

**Basic Books in Science**

**Book 6**

**The planet we live on:  
The beginnings of  
the Earth Sciences**



**Chris King**

**BASIC BOOKS IN SCIENCE** – a Series of books that  
start *at the beginning*

## Book 6

# The planet we live on - the beginnings of the Earth Sciences

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### Acknowledgements

In a world increasingly driven by information technology and market forces, no educational experiment can expect to make a significant impact without the availability of effective bridges to the ‘user community’ – the students and their teachers.

In the case of “Basic Books in Science” (for brevity, “the Series”), these bridges have been provided as a result of the enthusiasm and good will of Dr. David Peat (The Pari Center for New Learning), who first offered to host the Series on his website, and of Dr. Jan Visser (The Learning Development Institute), who set up a parallel channel for further development of the project with the use of Distance Learning techniques. The credit for setting up and maintaining the bridgeheads, and for promoting the project in general, must go entirely to them.

Education is a global enterprise with no boundaries and, as such, is sure to meet linguistic difficulties: these will be ameliorated by the provision of translations into some of the world’s more widely used languages. We are most grateful to Dr. Angel S. Sanz (Madrid), who has already prepared Spanish versions of the first few books in the Series: these are being posted on the websites indicated as soon as they are ready. This represents a massive step forward: we are now seeking other translators, at first for French and Arabic editions.

The importance of having feedback from user groups, especially those in the Developing World, should not be underestimated. We are grateful for the interest shown by universities in Sub-Saharan Africa (e.g. University of the Western Cape and Kenyatta University), where trainee teachers are making use of the Series; and to the Illinois Mathematics and Science Academy (IMSA) where material from the Series is being used in teaching groups of refugee children from many parts of the world.

All who have contributed to the Series in any way are warmly thanked: they have given freely of their time and energy ‘for the love of Science’. Paperback copies of the books in the Series will soon be available, but this will not jeopardize their free downloading from the Web.

Pisa 10 May 2007

Roy McWeeny (Series Editor)

Chris King would like to thank Stephen Davis of Geopix, who kindly supplied some of the images, and Elizabeth Devon, Dee Edwards, Peter Kennett, Pete Loader and Dave Williams for their very helpful comments on early drafts of this book. Without their contributions, the book wouldn’t be as accessible and accurate as it now is - however any remaining errors are mine. Many of the images used were sourced from copyright-waived internet sites, since funding was not available to purchase images from other sources - for this reason the quality of the images, and the style of some of the diagrams used, is

variable. The sources of all the images are acknowledged in the final pages - many thanks to all those who made them available, particularly Stephen Davies from Geopix and Peter Kennett from the Earth Science Education Unit. I am also hugely indebted to Henry Law for technical and editorial support and for managing the layout of the text, and to my wife Phoebe and my family, for putting up with me during the writing.

Manchester, October 2010

Chris King (Author)

## BASIC BOOKS IN SCIENCE

– a Series of books that start *at the beginning*

### About this Series

All human progress depends on **education**: to get it we need books and schools. Science Education is especially important.

Unfortunately, books and schools are not always easy to find. But nowadays all the world's knowledge should be freely available to everyone – through the Internet that connects all the world's computers.

The aim of the Series is to bring basic knowledge in all areas of science within the reach of everyone. Every Book will cover in some depth a clearly defined area, starting from the very beginning and leading up to university level, and will be available on the Internet *at no cost to the reader*. To obtain a copy it should be enough to make a single visit to any library or public office with a personal computer and a telephone line. Each book will serve as one of the 'building blocks' out of which Science is built; and together they will form a 'give-away' science library.

