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The Geology of Germany

A Process-Oriented Approach

 Springer

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Preface

Our scientific perception of the world has radically changed over the last 200 years and a significant part of this originated from the valuable insight into past Earth processes gained by studying the regional and global geological record. The oldest geological maps of Germany date back to the eighteenth and nineteenth centuries, when the first systematic surveying of the land was undertaken. During the discovery and unraveling of the rock record, Germany played center stage to a number of important geoscientific discussions of global importance. Probably, the earliest relevant debate concerned the origin of basaltic rock (hence known as the basalt conflict) between two 18th century prominent science schools: the Neptunists and the Plutonists.

Since the founding of modern geological science in the middle of the 19th century, many generations of geologists have continued to unravel the details of Earth's history. This work has been anchored by systematic mapping in the form of national geological surveys, and in-depth research and scientific debate conducted by universities and other research centers. Paleontologists have contributed not only to the understanding of the origin of life but have also established a valuable biostratigraphy that enables age classification of sedimentary rocks. The practice of geological science has become an interdisciplinary part of the Earth's Sciences curriculum, based on the interaction of geochemists, geophysicists, hydrogeologists, mineralogists, paleontologists, petrologists, physical geographers, sedimentologists, structural geologists, and volcanologists. All of these disciplines are encompassed today by the unifying concept of plate tectonics that was established in the 1960s, which evolved from the findings of Alfred Wegener with his groundbreaking 1912 publication on the continental drift theory. It took more than 50 years for the theory of plate tectonics to be widely accepted, following the discovery of seafloor spreading. Viewing geological history in the light of current modern scientific principles, based on the concept of plate tectonics and the regional geology of Germany and Central Europe, is the foundation of this book.

Since geology is a science based on a combination of both observational and analytical methods, outcrops that once provided excellent insights into the geological record should not be lost: such as backfilled, flooded or overgrown quarries or sealed, inaccessible roadside cuts and mines. Several renowned and well-documented outcrops important to the geological history of Germany, as those found at Hagen-Vorhalle, are now found deteriorated or even completely closed. Therefore, this book intends to broaden the awareness of the need to preserve significant geological sites by taking into account the importance of the conservation of geological monuments and newly formed Geoparks. Geotope protection is to geologists just as important as biotope conservation is to ecologists. For this reason, geoscientific issues should also have a chance to be at the forefront of conservation needs, especially when it comes to accessing and preserving rock exposures in quarries or road cuts, which are fundamental to progressing geoscientific knowledge.

This book is primarily intended for students of geosciences, other science-oriented university degree programs, and a broad readership interested in the natural sciences. Originating from an introductory lecture series on the regional geology of Germany and Central Europe, its text is therefore written at a level that does not require prior geological expertise. In order to

make it easier for all interested readers to understand the geology, a large number of supplementary “Boxes” are inserted to cover individual topics and terms in a concise, summarized form. Some general and introductory chapters on the themes of time, rocks, age dating, and plate tectonics precede the regional geological chapters. The regional geology starts with a consideration of earthquake activity in Germany in the context of large-scale plate tectonics. All subsequent chapters are ordered according to their stratigraphic development, starting with the oldest rocks and minerals found in Germany and finishing with the most recent ones. This particular book structure places the various successive geological events into the context of the Earth’s complex evolving history. Following a detailed description of the Variscan Orogeny, which occurred at the end of the Paleozoic and brought together the geological units of Germany, the following Mesozoic history of the country is explained as part of Central Europe.

The unique development of the younger, Alpine region is of fundamental importance for understanding the geological development of Central Europe. The geology of the Alpine region is addressed in a separate chapter, regardless of country borders. The following Tertiary chapter covers the Cenozoic evolution of Germany at the foothills of the Alps with its special basin development and volcanic events. The asteroid impacts of the Nördlinger Ries and the Steinheim Basin are also described in a separate chapter devoted to these events. As a large part of the German landscape was shaped by the special climatic conditions of the geologically recent glaciation, the Quaternary deposits and erosional features caused by the glaciations are dealt with in the final chapter of the book.

