

Fundamentals of Geophysics

Third Edition

WILLIAM LOWRIE

Swiss Federal Institute of Technology Zürich

ANDREAS FICHTNER

Swiss Federal Institute of Technology Zürich



CAMBRIDGE
UNIVERSITY PRESS

Contents

<i>Preface</i>	<i>page ix</i>	4	Gravity Surveying	87
			Preview	87
1	The Solar System	1	4.1 Gravity Measurement and Reduction	87
	Preview	1	4.2 Interpretation of Gravity Anomalies	101
1.1	The Planets	1	4.3 Isostasy	118
1.2	The Discovery of the Planets and Determination of Their Orbits	5	4.4 Suggestions for Further Reading	123
1.3	Kepler's Laws of Planetary Motion	7	4.5 Review Questions	123
1.4	Characteristics of the Planets and Their Orbits	7	4.6 Exercises	124
1.5	The Inner (Terrestrial) Planets and the Moon	10	4.7 Computational Exercises	124
1.6	The Outer (Giant) Planets	15	5	Rheology of the Earth
1.7	The Outer Solar System: Trans-Neptunian Objects	17	5.1 Elastic Deformation	125
1.8	Suggestions for Further Reading	19	5.2 Viscous Flow	132
1.9	Review Questions	19	5.3 Deviations from Perfect Elasticity and Viscous Flow	134
1.10	Exercises	20	5.4 Lithosphere Rigidity	137
2	Plate Tectonics	21	5.5 Mantle Viscosity	140
	Preview	21	5.6 Suggestions for Further Reading	144
2.1	Historical Introduction	21	5.7 Review Questions	144
2.2	Continental Drift	22	5.8 Exercises	144
2.3	Earth Structure	24	5.9 Computational Exercises	145
2.4	Types of Plate Margin	26	6	Seismology
2.5	Sea-Floor Spreading	28	Preview	146
2.6	Plate Margin Features	31	6.1 Introduction	146
2.7	Triple Junctions	35	6.2 Seismic Waves	147
2.8	Hotspots	38	6.3 Seismic Waves in the Heterogeneous Earth	159
2.9	Plate Motion on the Surface of a Sphere	41	6.4 Ambient Seismic Waves	176
2.10	Forces Driving Plate Tectonic Motions	43	6.5 Seismometry	180
2.11	Suggestions for Further Reading	45	6.6 Suggestions for Further Reading	187
2.12	Review Questions	45	6.7 Review Questions	187
2.13	Exercises	47	6.8 Exercises	188
2.14	Computational Exercises	47	6.9 Computational Exercises	190
3	Gravity and the Figure of the Earth	48	7	Earthquakes and the Earth's Internal Structure
	Preview	48	Preview	191
3.1	The Earth's Size and Shape	48	7.1 Introduction	191
3.2	Gravitation	50	7.2 Earthquake Seismology	191
3.3	The Earth's Rotation	54	7.3 Earthquakes and Human Society	209
3.4	The Earth's Figure and Gravity	68	7.4 Internal Structure of the Earth	217
3.5	Space Geodesy	76	7.5 Suggestions for Further Reading	233
3.6	Suggestions for Further Reading	84	7.6 Review Questions	233
3.7	Review Questions	84		
3.8	Exercises	85		
3.9	Computational Exercises	86		

7.7	Exercises	233	10.5	Resistivity Surveying	296
7.8	Computational Exercises	234	10.6	Electromagnetic Surveying	304
8	Geochronology	235	10.7	Electrical Conductivity in the Earth	314
	Preview	235	10.8	Suggestions for Further Reading	315
8.1	Time	235	10.9	Review Questions	315
8.2	Historical Estimates of the Earth's Age	237	10.10	Exercises	316
8.3	Radioactivity	239	10.11	Computational Exercises	316
8.4	Radiometric Age Determination	242	11	The Earth's Magnetic Field	317
8.5	Ages of the Earth and the Solar System	249		Preview	317
8.6	Suggestions for Further Reading	251	11.1	Magnetism	317
8.7	Review Questions	251	11.2	Geomagnetism	319
8.8	Exercises	251	11.3	Magnetic Fields of the Sun, Moon, and Planets	334
8.9	Computational Exercises	252	11.4	Magnetic Surveying	340
9	The Earth's Heat	253	11.5	Suggestions for Further Reading	354
	Preview	253	11.6	Review Questions	354
9.1	Introduction	253	11.7	Exercises	354
9.2	Thermodynamic Principles	253	11.8	Computational Exercises	355
9.3	Temperature Inside the Earth	255	12	Paleomagnetism	356
9.4	Heat Transport in the Earth	257		Preview	356
9.5	Sources of Heat in the Earth	260	12.1	Rock Magnetism	356
9.6	The Heat Conduction Equation	262	12.2	Apparent Polar Wander and Tectonics	368
9.7	Continental Heat Flow	267	12.3	Geomagnetic Polarity	383
9.8	Oceanic Heat Flow	271	12.4	Suggestions for Further Reading	392
9.9	Mantle Convection	280	12.5	Review Questions	392
9.10	Suggestions for Further Reading	286	12.6	Exercises	392
9.11	Review Questions	286	12.7	Computational Exercises	393
9.12	Exercises	287			
9.13	Computational Exercises	287		<i>Appendices</i>	
10	Geoelectricity	288	A	The Three-Dimensional Wave Equation	394
	Preview	288	B	Cooling of a Semi-Infinite Half-Space	397
10.1	Introduction	288	C	Magnetic Behavior of Rock-Forming Minerals	399
10.2	Electrical Principles	288	D	Magnetic Anisotropy	402
10.3	Electrical Properties of the Earth	292		<i>Bibliography</i>	405
10.4	Natural Potentials and Currents	293		<i>Index</i>	411