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BOOK REVIEW

Ashley G. Davies, Volcanism on Io, a Comparison with Earth

Cambridge University Press, Cambridge, UK, 2007, I-XV+355 pp, bibliography and index. Price: £65, US $125.00 (hardcover), ISBN:13 978-0-521-850003-2 Hardback

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Jupiter's moon Io, the most volcanically active planetary body in the Solar System, is the topic of this detailed scientific textbook by Ashley Davies. The release of this book coincides with a time of renewed interest in the exploration of the moons and planets of the outer Solar System, with NASA and ESA both currently debating whether to return to the Jovian or the Saturnian system.

Io is a worthy subject of interest. A small body, about the size of our own Moon, it is trapped in a gravitational tug of war between Jupiter and its sister moons Europa and Ganymede. These tidal stresses have resulted in Io having a molten interior, and extensive planetary melting has resulted in an abundance of volcanic activity across the moon. It has seas of lava, gigantic erupting volcanic plumes of dusty sulphur, and the most extensive lava flow ever witnessed in the Solar System (p. 159). Io's surface is also apparently lacking in impact craters, suggesting a remarkable resurfacing rate, and it exhibits impressive topographic variation, with mountains taller than Mt. Everest and depressions deeper than the Grand Canyon (p. 239). The second smallest of the Galileo satellites, Io is indeed a volcanologist's paradise.

Everything we know about Io has been gleaned either from ground-based astronomy or from observations by the Voyager and Galileo spacecraft. The book coincides with the release of a major review volume discussing Io after the Galileo mission, edited by Lopes and Spencer (2006). However, Davies' work, entitled Volcanism on Io, is the first book to focus principally on the observations and interpretations of Ionian volcanic activity and compare these processes to those seen on Earth. This comparative planetology perspective offers an insight into the challenges faced by planetary volcanologists, where understanding the formation and evolution of planetary bodies often requires the integration of several different scientific disciplines.

The book is divided into six sections. The first of these introduces a brief history of the exploration of Io and outlines some of the major discoveries made by remote sensing missions. [It seems a shame that the book was published just prior to spectacular images of an erupting volcanic plume recently captured by the New Horizons mission, on route to

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Pluto (Spencer et al., 2007).] The author also highlights the importance of ground-based astronomical techniques and discusses how important they have been in the long term monitoring of volcanic activity on Io.

The book proceeds with some more scene setting, reviewing styles of planetary volcanism (a good review for any planetary science student), and then continues with a very detailed section outlining methods of spectral observations of Io and the theoretical modelling of volcanic eruption processes. This section serves to provide a better understanding of the methodology of scientific discovery from initial observations and data collection, through to theory and model development, and finally validation of models using available datasets.

The most voluminous section of the book (Sect. 4: pp. 155–234) provides a geological field guide through different volcanic-type localities on Io, coupled with descriptions of suitable Earth-based analogies. There are also frequent discussions of volcanic features on other planets, including Mars, Venus, and our own Moon, to complete the comparative planetology story. The reader is introduced to the sulphur-rich nature of Io's surface and immersed into the ongoing debate regarding evidence of the temperature and chemical composition of erupted silicate lava (p. 169); it is argued whether Io magma is of ultra-high temperature ultramafic akin to komatiite lavas that erupted early in Earth's history, or if it is of lower temperature, akin to modern-day basaltic lavas. The book continues by offering global perspective of Io's major volcanic processes. It attempts to synthesize the discussed volcanologic observations with theories regarding Io's internal makeup and magmatic evolution.

The author, Ashley Davies, is a research scientist based at NASA's Jet Propulsion Laboratory who currently specializes in science-driven spacecraft autonomy. He holds a Ph.D. in volcanology from the University of Lancaster, UK, and subsequently he has co-authored tens of peer-reviewed research papers discussing remote sensing observations of volcanic processes. He is ideally placed to write such an in-depth review of comparative volcanology through his involvement with both terrestrial volcano monitoring programs (i.e., ASTER), and his involvement with the Near-Infrared Mapping Spectrometer (NIMS) instrument on the Galileo mission. His enthusiasm for understanding how volcanoes work is clearly illustrated through the level of detail involved in describing the methodology of both observational spectroscopy and theoretical modelling of magmatic systems.

The book is well illustrated with appropriate scientific diagrams and graphs that are often modified from Davies' own research papers. Images of volcanism on Io and Earth are presented both in black and white, and in 16 colour plates. These plates reveal the true beauty and diversity of the yellow, brown, red, and black hues of the Ionian surface, as captured by the Voyager and Galileo missions. Some of the colour pages include the assembly of multiple smaller images (e.g., Plates 9 and 11), but they unfortunately look a little overcrowded and undersized. In many chapters, data and comparative planetary facts are often presented in concise tables, which nicely summarize long paragraphs of complimentary text.

I would use this book (particularly tabulated data and key facts) to aid teaching of an undergraduate course in planetary volcanism. However, I believe it to be more suitable for teaching advanced level undergraduate courses, and I would instead particularly recommend it for use by graduate level students and researchers interested in planetary science. It is especially suitable for terrestrial volcanologists wishing to better understand volcanic processes on other planets, but readers with an astronomy background may have to labour through some of the geological terminology used in the later chapters.

The scientific appropriateness of this book is affirmed by the author qualifying that chapters in this book were reviewed by numerous experts. A scientific referencing style is used throughout, and a comprehensive reference section and index provided. However, thank goodness for the abbreviation description pages, as this book has acronyms galore. The book is rather an expense at £65, but at ~£35 less than the recommended retail price for the Lopes and Spencer (2006) Io volume, this book provides a comparatively cheaper textbook about Io.

Exploration of any planetary body, while offering a tantalizing glimpse of a new world, often leads to many new questions and scientific conundrums. There is obviously still a great deal still to know about Io, and Ashley Davies concludes his book with a brief summary of the major outstanding scientific issues regarding Io's volcanic processes and magmatic evolution, and offers an insight into the future exploration of Io by proposed missions and astronomical observations.

References

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