The compilation of such a book is not possible without critical review. We would like to thank all those who helped with valuable hints, comments, and additions to the text, as well as those who supplied their photographic material in addition to drawings and designs. Our special thanks go to Horst Hann (Stuttgart), Helmut Weller, Jürgen Eidam†, and Heiko Hüneke (all Greifswald) for their help on the subject of the Paleozoic and older rocks. Werner Stackebrandt (Potsdam) corrected and supplemented the Mesozoic chapter and provided valuable input. Wolfgang Frisch (Vienna/Austria) and Hans-Jürgen Gawlick (Leoben/Austria) made helpful contributions to the Alpine chapter by suggesting corrections and additions. Kurt Goth (Dresden) helped by providing comments and corrections on the Tertiary chapter and Horst Kämpf (Potsdam) provided input on earthquakes and volcanism. Finally, our thanks go to Henrik Rother (Halle) for his revision and correction of the chapter on the Ice Ages and to Matthias Meschede (Paris/France) for his comments on the introductory chapters as well as Manfred Menning (Potsdam) for his help on stratigraphic tables and terminology. The former coworkers in our graphics lab, Heike Sengpiehl and Dagmar Lau, created the basis for many of the drawings, often by the tedious digitizing of templates. We also thank Stefan Meng (Greifswald) and Claus Meschede (Aachen) for providing useful photographs. Jörg Hartleib and André Deutschmann (Greifswald) helped with the satellite imagery and digital elevation models. Finally, yet importantly, our thanks go to our families for their understanding of the many hours spent clicking and typing on the computer during the compilation of this book.

This textbook presents an updated English version of the German “Geologie Deutschlands” by Martin Meschede, which was first published in 2015 with its second edition appearing in 2018. Such a work can only attempt to convey the current state of science and, as a result, future revisions and changes are therefore inevitable. We are most grateful to colleagues who have helped to make improvements to the first edition of the German version of the book, which have been incorporated into this new English version. We would like to particularly thank Wolfgang Franke (Frankfurt a. M.), who has provided extensive feedback on the older units covered in the book (Paleozoic and older) by providing a number of valuable references and constructive suggestions concerning the controversial nature of Late Paleozoic plate tectonic model. Furthermore, we thank Peter Suhr and Kurt Goth, both from the State Office for the Environment and Geology (Saxony) as well as Eckhard Groll (Eberswalde), Thorsten

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We are always open to constructive comments and would be pleased to receive any feedback or suggestions that may improve the content of this book book (email: meschede@uni-greifswald.de, warr@uni-greifswald.de).

Greifswald, Germany
December 2018

Martin Meschede

Laurence N. Warr

Contents

1	Introduction	1
2	Time and Geological Periods	3
3	Rocks and the Geological Record	9
4	The Age of the Rocks	19
5	Plate Tectonics, the Unifying Theory	25
6	Tectonics Units of Europe	33
	6.1 Ancestral Europe	33
	6.2 Paleo-Europe	33
	6.3 Meso-Europe	35
	6.4 Neo-Europe	35
7	Overview of the Plate Tectonic History of Europe	37
8	The Dynamic Earth, Earthquakes in Germany	41
9	Early Geological Evolution of Germany	53
	9.1 The Pre-variscan Basement	56
	9.2 Occurrences of Proterozoic and Early Paleozoic Units	57
	9.2.1 Harz Mountains	57
	9.2.2 Rheinisches Schiefergebirge	58
	9.2.3 Lusatia	58
	9.2.4 Elbe Zone	59
	9.2.5 Erzgebirge	59
	9.2.6 Schwarzburg Anticlinorium, Vesser Zone	60
	9.2.7 Bohemian Massif	61
	9.2.8 Black Forest	62
10	Late Paleozoic of Germany	63
	10.1 The Variscan Orogeny	63
	10.1.1 Rhenohercynian Zone	65
	10.1.2 Saxothuringian Zone	67
	10.1.3 Moldanubian Zone	67
	10.2 Development of the Variscan Orogeny Through Time	68
	10.2.1 Devonian	69
	10.2.2 Carboniferous	78
	10.3 The Variscides in Germany	83
	10.3.1 Regional Geology of the Rhenohercynian	83
	10.3.2 Northern Phyllite Zone	99