### About this book

This book, like the others in the Series, is written in simple English – the language most widely used in science and technology. It provides an introduction to the study of 'Earth science', but 'Earth science' is interpreted differently in different countries. In some regions of the Earth, such as on the Pacific margins, it usually covers all the science relating to the Earth, including geology, meteorology, oceanography, geomorphology and soil science. It therefore covers much of physical geography in these regions, where geography is often not a strong school subject. In other countries 'Earth science' has a rather narrower definition, largely covering only geology, whilst other aspects of 'Earth science' are covered in geography. Nevertheless, wherever on Earth this book is being read, if you want to study 'Earth science' in Higher Education, at College or University, you will study mainly geology. So this book has been written as an introductory guide to geology, to interest you in the subject and to enthuse you to study geology at higher levels.

The study of geology takes many forms, but the way that most geologists begin their work is to interrogate the Earth for clues about Earth processes, in the past, present and future. This is the approach of the 'rock detective', looking for clues that will answer scientific questions about the Earth. Answering some questions always poses other questions, and so the study of geology continues ....

### Notes to the Reader.

- When Chapters have several Sections they are numbered so that “Section 2.3” will mean “Chapter 2, Section 3”.
- Important ‘key’ words are printed in **boldface**: they are collected in the Glossary at the end of the book.
- You will find some parts of the text in a blue colour. In an electronic version of this book, clicking with your computer mouse on these blue sections takes you straight to the section referred to in the blue text.

**Looking ahead** — If you came across a cliff face on a mountain, in a coastal area or in a cutting or old quarry, and it was made of interesting-looking rocks - how could you find out more? The first Chapter of this book will help you to learn to ‘read’ a rock face, by finding out about the minerals that make up the rocks and how they are formed. Then you will be introduced to how the rocks themselves were formed, in sedimentary, igneous and metamorphic ways. When you know how rocks formed, you can understand how they were often later deformed, usually deep within the Earth. As these things happen to the rocks, they retain clues of the order of the events, allowing us to work out the sequence of processes and thus the geological histories of whole areas, as well as what might happen next.

The landscape also contains clues to how it formed, so by standing on a hill with a good view, you will see evidence of the underlying rock structure and how this has controlled the shape of the land. You can see clues to the processes that are still active there and the ways that the land is being used by humans. This approach, covered by Chapter 2, is another way of interpreting the evidence of your own observations to find out ‘how the Earth works’ now and in the past. In doing these you will be applying some of the ‘big ideas’ of geology, outlined in Chapter 3. Ideas about the rock cycle developed from the 1700s onwards but it wasn’t until the 1960s that the theory of plate tectonics was understood, explaining many aspects of the Earth that scientists hadn’t been able explain before then. In the 21st century, ‘climate change’ and the supply of raw materials are the most important areas of geoscientific study, helping us to understand how we will need to live on Earth in the future. Important threads that hold studies of these issues together are an understanding of geological time related to the evolution of life, and how the Earth changed in the past through plate tectonic movement, as in Chapter 4.

The basic understanding developed through Chapters 1 to 4 allows you to respond to the Chapter 5 coverage of media reports about geoscience events. The media often report events that might affect you directly, such as Earth hazards and local quarrying and landfill sites, as well as longer term issues on which you might have an impact, such as in ‘climate change’. The media often report spectacular fossil finds as well, also covered by Chapter 5. This builds up to Chapter 6, covering what geologists actually ‘do’ today. Here you can get a feel for what an oil geologist and a mineral prospector does and how we look for underground water. Find out about the vital work that geologists do in construction and in conserving the environment and finally visit the applied and ‘blue skies’ studies carried out by research geologists. Through this final Chapter, you will gain a taste of what a working geologist does from day to day - and this might encourage you to carry your geological studies further.

