

Cambridge University Press

978-0-521-80393-9 - *Worlds on Fire: Volcanoes on the Earth, the Moon, Mars, Venus and Io*
Charles Frankel

Frontmatter

[More information](#)

Worlds on Fire

Volcanoes on the Earth, the Moon, Mars, Venus and Io

Worlds on Fire takes the reader on a fascinating tour of the mightiest volcanoes in the Solar System. From Kilauea volcano in Hawaii and Mount Etna in Sicily, it leaps to the lava fields and rilles of the Moon, retraces the historic footsteps of the *Apollo* astronauts and describes new volcanic provinces to explore. The three largest volcanoes of Mars – Olympus Mons, Alba Patera and Arsia Mons – are profiled, amongst others. The strange world of Venus, revealed by radar, opens our perspective of volcanism to features never seen before: pancake domes of puffed-up lava, and gigantic fault rings sitting over buried magma chambers. The tour of the Solar System ends with the only current eruptions outside of Earth: the spectacular volcanoes of Io – Jupiter’s fiery moon. This highly readable book, illustrated with the most recent imagery from spacecraft, will appeal to general readers, and students of Earth and planetary sciences.

CHARLES FRANKEL is a geologist who has written several books and directed scientific documentaries.

Cambridge University Press

978-0-521-80393-9 - Worlds on Fire: Volcanoes on the Earth, the Moon, Mars, Venus and Io
Charles Frankel

Frontmatter

[More information](#)

Worlds on Fire

*Volcanoes on the Earth, the Moon,
Mars, Venus and Io*

CHARLES FRANKEL



CAMBRIDGE
UNIVERSITY PRESS

Cambridge University Press

978-0-521-80393-9 - Worlds on Fire: Volcanoes on the Earth, the Moon, Mars, Venus and Io
Charles Frankel

Frontmatter

[More information](#)

PUBLISHED BY THE PRESS SYNDICATE OF THE UNIVERSITY OF CAMBRIDGE
The Pitt Building, Trumpington Street, Cambridge, United Kingdom

CAMBRIDGE UNIVERSITY PRESS
The Edinburgh Building, Cambridge CB2 2RU, UK
40 West 20th Street, New York, NY 10011-4211, USA
477 Williamstown Road, Port Melbourne, VIC 3207, Australia
Ruiz de Alarcón 13, 28014 Madrid, Spain
Dock House, The Waterfront, Cape Town 8001, South Africa
<http://www.cambridge.org>

Copyright © C. S. Frankel 2005

This book is in copyright. Subject to statutory exception
and to the provisions of relevant collective licensing agreements,
no reproduction of any part may take place without
the written permission of Cambridge University Press.

First published 2005

Printed in the United Kingdom at the University Press, Cambridge

Typeface 9.5/15pt Trump Mediaeval *System* QuarkXPress™ [sE]

A catalogue record for this book is available from the British Library

ISBN 978 0 521 80393 9 hardback
ISBN 0 521 80393 4 hardback

The publisher has used its best endeavours to ensure that the URLs for external websites referred to in this book are correct and active at the time of going to press. However, the publisher has no responsibility for the websites and can make no guarantee that a site will remain live or that the content is or will remain appropriate.

Cambridge University Press

978-0-521-80393-9 - Worlds on Fire: Volcanoes on the Earth, the Moon, Mars, Venus and Io
Charles Frankel

Frontmatter

[More information](#)

Contents

| | |
|--|---------------|
| Introduction | <i>page</i> 1 |
| 1 Volcanism on Earth | 4 |
| Why is the Earth hot? | 4 |
| Core, mantle and crust | 7 |
| Hot spots | 11 |
| Plate tectonics | 12 |
| Under the volcano | 15 |
| The role of gas | 18 |
| Eruption! | 21 |
| Volcanoes and climate | 24 |
| Volcanoes and death | 26 |
| Volcanoes and life | 30 |
| 2 A tour of terrestrial volcanoes | 33 |
| Krafla (Iceland) | 33 |
| Kilauea (Hawaii) | 40 |
| Etna (Sicily) | 46 |
| Ol Doinyo Lengai (Tanzania) | 54 |
| Mount Pelée (Martinique) | 59 |
| 3 Volcanism on the Moon | 64 |
| First impressions | 64 |
| Close-up views of the Moon | 66 |
| <i>Apollo 11</i> : touchdown in a lava field | 67 |
| <i>Apollo 12</i> : the Ocean of Storms | 70 |
| <i>Apollo 15</i> : excursion to Hadley Rille | 72 |
| <i>Apollo 17</i> : a geologist on the Moon | 76 |
| Lava fountains on the Moon | 79 |

