



Atlas of the Galilean satellites

by Paul Schenk

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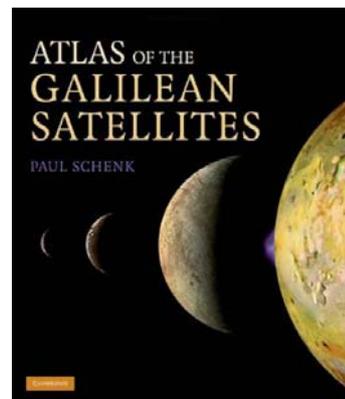
Imagine the thrill if all the *Galileo* orbiter images of Jupiter's moons, instead of trickling back slowly and unreliably over 8 fraught years, had been compressed into a few complete *Voyager*-style flybys. That is the experience that we can now enjoy thanks to this splendid and long-awaited volume – the first proper atlas of these large and fascinating worlds. It has long been needed, because the imagery of them has never been properly synthesised until now. Indeed, due to the grievous communications problems of the *Galileo* orbiter, the coverage of each satellite was very uneven; the exact positions of the closest images were often not known; and some of the images of Io were electronically scrambled. So the mapping of all these data has incurred more than the usual challenges. These challenges have been expertly overcome by Dr Paul Schenk, one of the leading scientists of the icy moons, who has compiled all the images into high-quality maps in a magnificent labour of love.

The atlas presents both a proper photomosaic atlas of each moon, and also a gazetteer of the higher-resolution *Galileo* imagery, with all the available mosaics and close-

up views properly assembled and projected. Projections of infrared colour images are also presented, displaying the patterns of composition of the icy moons, and the temperatures of the fresh lavas of Io.

For Io's major volcanoes (Amirani, Pele, Prometheus, Thor, and Tvashtar), there are clearly laid out comparisons of the visible and thermal-infrared imagery at different flybys, showing the changes in the lava flows or in the erupting calderas.

The atlas is very revealing even to someone who is already familiar with these worlds. In spite of the patchy coverage, it is a great improvement on the *Voyager* maps, so we can now see global patterns of features. Callisto has faint leopard-spots which probably represent flattened scars of ancient impacts; Ganymede has grooved bands of bright ice that curve between the ancient crustal plates; Europa has globe-spanning ridges and bands that suggest a reorientation of the ice crust above its ocean; and Io has mountains and calderas, randomly scattered but mysteriously nestling against each other. The closest images, with resolu-



tions of tens of metres, reveal remarkably different surface textures on each world. Callisto has icy pinnacles that erosion has left standing above the dark plains of eroded dirt. Ganymede has a 'ploughed field' texture, even in areas that seemed smooth from farther away. Much of Europa is an intricate quilt of endless generations of ridges, but other areas have been almost entirely covered by ice-rubble chaos. And Io shows an enigmatic ridged and pitted texture both on mountains and on plains, as if the whole surface is made of soft, readily eroded volcanic deposits.

Of course it is not possible to represent all the coverage at full resolution within a manageable book. Most of the projected images are at a quarter of their original resolution. The raw images can be obtained from NASA (<http://pds-imaging.jpl.nasa.gov/search/search.html>), but even if the enthusiast has the time to download and assemble them, one will still need this atlas to provide their location and context. Official maps are also available on-line (<http://astrogeology.usgs.gov/>), but only to 1 km resolution and without feature names, so again, they complement this atlas but do not substitute for it.

In well-written introductory chapters, the author gives an overview of the geology and geography of each world. With a licence allowable to someone who has invested so much labour in the atlas itself, he acknowledges that 'the text tends to be biased toward my own perspective'. So he insists that Ganymede's bright bands were created by flooding with water ('volcanism') rather than by serial fracturing; but conversely, that Europa's chaos regions were created by slow glacial overturning ('diapirism'), and not directly by liquid water. The reader should be aware that other scientists would argue differently. Anyway, the book makes it clear that much remains to be learned from future probes.

The production is generally impressive, but some imperfections should be pointed out. The colour images are printed at high contrast so some areas are very dark. And the binding is ephemeral: half of my copy has now converted itself to a rather handy loose-leaf format.

In spite of these quibbles, the atlas is not only indispensable for anyone interested in the worlds of our solar system: it is also a wonderful treat. At last we can explore each of these strange new worlds as a whole.

John H. Rogers

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