# Contents

<b>1 Reading rock exposures: how rock exposures contain evidence of how they were formed and subsequently deformed</b>	<b>1</b>
1.1 Rock exposures are formed of minerals, rocks and fossils . . . . .	1
1.2 Minerals are formed in a number of geological environments . . . . .	2
1.2.1 Igneous rocks . . . . .	4
1.2.2 Metamorphic rocks . . . . .	5
1.2.3 Evaporites . . . . .	7
1.2.4 Sedimentary rocks . . . . .	7
1.2.5 Veins and ores . . . . .	7
1.3 Sedimentary rocks - formed by a range of surface processes in a variety of environments . . . . .	11
1.4 Igneous rocks - formed from molten rock by a range of processes . . . . .	25
1.5 Metamorphic rocks - formed by heat and pressure in metamorphic processes	32
1.6 Deformation in rocks - geological structures . . . . .	37
1.7 Rock exposures contain evidence of the sequence of geological events that formed and deformed them . . . . .	46
<b>2 Reading landscapes: how landscapes contain evidence of the relationship between past and present processes and the underlying geology</b>	<b>56</b>
2.1 The landscape is subject to processes of weathering, erosion and transportation . . . . .	56
2.2 Valley shapes generally reflect the mode of their formation . . . . .	62
2.3 Landforms often reflect underlying geological structure . . . . .	64
2.4 Modification of the landscape by human activity is often influenced by the underlying geology . . . . .	66
2.5 Important rock exposures should be conserved . . . . .	68
<b>3 Understanding the ‘big ideas’: major concepts that underpin our current understanding of the Earth</b>	<b>71</b>
3.1 The rock cycle (Hutton, 18th Century) . . . . .	71



3.2	Plate tectonics (20th Century) . . . . .	74
3.3	Global temperature/sea level change (21st Century) . . . . .	89
<b>4</b>	<b>Major geological events fit into a timeline, beginning with the formation of the Earth</b>	<b>98</b>
4.1	The origin and development of life . . . . .	98
4.2	The development of Earth's continental jigsaw . . . . .	105
<b>5</b>	<b>Current geological events commonly reported in the media</b>	<b>110</b>
5.1	Earth hazards . . . . .	110
5.2	Human impacts on climate change . . . . .	123
5.3	Great fossil finds . . . . .	126
5.4	Planning, quarrying and landfill . . . . .	131
<b>6</b>	<b>Understanding what geologists do: how geologists use investigational skills in their work today</b>	<b>137</b>
6.1	What geologists do . . . . .	137
6.2	Oil/gas exploration . . . . .	138
6.3	Mineral prospecting and mining . . . . .	141
6.4	Hydrogeology . . . . .	142
6.5	Environmental geology . . . . .	145
6.6	Geotechnical engineering . . . . .	146
6.7	Academic research geologists . . . . .	148
	<b>Glossary</b>	<b>151</b>
	<b>Acknowledgements</b>	<b>171</b>

# List of Figures

1.1	Studying a rock exposure. . . . .	1
1.2	Sandstone. . . . .	2
1.3	Granite. . . . .	2
1.4	A crystal of the mineral diamond. . . . .	3
1.5	Crystals of the mineral calcite. . . . .	3
1.6	Granite, close up view. . . . .	5
1.7	Gneiss, close up view . . . . .	5
1.8	A garnet crystal. . . . .	6
1.9	Marble. . . . .	6
1.10	Salt deposited by evaporation of a drying lake. . . . .	6
1.11	A cemented sedimentary rock. . . . .	6
1.12	A mineral vein. . . . .	8
1.13	Hematite with calcite. . . . .	8
1.14	Some important minerals and their identification properties . . . . .	9
1.15	Important minerals - 2 . . . . .	10
1.16	A sedimentary rock face. . . . .	11
1.17	Sedimentary rocks showing bedding. . . . .	12
1.18	A breccia. . . . .	12
1.19	Mudstone, in a cliff face. . . . .	13
1.20	Conglomerate. . . . .	14
1.21	A piece of sandstone. . . . .	14
1.22	Angular desert sediment. . . . .	14
1.23	Dried up lake salt deposits. . . . .	14
1.24	Cross bedding in sandstones. . . . .	15
1.25	Ancient mud cracks preserved in mudstone. . . . .	15
1.26	Ancient wave ripple marks preserved in sandstone. . . . .	16
1.27	Modern sand dunes. . . . .	16
1.28	Ancient dune cross bedding preserved in a sandstone cliff face. . . . .	17
1.29	Tracks, trails and burrows preserved on a ripple-marked sandstone. . . . .	17