10.3.3	Regional Geology of the Saxothuringian	99
10.3.4	Saxothuringian (excluding the Mid-German Crystalline Zone)	102
10.3.5	Regional Geology of the Moldanubian	108
11	Permian and Mesozoic Geology of Germany	115
11.1	Post-Variscan History	115
11.2	Permian	116
11.2.1	Rotliegend	116
11.2.2	Zechstein	134
11.3	Permian/Triassic Boundary	148
11.4	Triassic	148
11.4.1	Buntsandstein (Bunter Sandstone)	150
11.4.2	Muschelkalk	156
11.4.3	Keuper	160
11.5	Triassic/Jurassic Boundary	161
11.6	Jurassic	163
11.6.1	Early Jurassic	165
11.6.2	Middle Jurassic	170
11.6.3	Late Jurassic	171
11.7	Cretaceous	174
11.7.1	Early Cretaceous	176
11.7.2	Late Cretaceous	181
11.8	Cretaceous/Tertiary Boundary	190
12	The Evolution of the Alps	191
12.1	Overview of the Tectonic Structure of the Alps	191
12.1.1	Helvetic	191
12.1.2	Penninic	191
12.1.3	Austroalpine and Southern Alpine Units	192
12.2	Development of the Alpine Region During the Permian	193
12.3	The Alpine Triassic	194
12.4	The Alpine Jurassic	195
12.5	The Alpine Region in the Cretaceous and Early Tertiary	199
12.6	The Tectonic Evolution of the Alps	201
13	Tertiary Basins	209
13.1	Tertiary Brown Coal Deposits	212
13.2	The Upper Rhine Graben	215
13.3	The Northern Alpine Foreland Basin—The Molasse	223
14	Tertiary and Quaternary Volcanism	233
14.1	Volcanism in the Eifel	233
14.2	Westerwald, Siebengebirge, Vogelsberg, Rhön, and Heldburger Gangschar	242
14.3	Small Chimneys in the Odenwald and the Messel Pit	243
14.4	Kaiserstuhl	245
14.5	Tuff Chimneys of Bad Urach, Hegau	245
14.6	Eger Graben Area, Fichtel Mountains, Vogtland, and Lusatia	246
15	Asteroid Craters	251

16 Germany During the Glacial Periods	259
16.1 Glacial and Interglacial Periods.	260
16.2 Deposits and Erosion Forms of the Glacial Periods	270
16.3 The Baltic Sea—A Relic from the Last Glaciation Period	278
Appendix	283
References	287
Index	297

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List of Figures

Fig. 2.1	A selection of changes in the development of humankind over time. From left: skull of <i>Homo erectus</i> (© INTERFOTO/Mary Evans/Natural History Museum); hand axe from Sarstedt, Lower Saxony (courtesy of the Lower Saxony State Office of cultural heritage preservation); megalith tomb, near Sassnitz, Rügen Island; Aachen cathedral; Benz patented motor vehicle from 1886 (by courtesy of the Daimler AG, Mercedes-Benz Classic, Stuttgart); networking of the internet (© Dreaming Andy—Fotolia.com)	4
Fig. 2.2	What remains? Preservation over time. From the left: Eocene sea urchins; the lance of Lehringen (courtesy of the Historical Museum of Verden); Cave painting from the Altamira Cave, northern Spain (© picture-alliance/akg-images); mosaic from the 10th century of the Hagia Sophia, Istanbul (© thinkstock/Getty Images International); hand colored photograph (status around 1900) and digital photograph (status of 2008) of the Rhône glacier (© J. Alean/M. Hambrey).	6
Fig. 2.3	The evolution of the Earth extrapolated to a calendar year; b.p. before present; B.C. Before Christ; A.D. in the year of the Lord	6
Fig. 3.1	How we can “look” into the earth: the principle of seismotomography (modified after Frisch and Meschede 2013)	9
Fig. 3.2	Earth’s rock cycle	10
Fig. 3.3	Granite (location: Weißenstein ruin, north of Erbdorf, in Upper Palatinate). Black—biotite, gray—quartz, white—feldspar (plagioclase, alkali feldspar) [N 49°54’50”/E 12°04’58”].	10
Fig. 3.4	Coarse-grained gabbro (location: Coverack, Great Britain). Black—pyroxene, little brown minerals—weathered olivine, white—plagioclase [N 50°00’14”/W 05°06’44”]	10
Fig. 3.5	Mineral composition of important igneous rock types ranging from ultramafic (right side of image) to granitic and quartz-free varieties with feldspathoid minerals (left side of image). V. volcanic rocks, P. plutonic rocks (modified after Frisch and Meschede 2013).	11
Fig. 3.6	Bowen’s reaction series: discontinuous series of mafic minerals, continuous series of plagioclase	11
Fig. 3.7	Basaltic dike with chilled margin, intruded into granite (till boulder of the Weichselian glaciation; location: Vierow, Baltic Sea shoreline, Mecklenburg-West Pomerania). White minerals in the basalt are calcite-filled vesicular cavities. [N 54°07’55”/E 13°34’44”].	12
Fig. 3.8	SiO ₄ tetrahedra with four bonding possibilities at the corners of the tetrahedron	12

