Contents

List of contributors page viii
Preface xiii
Acknowledgements xiv

Introduction 1
JONATHAN I. LUNINE

1 The history and significance of ice on Earth 6
ROBERT BINDSCHADLER
The water planet 7
Early glaciations 8
Ice sheets, sea level, and climate 9
Ice sheet response 13
Snow and sea ice 15
Ice sheets and weather 17
Metamorphosis of snow into ice 20
Climate tape recorder 21
Ice sheet facies 23
Ice sheet motion 24
Ice shelves 28
Ice landscaping 29
Meteorite catchers 30
Summary 32

2 Ice on Mercury and the Moon 33
BRYAN BUTLER
Mercury 33
The Moon 50
Future missions 58

3 How the Earth got its atmosphere 60
TOBIAS OWEN
How planets keep their atmospheres 60
Why small planets have different atmospheres 62
Frigid worlds, atmospheric evolution, and cosmic
time travel 63
The sources of atmospheres: problems with meteorites 65
The sources of atmospheres: icy planetesimals? 67
Solar Composition Icy Planetesimals (SCIPs):
a new type of icy planetesimal 69
The sources of atmospheres: a rocky component? 72
The importance of impact erosion 74
Tests of the model 75

4 The frozen landscape of Mars
Michael T. Mellon
Mars: yesterday and today 79
Polar deposits 81
Seasons bring change 85
Shapes in the polar landscape 86
Deep in the ice cap 88
The sky above 89
The permafrost below 92
Buried ice from the past 94
Running water from frozen ground 95
Moving ice 98
At the limits of vision 99
Impact craters in the permafrost? 101
Climate change 103
An elusive resource 105
Hazards of living on ice 107
Life? 108
The future 109

5 The ice moons of Sol
Paul M. Schenk
Moon madness 112
Water! Water! 113
Organic stews? 114
Energy to spare 118
Ice worlds – Oceanus Amokium? 121
## Table of Contents

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Triton, Pluto, and beyond</td>
</tr>
<tr>
<td></td>
<td><strong>John A. Stansberry</strong></td>
</tr>
<tr>
<td></td>
<td>Pluto’s story</td>
</tr>
<tr>
<td></td>
<td>Triton and the Trans-Neptunian objects (TNOs)</td>
</tr>
<tr>
<td></td>
<td>Triton and Pluto: twin siblings of a distant Sun</td>
</tr>
<tr>
<td></td>
<td>Geology recorded in water ice “rock”</td>
</tr>
<tr>
<td></td>
<td>Tidal evolution and giant impacts</td>
</tr>
<tr>
<td></td>
<td>Kuiper Belt objects: cousins to Triton and Pluto</td>
</tr>
<tr>
<td></td>
<td>Triton and Pluto today</td>
</tr>
<tr>
<td></td>
<td>Nitrogen, methane, and atmospheres</td>
</tr>
<tr>
<td></td>
<td>Ice transport and seasons</td>
</tr>
<tr>
<td></td>
<td>The fate of Pluto’s atmosphere</td>
</tr>
<tr>
<td></td>
<td>Not yet explored</td>
</tr>
<tr>
<td>7</td>
<td>Comets: ices from the beginning of time</td>
</tr>
<tr>
<td></td>
<td><strong>Dale P. Cruikshank</strong></td>
</tr>
<tr>
<td></td>
<td>What are comets?</td>
</tr>
<tr>
<td></td>
<td>The interstellar medium, and the death of stars</td>
</tr>
<tr>
<td></td>
<td>Comets are formed</td>
</tr>
<tr>
<td></td>
<td>The composition of comets</td>
</tr>
<tr>
<td></td>
<td>Special properties of water ice</td>
</tr>
<tr>
<td></td>
<td>What comets are made of</td>
</tr>
<tr>
<td></td>
<td>Comet dust</td>
</tr>
<tr>
<td></td>
<td>Where do comets come from?</td>
</tr>
<tr>
<td></td>
<td>Space missions to comets</td>
</tr>
<tr>
<td></td>
<td>Conclusion</td>
</tr>
<tr>
<td></td>
<td><strong>Index</strong></td>
</tr>
</tbody>
</table>

© Cambridge University Press

[www.cambridge.org](http://www.cambridge.org)