1.30	Coal seams in an opencast coal quarry. . . . .	18
1.31	Limestone, close up view. . . . .	19
1.32	Oolitic limestone, close up view. . . . .	20
1.33	Turbidite sequence, tilted by folding. . . . .	20
1.34	A melting glacier depositing glacial till. . . . .	21
1.35	A fossil colonial coral preserved in shallow tropical sea sediments. . . . .	22
1.36	Fossilised trees that must have grown on the land. . . . .	22
1.37	A fossil trilobite, found in shallow sea sediment. . . . .	23
1.38	Fossil ammonites, indicating sediments that were deposited in the sea. . . . .	24
1.39	'massive' igneous rocks; a granite rock face without layers. . . . .	26
1.40	Gabbro, close up view. . . . .	27
1.41	Basalt with vesicles, close up view. . . . .	28
1.42	Granite, close up view. . . . .	28
1.43	Basalt erupting from a fissure. . . . .	29
1.44	A basalt flow that cooled and fractured into vertical columnar basalt. . . . .	30
1.45	A basalt pillow lava exposed in a rock face. . . . .	30
1.46	A central vent volcano. . . . .	31
1.47	Deposit of volcanic ash with small bombs in the upper layer. . . . .	32
1.48	Igneous dykes cutting through the surrounding rock. . . . .	33
1.49	An old slate quarry. . . . .	34
1.50	Mudstone metamorphosed in a metamorphic aureole. . . . .	35
1.51	Slate – a low-grade metamorphic rock. . . . .	36
1.52	Bedding and cleavage in slate. . . . .	37
1.53	Schist, a medium-grade metamorphic rock. . . . .	38
1.54	Gneiss, a high-grade metamorphic rock. . . . .	39
1.55	Marble. . . . .	39
1.56	Metaquartzite. . . . .	40
1.57	Folded rocks, showing a syncline and an anticline. . . . .	41
1.58	A region of folded rocks seen from the air. . . . .	42
1.59	Reverse faults. . . . .	43
1.60	A thrust fault. . . . .	43
1.61	A normal fault. . . . .	44
1.62	A strike-slip fault. . . . .	44
1.63	A quarry wall, showing bedding planes and joints. . . . .	45
1.64	An unconformity. . . . .	46
1.65	Graptolites. . . . .	49
1.66	Graptolite evolution. . . . .	49

1.67	A shelled cephalopod. . . . .	51
1.68	A shelled cephalopod fossil with the outer shell removed. . . . .	52
1.69	A coiled cephalopod fossil with the outer shell removed. . . . .	52
1.70	The change of ammonoid suture lines over time. . . . .	53
1.71	The geological time scale, used internationally . . . . .	55
2.1	Glastonbury Tor. . . . .	57
2.2	Freeze-thaw weathering. . . . .	57
2.3	Rock fragments loosened by freeze-thaw weathering. . . . .	58
2.4	Granite affected by heating and cooling in a desert area. . . . .	59
2.5	Discolouration caused by chemical weathering. . . . .	59
2.6	Limestone pavement. . . . .	60
2.7	Biological weathering. . . . .	60
2.8	River-sorted sediments. . . . .	61
2.9	A wind storm, transporting sand and carrying finer sediment. . . . .	61
2.10	Boulders and clay transported by a glacier. . . . .	62
2.11	A V-shaped valley. . . . .	63
2.12	A U-shaped valley. . . . .	63
2.13	A meandering river channel. . . . .	63
2.14	A plateau formed of tough, flat-lying lava flows. . . . .	63
2.15	A cuesta. . . . .	65
2.16	A ridge of steeply dipping rocks, with weaker rocks on either side. . . . .	65
2.17	An eroded large fault. . . . .	65
2.18	A granite tor. . . . .	65
2.19	A bay cut by erosion into weaker rocks. . . . .	66
2.20	A quarry in the distance. . . . .	67
2.21	A working quarry. . . . .	67
2.22	A working mine. . . . .	67
2.23	An abandoned mine. . . . .	67
2.24	A restored quarry. . . . .	67
2.25	Dinosaur tracks conserved in an old quarry. . . . .	68
2.26	A castle on a volcanic plug in the Bohemian Paradise Geopark. . . . .	69
2.27	Hazardous material in an old metal-mining area . . . . .	69
3.1	The unconformity at Siccar Point near Edinburgh . . . . .	71
3.2	The rock cycle, as we know it today. . . . .	73
3.3	James Hutton, the ‘Founder of Modern Geology’. . . . .	74