Fig. 3.9	Diagrams used to distinguish between different types of basalts occurring at mid-ocean ridges, volcanic arcs or above subduction zones and hot spots. The triangular diagram requires a recalculation of element contents normalized to a 100% total. To make fields more visible, some elements are scaled up or down by a given factor. The so-called spider diagram (bottom left) shows the concentration of elements normalized to average MORB (mid-ocean ridge basalt) values. The scale on the y-axis of the spider diagram is logarithmic. Ti/100–Zr–3–Y diagram after Pearce and Cann (1973), 2Nb–Zr/4–Y diagram after Meschede (1986), spider diagram patterns from Pearce (1983)	13
Fig. 3.10	Columnar basalt with polygonal structures visible at the surface. The hexagonally arranged fractures are caused by shrinkage during the cooling of the basaltic rock that originated from melt	14
Fig. 3.11	TAS diagram (total alkali vs. silica) used to subdivide magmatic rocks and their evolution according to their content of alkali metals and SiO ₂ . Normal letters—volcanic rocks; italic/red—intrusive plutonic rocks equivalent to the extrusive volcanic varieties (modified after Le Maitre 2005)	16
Fig. 3.12	Stages of metamorphism and the types of meta-basaltic rocks that develop. (From top left) non-metamorphic: basalt; low-grade metamorphic: greenschist (greenschist facies); medium-grade metamorphic: amphibolite (amphibolite facies); high-grade metamorphic: pyroxene granulite (granulite facies)	17
Fig. 3.13	Diagram showing the types of metamorphic facies that develop under different conditions of pressure and temperature (after Frisch and Meschede 2013)	18
Fig. 4.1	Ammonite (<i>Schloenbachia varians</i>) from the Cenomanian, Late Cretaceous (location: Rütten/Möhne, Mildental). [N 51°29'59"/E 08°25'13"]	19
Fig. 4.2	Decay of the radioactive Rb isotope (⁸⁷ Rb) to the stable Sr isotope (⁸⁷ Sr) by releasing an electron and transforming a neutron into a proton	21
Fig. 4.3	Modification of the proportion of radioactive mother isotopes to stable daughter isotopes with an increasing number of half-lives	22
Fig. 4.4	Isochron diagram of the Rb–Sr age-dating method	23
Fig. 4.5	U–Pb age dating of zircons from a gneiss sample using the concordia–discordia diagram	24
Fig. 5.1	Schematic cross-section of the Earth as seen from the South Pole. To illustrate the differences between the oceanic and continental lithosphere, the thickness of these units is exaggerated. With a realistic scaling, the lithosphere would be thinner than 1 mm in the illustration (comp. Fig. 5.2). Modified after Condie (1997), Schubert et al. (2001), Tackley (2008), Torsvik et al. (2014). LLSVP large low shear wave velocity provinces beneath Africa (Tuzo) and the Pacific (Jason), PGZ plume generation zones, thin arrows above Tuzo and Jason indicate buoyant upwelling resulting in the deflection of the geoid (dashed lines)	26
Fig. 5.2	Earth structure according to its mineralogical, petrological, and geophysical properties. Modified after Stüwe (2000)	26
Fig. 5.3	Earth's current distribution of lithospheric plates	27
Fig. 5.4	Schematic representation of plate tectonic processes acting on the Earth's surface and mantle (various sources)	28
Fig. 5.5	Cyclic succession of plate tectonic processes according to the Wilson Cycle	29
Fig. 5.6	Schematic structure of a typical ophiolite sequence.	30