Cambridge University Press

978-0-521-80393-9 - Worlds on Fire: Volcanoes on the Earth, the Moon, Mars, Venus and Io
Charles Frankel

Frontmatter

[More information](#)

vi CONTENTS

| | |
|--|------------|
| Treasures of <i>Apollo</i> | 82 |
| Remote-sensing: the big picture | 85 |
| The magma ocean | 89 |
| Mare volcanism | 92 |
| Looking for volcanoes | 94 |
| 4 A tour of lunar volcanoes | 97 |
| Hadley Rille | 97 |
| Taurus-Littrow valley | 104 |
| The Marius Hills | 110 |
| The Gruithuisen domes | 116 |
| The Aristarchus plateau and Schroeter's valley | 120 |
| 5 Volcanism on Mars | 127 |
| The discovery of Mars | 129 |
| Giant volcanoes | 132 |
| Tharsis and Alba Patera | 134 |
| Elysium and Hellas | 136 |
| Eruptions on Mars | 138 |
| Landfall on Mars: the <i>Viking</i> missions | 143 |
| Martian minerals | 145 |
| <i>Pathfinder</i> and the andesite mystery | 148 |
| <i>Mars Global Surveyor</i> | 150 |
| <i>Spirit</i> and <i>Opportunity</i> | 151 |
| Meteorites from Mars | 154 |
| Young lava | 158 |
| Hydrothermal activity and life on Mars | 161 |
| Plate tectonics on Mars | 165 |
| Volcanoes and the Martian climate | 167 |
| Exploring Mars | 170 |
| 6 A tour of Martian volcanoes | 174 |
| Olympus Mons | 174 |
| Arsia Mons | 184 |

Cambridge University Press

978-0-521-80393-9 - Worlds on Fire: Volcanoes on the Earth, the Moon, Mars, Venus and Io
Charles Frankel

Frontmatter

[More information](#)

CONTENTS vii

| | |
|---------------------------------------|------------|
| Alba Patera | 190 |
| Hecates Tholus | 196 |
| Hadriaca Patera | 202 |
| 7 Volcanism on Venus | 207 |
| An original planet | 207 |
| Descent into hell | 209 |
| The basalts of Venus | 210 |
| Volcanic gases | 213 |
| Venus drops her veil | 215 |
| In search of plate tectonics | 217 |
| <i>Magellan</i> explores Venus | 219 |
| Large volcanoes on Venus | 221 |
| Spiders and crowns | 224 |
| Pancakes and ticks | 227 |
| Lava flows on Venus | 229 |
| Eruptions on Venus | 232 |
| Spatial distribution of volcanoes | 234 |
| The life and times of Venus | 236 |
| Melting the surface | 239 |
| 8 A tour of Venusian volcanoes | 242 |
| Theia Mons (Beta Regio) | 242 |
| Sapas Mons | 248 |
| Gula Mons and Idem-Kuva Corona | 255 |
| Pancake domes (Alpha Regio) | 260 |
| Ammavaru and Mylitta Fluctus | 265 |
| 9 Volcanism on Io | 271 |
| Eruptions on Io | 272 |
| The power of tides | 275 |
| Persistent hot spots | 276 |
| Calderas on Io | 279 |
| The color of sulfur | 281 |

Cambridge University Press

978-0-521-80393-9 - Worlds on Fire: Volcanoes on the Earth, the Moon, Mars, Venus and Io
Charles Frankel

Frontmatter

[More information](#)

viii CONTENTS

| | |
|--|-----|
| The heat rises | 285 |
| <i>Galileo</i> at Jupiter: Io revisited | 287 |
| The Pillan eruption | 289 |
| Global Io | 292 |
| The I-24 flyby: Pele's lava lake revealed | 295 |
| The I-25 flyby: Tvashtar's curtain of fire | 297 |
| The I-27 flyby: calderas and lava flows | 298 |
| The 2001 flybys | 302 |
| Farewell to Io | 304 |
| | |
| 10 A tour of Ionian volcanoes | 305 |
| Pele | 305 |
| Loki | 312 |
| Prometheus | 317 |
| Ra Patera | 322 |
| Emakong Patera | 326 |
| | |
| Bibliography (and websites) | 331 |
| Glossary | 337 |
| Index | 346 |

Colour plates between pages 150 and 151

List of boxed text

| | |
|------------------------------------|----|
| Distribution of volcanoes on Earth | 8 |
| Mid-ocean ridges | 13 |
| The great calderas | 19 |
| Hot spots and flood basalts | 29 |