3.4	Alfred Wegener, the polar explorer and meteorologist who proposed the ‘Theory of Continental Drift’, as commemorated in this German postage stamp. . . . .	75
3.5	A page of Wegener’s 1929 book ‘The origin of continents and oceans’ showing maps of how the continents had moved by his ‘Theory of Continental Drift’. . . . .	76
3.6	A ship used for ocean surveying in the 1960s, mapping the sea floor and measuring ocean-floor magnetism. . . . .	77
3.7	The structure of the Earth . . . . .	78
3.8	Convection currents in the mantle. . . . .	78
3.9	The Mid-Atlantic Ridge. . . . .	79
3.10	The rift valley in the centre of the Mid-Atlantic Ridge on Iceland. . . . .	80
3.11	A constructive boundary . . . . .	81
3.12	The formation of magnetic stripes at a constructive plate margin. . . . .	81
3.13	The magnetic stripes south of Iceland. . . . .	82
3.14	Oceanic ridges are offset by transform faults. . . . .	83
3.15	The San Andreas Fault cutting a straight line across California, with a fault scarp on the left and many diverted stream beds. . . . .	84
3.16	The age of the ocean floor, from the youngest in red to the oldest in blue. . . . .	85
3.17	An ocean versus ocean destructive margin . . . . .	86
3.18	The conical shape of central-vent andesitic volcanoes . . . . .	86
3.19	An ocean versus continent destructive margin . . . . .	87
3.20	The conical shape of most continental volcanoes . . . . .	87
3.21	A continent versus continent destructive margin. . . . .	88
3.22	The Hawaiian island chain . . . . .	88
3.23	Map of the major tectonic plates on Earth. . . . .	88
3.24	Stromatolite fossils in ancient rocks. . . . .	88
3.25	Global temperature change over the last 500 million years (the Phanerozoic time period), obtained by measuring change in the oxygen isotope compositions of fossils. . . . .	90
3.26	Global temperature change over the last 450 thousand years, obtained from deuterium isotope measurements. The ratios were measured in the EPICA and Vostock ice cores and have been converted to ice volume estimations in the lower graph. . . . .	91
3.27	Global temperature change over the last 2000 years . . . . .	92
3.28	Carbon dioxide in the Earth’s atmosphere over the past 40,000 years . . . . .	92
3.29	A computer generated prediction for the global effects of a 3°C increase in global temperature. . . . .	93