Fig. 6.1	The tectonic subdivision of Europe showing the three major cratonic units Baltica, Laurentia, and Gondwana and assignment to the microplates of Avalonia, Armorica, and Norica. Modified after Kossmat (1927), Franke (1989), Martínez et al. (2007) and others sources.	34
Fig. 7.1	Reconstruction of the global plate tectonic evolution showing events of Central Europe following the breakup of the supercontinent of Rodinia. <i>Ad</i> Adriatic-Apulian Plate, <i>Al</i> Alps, <i>An</i> Anatolian Plate, <i>Ca</i> Carpathians, <i>Dk</i> Denmark, <i>E</i> England, <i>F</i> France, <i>Fl</i> Florida, <i>G</i> Germany, <i>GB</i> Great Britain, <i>Ib</i> Iberia, <i>Ir</i> Ireland, <i>Pe</i> Penninic Ocean, <i>Ma</i> Madagascar, <i>Mo</i> Moesia (presently Romania), <i>N</i> Norica, <i>Nf</i> Newfoundland, <i>Py</i> Pyrenees Ocean, <i>Sc</i> Scotland, <i>Scn</i> Scandinavia, <i>Yu</i> Yucatán. Modified after Tait et al. (1997), Hunter and Easterbrook (2004), Lawver et al. (2009), Frisch et al. (2011), Frisch and Meschede (2013) and other sources.	38
Fig. 8.1	Earthquake activity of Germany and neighboring areas showing a selection of important earthquakes that occurred over the last 100 years. The colored marking on the map indicates the probability of an earthquake reoccurring based on past records. The highest risk areas correspond with young graben structures. Modified after Grünthal and Wahlström (2003), and Leydecker (2011)	42
Fig. 8.2	During the earthquake of September 3, 1978, in the Swabian Alb, a side tower of Hohenzollern Castle, located in the Hohenzollern Graben, was severely damaged. (© picture-alliance/dpa). [N 48°19'23"/E08°58'2"].	44
Fig. 8.3	Contemporary illustration of the Lisbon earthquake of November 1755. (© picture-alliance/akg-images).	45
Fig. 8.4	The European Cenozoic Rift System (ECRIS), which extends from the Rhone Graben across the Bresse and the Upper Rhine Graben, to the Lower Rhine Bay. Modified after Frisch et al. (2011).	46
Fig. 8.5	Tertiary and Quaternary graben systems located in southwest Germany. Red arrows indicate the direction of today's dominant horizontally oriented principal compressive stresses (Blundell et al. 1992; Heidbach et al. 2008). The change of stress field that occurred between Early, Middle and Late Tertiary is shown in the two schematic figures below. The older stress field caused the formation of the Upper Rhine Graben. The younger stress field formed the Lower Rhine Bay graben, some smaller graben systems, and the left-lateral strike slip movements of the Upper Rhine Graben. Volcanoes related to the Tertiary development of the graben systems are shown in green. Modified after Frisch and Meschede (2013)	47
Fig. 8.6	Tectonic overview and geological cross-section (A–B) of the Lower Rhine Bay. Modified after Walter (2007), Geologisches Landesamt Nordrhein-Westfalen (1988).	48
Fig. 8.7	Tectonic overview of the graben system near of the Albstadt Shear Zone. Modified after Reinecker and Schneider (2002)	49
Fig. 8.8	3D-view of the Albstadt Shear Zone. The shear zone occurs as a strike-slip fault in the basement and closer to the surface transfers into graben structures. Modified and completed after Reinecker and Schneider (2002)	50
Fig. 8.9	Inverted relief of the Hohenzollern Graben in the area of the Hohenzollern Castle. Modified after Geyer and Gwinner (2011).	51
Fig. 8.10	Step-forming layers in the gently dipping Triassic and Jurassic sedimentary rocks of southern Germany (Swabian and Franconian Alb). Modified after Wagner (1960).	51

