-dated by Frank Stacey and his new co-author Paul Davis. Building on the success of previous editions, which have served generations of graduate students and researchers for nearly forty years, this new edition will be an invaluable resource for graduate students looking for the necessary physical and mathematical foundations to embark on their own research careers in geophysics.

The book presents a detailed, critical analysis of the whole range of global geophysics topics and traces our understanding of the Earth, from its origin and composition to recent ideas about rotation of the inner core. The division of this new edition into an increased number of shorter chapters is designed to make the material more accessible, and allows students to focus on topics of particular interest. New chapters on elastic and inelastic properties, rock mechanics, kinematics of earthquake processes, earthquake dynamics and thermal properties have been added. A brief concluding chapter also reviews contributions from solid Earth studies to our understanding of climate change and the potential for 'alternative' energies.

Appendices, presenting fundamental data and advanced mathematical concepts, and an extensive reference list, are provided as tools to aid readers wishing to pursue topics beyond the level of the book. Over 140 student exercises of varying levels of difficulty are also included, and full solutions are available online at www.cambridge.org/9780521873628.

Frank Stacey is a graduate of London University. After appointments in Canada, Australia and UK, he went to the University of Queensland in 1964 and it was there that the first three editions of 'Physics of the Earth' were written. After retirement as Professor of Applied Physics, he joined CSIRO Exploration and Mining (in 1997) to continue geophysical research. He has published on a wide range of geophysical topics and has been recognized by his peers by election to fellowship of the Australian Academy of Science and the American Geophysical Union and by the award of the inaugural Neel medal of the European Geophysical Society, as well as numerous visiting lectureships at institutions around the world. Professor Stacey is also the author/editor of three other books.

Paul Davis is a graduate of the University of Queensland. After appointments in Edmonton, Canada, and Cambridge, he joined the University of California at Los Angeles (UCLA), where he is Professor of Geophysics. He has published extensively on geophysical topics, especially seismology. His professional honours include a Guggenheim fellowship, fellowship of the Royal Astronomical Society and the American Geophysical Union and a visiting Leverhulme professorship to the University of Oxford. He has served a term as editor of the Journal of Geophysical Research (Solid Earth). Professor Davis is also the co-author of another undergraduate textbook.



Gemini XI photograph of the Gulf of Aden and the Red Sea by NASA astronauts Charles Conrad and Richard F. Gordon. This is one of the areas of particular interest in the theory of sea floor spreading. A line of earthquake epicentres extends from the ridge system in the Indian Ocean, up the middle of the Gulf of Aden and into the Red Sea, marking the axis of a new ridge along which mantle material is rising as the Africa and Arabia plates part. Courtesy of the National Aeronautics and Space Administration, Washington.

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Fourth edition

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Preface

As with previous editions of this title, our principal aim is to present a coherent account of the Earth that will satisfy advanced students with diverse backgrounds. We have endeavoured to explore the physical principles of the subject in a way that encourages critical appraisal. This requires the reader to have some familiarity with a wide range of inter-related ideas, for which there is no clearly preferred, logical order of presentation. Should the properties of meteorites precede or follow the isotopic methods used to study them? Is it important to understand something about the Earth's internal heat before studying seismology or vice versa? Can we be clear about the evidence for tectonic activity without knowing about the behaviour of the geomagnetic field? We have attempted to avoid the need for answers to these questions by beginning each chapter with what we call a preamble. Our preambles are not intended to be synopses of the chapters or even introductions in the conventional sense, but glue to hold the subject together, with glimpses of related concepts from other chapters. We hope to convey in this way a feel for the unity of the subject. Especially for students using this book as a text, we suggest reading all of the preambles before looking deeper into any of the chapters.

The appendices and the list of references are also indications of our philosophy. They are included as tools to aid students, or others, who are pursuing topics beyond the level of this book, questioning the approach we have taken or simply seeking convenient reference material. We often learn most effectively by doubting something we read and conducting an independent check, either by a calculation or by a literature search. This is especially true in using a text such as ours, which introduces ideas that are recent and await confirmation or are even disputed. One of the appendices is a set of problems, many of which we have used with our own classes. They have a wide range of sophistication, from near trivial to difficult. For convenience they are numbered to identify them with particular chapters, but in many cases it is not clear to which chapters they are most relevant. Problems that provide bridges between topics are probably the most useful and we draw attention to some of them in the text. Our own solutions are presented on a website: www.cambridge.org/9780521873628.

We like to think that this book will be read by the next generation of geophysicists, who will develop an understanding of things that currently puzzle us or correct things that we have got wrong. We refer in the text to some of the tantalizing questions that await their attention and they will find more that we have not thought of. Advice about our errors, omissions and obscurities will be appreciated. We thank colleagues who have reviewed draft chapters and helped us to minimize the flaws: Charles Barton, Peter Bird, Emily Brodsky, Shamita Das, David Dunlop, Emily Foote, Mark Harrison, Donald Isaak, Ian Jackson, Mark Jacobson, Per Jögi, Brian Kennett, Andrew King, Frank Kyte, David Loper, Kevin McKeegan, Ronald Merrill, Francis Nimmo, Richard Peltier, Henry Pollack, Joy Stacey, Sabine Stanley and George Williams.

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