3.30	A graph of observed increases in sea level over the past 50 years with projections of the effects of the melting of continental ice sheets in the next 100 years. . . . .	94
3.31	The ‘Keeling Curve’ of atmospheric carbon dioxide measurements, showing annual cycles and a steady increase. . . . .	95
3.32	A photograph of James Lovelock, taken recently. . . . .	96
3.33	One of James Lovelock’s ‘Daisyworld’ simulations . . . . .	96
4.1	William Smith’s geological map. . . . .	99
4.2	Key events in the evolution of life. . . . .	100
4.3	Key events of life shown on a geological time line. . . . .	101
4.4	Two early fossil fish . . . . .	102
4.5	A fossil amphibian. . . . .	104
4.6	A fossil reptile. . . . .	104
4.7	A fossil mammal . . . . .	104
4.8	The earliest fossil bird that has been found - <i>Archaeopteryx</i> . . . . .	104
4.9	The change of biodiversity over time. . . . .	105
4.10	A cladogram showing the relationships of the major groups of life on Earth. . . . .	106
4.11	The relationships of major animal groups, shown by a cladogram. . . . .	106
4.12	The 450 million year old Earth. . . . .	107
4.13	The 375 million year old Earth. . . . .	107
4.14	Supercontinent Pangaea, 275 million years ago. . . . .	107
4.15	Continents on the 100 million year old Earth. . . . .	107
4.16	‘Milestones’ in the evolution of planet Earth . . . . .	109
5.1	A school in San Salvador destroyed by an earthquake. . . . .	110
5.2	Strike-slip movement in the San Andreas Fault. . . . .	111
5.3	Earthquake damage in Japan - Chuetsu earthquake, 2004. . . . .	112
5.4	The South East Asian tsunami, 26th December, 2004. . . . .	113
5.5	A basaltic eruption. . . . .	114
5.6	An ash eruption. . . . .	115
5.7	A lahar from the crater of Mount St. Helens. . . . .	116
5.8	A bus damaged by a lahar flow from Mount St. Helens. . . . .	116
5.9	Pyroclastic flows (nueés ardentes). . . . .	116
5.10	A hazard zone map. . . . .	117
5.11	Landslide triggered by the El Salvador earthquake in 2001. . . . .	118
5.12	Buildings that did not resist the Mexico City earthquake of 1985. . . . .	119
5.13	Seismic monitoring of volcanic activity. . . . .	120

5.14	A GPS remote volcano monitoring station. . . . .	121
5.15	An interferogram of the Izmit earthquake, Turkey, 1999. . . . .	122
5.16	The sources of fuel used in current world energy consumption. . . . .	124
5.17	A windfarm in Ireland. . . . .	125
5.18	Solar panels being used in Mallorca. . . . .	125
5.19	An <i>Archaeopteryx</i> fossil. . . . .	127
5.20	A fossil from the Cambrian Burgess Shale. . . . .	128
5.21	A dinosaur excavation. . . . .	130
5.22	A dinosaur reconstruction showing how they might have lived. . . . .	131
5.23	The <i>Australopithecus</i> skeleton ‘Lucy’. . . . .	132
5.24	A reconstruction of the ‘Lucy’ <i>Australopithecus</i> skeleton. . . . .	132
5.25	A working aggregate-producing quarry on Sifnos, Greece. . . . .	133
5.26	The Eden ‘biome’ Project in Cornwall, UK, in an old china clay pit. . . . .	135
5.27	A landfill site in Hawaii, USA. . . . .	136
6.1	Geologists at work, examining cores from a borehole. . . . .	137
6.2	A drilling rig used for oil/gas exploration in the North Sea. . . . .	139
6.3	Different types of oil and gas traps. . . . .	140
6.4	A seismic cross section. . . . .	140
6.5	Electrical resistivity surveying. . . . .	142
6.6	Groundwater flowing out of the bedrock in a spring. . . . .	143
6.7	Groundwater flow. . . . .	143
6.8	A wind pump extracting groundwater to be used by agriculture. . . . .	144
6.9	Acid mine drainage from an abandoned mine in Spain. . . . .	146
6.10	A slab foundation. . . . .	147
6.11	Deep foundations being constructed in Spain. . . . .	147
6.12	A retaining wall supporting weaker materials in a cutting. . . . .	147
6.13	Gabions supporting a river bank. . . . .	147
6.14	Did an asteroid impact cause dinosaurs to become extinct?.... . . . .	148
6.15	... or did huge volcanic eruptions cause the dinosaurs to die out? . . . . .	148
6.16	A team of geologists at work on a volcano. . . . .	150