Earth as an Evolving Planetary System

Kent C. Condie

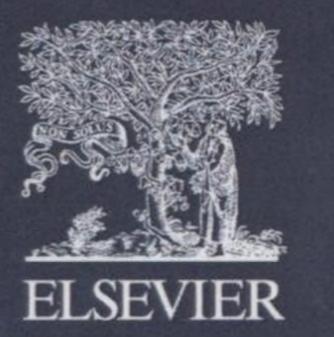
Earth as an Evolving Planetary System, Fourth Edition discusses key topics dealing with the evolution and interaction through time of Earth's crust, mantle, core, atmosphere, hydrosphere, and biosphere. It addresses the questions of why Earth is unique among planets of the solar system, and how the various subsystems in the planet have interacted over 4.6 billion years in the habitable planet that we live on. This new edition includes over 100 new pages of material, data, and images and is a key reference for students and researchers in Earth and planetary sciences.

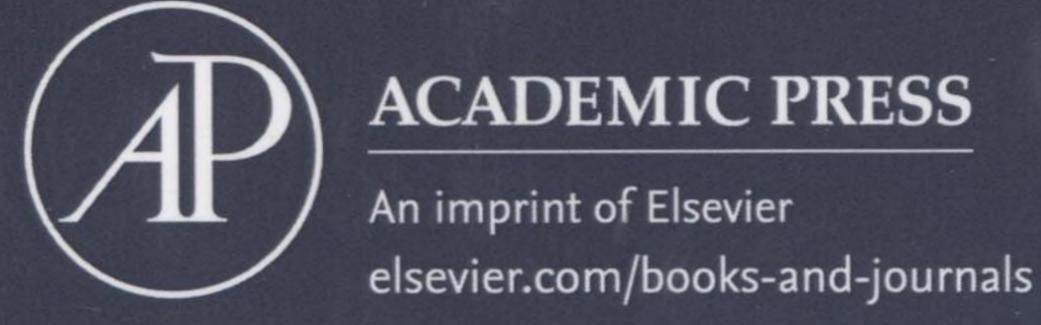
Earth as an Evolving Planetary System, Fourth Edition includes new material that has become available since the third edition, including new sections on the Mid-lithosphere discontinuity, geoneutrinos, mantle oxidation, continental emergence, Earth cycles (new chapter) and recycling processes, the evolution of Earth from a stagnant lid to a plate tectonic regime, the controversy over how the continents have grown, when plate tectonics began, and exoplanets.

- Presents comprehensive coverage of the Earth's interacting systems through time
- Compares and contrasts Earth to other terrestrial planets with very different histories
- Includes a new and exciting chapter on Earth's cycles and their possible origins

About the Author

Kent C. Condie is emeritus professor of geochemistry at New Mexico Institute of Mining and Technology, Socorro, NM where he taught from 1970 to 2015. His textbook, Plate Tectonics and Crustal Evolution, was first published in 1976 and has gone through four editions. In addition, Condie has written seven other professional books the most recent of which, Earth as an Evolving Planetary System is now in the fourth edition. He is author or co-author of over 750 articles published scientific journals. He was awarded NMT's Distinguished Research Award in 1987. In addition, he was elected the Vice President of the International Association for Gondwana Research in 2002 and in 2007 was bestowed an Honorary Doctorate Degree from the University of Pretoria in South Africa. He was awarded the Penrose Medal of the Geological Society of America in 2018.







Preface	vii	Mantle plumes	107
1 ICIACC		Large low S-wave velocity provinces	112
1. Earth as a planetary system		Mantle composition	114
1. Latti as a planetary system		Convection in the mantle	121
Structure of Earth	2	Further reading	124
Plate tectonics	3		
Is the Earth unique?	5	5. The core	
Interacting Earth subsystems	5		127
Great events in Earth history	7	Introduction	127
Further reading	7	Core temperature	127
		The inner core	128
2. The crust		Composition of the core	130
Introduction	9	Age of the core	131
Seismic crustal structure	9	Generation of Earth's magnetic field	132
Crustal types	12	Origin of the core	136
Continent size	18	What the future holds	138
Heat flow and heat production	18	Further reading	138
Exhumation and cratonization	22		
Processes in the continental crust	25	6. Crustal and mantle evolution	
Crustal composition	26	Introduction	139
Crustal provinces and terranes	33	The Hadean	139
Crustal provinces and terrane boundaries	36	Crustal origin	145
The United Plates of America	37	Earth's oldest rocks	146
	37	Origin and growth of continents	150
Further reading	31	Continental growth rates	154
3 Tastania sattings		Freeboard	155
3. Tectonic settings		Global changes at the end of the Archean	167
Introduction	39	Evolution of the subcontinental lithosphere	176
Ocean ridges	39	The onset of plate tectonics	178
Tectonic settings related to mantle plumes	43	Earth's thermal history	191
Continental rifts	52	Further reading	195
Cratons and passive margins	54		
Convergent margins	55	7. Earth cycles	
Orogens	63		107
Uncertain tectonic settings	69	Introduction	197
Mineral and energy deposits	75	Supercontinents	201
Further reading	79	The supercontinent cycle	216
		The carbon cycle	224
4. The mantle		Epilogue	226
Introduction	Q1	Further reading	227
	81		
Seismic structure of the mantle	81	8. The atmosphere and hydrosphere	
Mantle tomography Good and density annualises	81 83	The modern atmosphere	229
Geoid and density anomalies		The primitive atmosphere	230
The lithearhard	84	The postcollision atmosphere	231
The lithosphere	87 97	The carbon cycle	234
The asthenosphere	, ,	Oxygen makes its entrance	236
The Transition Zone	100	The carbon isotope record	244
The lower mantle	100	The sulfur isotope record	246
Water in the mantle	105	Phanerozoic atmospheric history	246
Plate driving forces	106	Thursday action of the state of	210

The hydrosphere	248	Biological benchmarks	288
Paleoclimates	258	Mass extinctions	289
Epilogue	268	The end Triassic extinction	296
Further reading	268	Impact and a 580-Ma extinction	303
		Further reading	303
9. The biosphere			
Introduction	269	10. Comparative planetary evolution	
The role of impacts	270	Introduction	305
The RNA world	271	Condensation and accretion of the planets	305
Hydrothermal vents and terrestrial hot springs	272	Members of the solar system	313
The first life	274	Volcanism in the solar system	343
Evidence of early life	275	Planetary crusts	344
Anoxygenic photosynthesis	276	Plate tectonics	344
Oxygenic photosynthesis	277	Mineral evolution	345
The tree of life	278	Evolution of the atmospheres of Earth, Venus, and Mars	345
The first fossils	279	The habitable zone in the solar system	347
Possibility of extraterrestrial life	280	Comparative planetary evolution	347
Appearance of eukaryotes	282	Extrasolar planets	349
Origin of metazoans	283	Further reading	352
Stromatolites	284		
Neoproterozoic multicellular organisms	284	Defense	252
The Cambrian Explosion	286	References	353
Evolution of phanerozoic life forms	287	Index	389