

# *Contents*

Preface	page ix
Acknowledgements	xv
<b>1. Fire and brimstone: how volcanoes work</b>	<b>1</b>
1.1 Origins of volcanoes: the mantle	4
1.2 Magma	9
1.3 Eruption parameters	14
1.4 Summary	21
<b>2. Eruption styles, hazards and ecosystem impacts</b>	<b>22</b>
2.1 Eruption clouds	23
2.2 Tephra falls	29
2.3 Pyroclastic currents & caldera formation	32
2.4 Lava flows and domes	36
2.5 Rock avalanches and mudflows	38
2.6 Tsunami	41
2.7 Earthquakes	42
2.8 Volcanic gas emissions	44
2.9 Recovery of ecosystems	46
2.10 Volcanic disasters	49
2.11 Summary	51
<b>3. Volcanoes and global climate change</b>	<b>53</b>
3.1 Pinatubo's global cloud	54
3.2 Atmospheric and climatic change	60
3.3 Recipe for a climate-forcing eruption	69
3.4 Summary	76
<b>4. Forensic volcanology</b>	<b>77</b>
4.1 Reading the rocks	78
4.2 Ice cores	95

4.3 Tree rings	102
4.4 Summary	106
<b>5. Relics, myths and chronicles</b>	109
5.1 Archaeological perspectives	110
5.2 Oral traditions	123
5.3 Crepuscular lights, cannonades and chronicles	128
5.4 Volcano forensics: a case study	134
5.5 Summary	138
<b>6. Killer plumes</b>	140
6.1 Mass extinctions	141
6.2 More about LIPs	141
6.3 LIP origins	144
6.4 LIPs, bolides and extinctions: the coincidences	148
6.5 Kill mechanisms	155
6.6 Hot LIPs and cold SLIPs	160
6.7 Summary	164
<b>7. Human origins</b>	166
7.1 The East African Rift Valley	167
7.2 The first humans	168
7.3 The Middle Stone Age and modern humans	171
7.4 Summary	179
<b>8. The ash giant/sulphur dwarf</b>	181
8.1 The eruption	181
8.2 Sulphur yield of the eruption	187
8.3 Climate change	190
8.4 The human story	196
8.5 Focus on India	201
8.6 Summary	205
<b>9. European volcanism in prehistory</b>	208
9.1 The Campanian eruption and the human revolution in Palaeolithic Europe	208
9.2 ‘Cultural devolution’ and the Laacher See eruption	216
9.3 Eruption of Santorini and decline of the Minoan civilisation	225
9.4 Summary	238
<b>10. The rise of Teotihuacán</b>	240
10.1 Popocatépetl	241
10.2 The Ilopango eruption	248
10.3 Summary	251
<b>11. Dark Ages: dark nature?</b>	253
11.1 The Mystery Cloud of 536 CE	254

11.2 Veils and whips	260
11.3 Summary	267
<b>12. The haze famine</b>	<b>269</b>
12.1 The eruption	270
12.2 Gas emissions and aerosol veil	276
12.3 Weather and climate	279
12.4 The haze famine	283
12.5 Long reach of the eruption	289
12.6 Summary	294
<b>13. The last great subsistence crisis in the Western world</b>	<b>295</b>
13.1 Sumbawa before the disaster	296
13.2 The eruption	296
13.3 Atmospheric and climate impacts	306
13.4 Human tragedy	308
13.5 Global reach of the eruption	312
13.6 Summary	318
<b>14. Volcanic catastrophe risk</b>	<b>320</b>
14.1 Three catastrophe scenarios	321
14.2 Risk control	334
14.3 Global warming: fake volcanoes and real eruptions	346
14.4 Shaken but not stirred	351
Appendix A: Large eruptions	355
Appendix B: Further reading and data sources	364
References	369
Index	385