Fig. 9.1	Tectonic map of Germany and adjacent regions without the Permo-Mesozoic cover. In addition to the Kossmat zones of the Variscan fold-and-thrust belt, the distribution of young graben structures, selected salt structures, and the Alpine Molasse are shown. Modified from the European Geotraverse map of Burollet et al. (1992)	54
Fig. 9.2	Distribution of continents and oceans during the Middle Ordovician (470 Ma). The topographic base for the paleogeographic map was provided by Ron Blakey, Flagstaff, Arizona (Blakey 2003)	55
Fig. 9.3	Geological map of the Ecker Valley dam area showing the Ecker Gneiss lying between the Harzburg gabbro-norite and the Brocken Granite. Modified after Franzke (2009)	57
Fig. 9.4	Geological map of Lusatia and the Elbe Zone showing the occurrence of Late Proterozoic and Early Paleozoic rocks (without the Quaternary cover). Modified and simplified after Kemnitz (2007) and Berger et al. (2008)	58
Fig. 9.5	Geological map of the central Schwarzburg Anticlinorium and the Vesser Zone showing the distribution of Late Proterozoic and Early Paleozoic rocks. Modified after Bankwitz et al. (1994) and Sommer and Katzung (2004)	60
Fig. 9.6	A dropstone in the Ordovician <i>Lederschiefer</i> at the northeastern limit of the village of Steinach, Thuringia. The exposure is located at the "Georgsfelsen" above the railway embankment. [N 50°26'19"/E 11°09'19"]	61
Fig. 10.1	Cross-sections showing the Late Silurian to Devonian evolution of the Variscides as a consequence of the collision between the Armorican Terrane Complex and Avalonia. Modified after Franke (2006)	65
Fig. 10.2	The Variscan Orogeny and the development of the Saxothuringian. Extensional movements along a crustal shear zone led to the elevation of the Granulite Massif as a metamorphic core complex. The high-pressure metamorphic rocks of the Erzgebirge were formed during the collision of the Saxothuringian and the Moldanubian. Circles represent respective midpoints relative to the observer. x: strike-slip fault. Modified after Enderle (1998) and Oncken (1993)	66
Fig. 10.3	Schematic cross-section through the Saxothuringian along a line crossing the Fichtel Mountains and the Thuringian Forest. Modified after Walter (2007)	68
Fig. 10.4	Early Devonian paleogeographic reconstruction of Central Europe. <i>MCZ</i> Mid-German Crystalline Zone, <i>Mo</i> Moldanubian, <i>Rh</i> Rhenohercynian, <i>Sa</i> Saxothuringian. Topographic base map from Blakey (2011), modified after Ziegler (1990)	69
Fig. 10.5	Early Devonian facies distribution across the Rhenohercynian zone from north to south along a line running parallel to the Rhine River. Modified after Stets and Schäfer (2002), stratigraphy after STD 2016, Deutsche Stratigraphische Kommission (2016)	70
Fig. 10.6	Early Devonian brittle stars (<i>Furcaster palaeozoicus</i>) in the Bundenbach Slate. Photograph with courtesy of the Bundenbach fossil museum [N49°50'54"/E 07°23'19"].	71
Fig. 10.7	Middle Devonian paleogeographic reconstruction of Central Europe. <i>MCZ</i> Mid-German Crystalline Zone, <i>Mo</i> Moldanubian, <i>Rh</i> Rhenohercynian, <i>Sa</i> Saxothuringian. Topographic base map from Blakey (2011), modified after Ziegler (1990)	72

Fig. 10.8	Profile section through the Middle Devonian Philippstein volcano in the Lahn–Dill area. A reef composed of corals and stromatopores formed on top of the volcano and emerged at the sea surface. Modified after Königshof et al. (2010)	72
Fig. 10.9	<i>Harzer Blutstein</i> (Harz bloodstone) from the Schalstein Formation (late Middle Devonian, Givetian; Weller 2008) formed as part of the volcano and reef complex of Elbingerode. The vitreous keratophyre of this unique form of ore is intensely red colored due to the finely dispersed hematite and pervasive thin pyrite veins; locally referred to as <i>Pyrittrum</i> (<i>Trum</i> is an old German mining expression for a narrow vein)	73
Fig. 10.10	Overview of the areas of limestone karstification in Germany	74
Fig. 10.11	Eocene paleo-cone karst developed in massive Devonian limestone (quarry Schneelsberg at Runkel-Hofen, near Limburg). The gaps between the karst cones are filled up with Oligocene sediment [N 50°25'51"/E 08°08'52"]	75
Fig. 10.12	Phanerozoic mass extinction events showing the five biggest episodes (the <i>big five phanerozoic extinction events</i>) corresponding to the Ordovician/Silurian boundary, the Late Devonian and the boundaries of the Permian/Triassic, Triassic/Jurassic, and Cretaceous/Tertiary periods. The percentages indicate the amount of extinction related to the number of genera living in the respective times. <i>CAMP</i> Central Atlantic Magmatic Province. Modified after Reitner (2011).	76
Fig. 10.13	The Kellwasser Horizon exposed in the Kellwasser Valley along the south side of the Oker dam lake in the Harz. This upper part of the horizon represents a mass extinction of about 60% of the known genera. Profile section modified after the wall chart of the Regionalverband Harz (2012) [N 51°49'12"/E 10°26'58"]	76
Fig. 10.14	Overview of the Carboniferous stratigraphic sequence of the Rhenohercynian, Germany. Modified after Kombrink et al. (2010) and STD 2016, Deutsche Stratigraphische Kommission (2016)	79
Fig. 10.15	Early Carboniferous paleogeographic reconstruction of Central Europe. <i>MCZ</i> Mid-German Crystalline Zone, <i>Mo</i> Moldanubian, <i>Rh</i> Rhenohercynian, <i>Sa</i> Saxothuringian. Topographic base map from Blakey (2011). Modified after Ziegler (1990) and Kombrink et al. (2010).	79
Fig. 10.16	Late Carboniferous paleogeographic reconstruction of Central Europe. <i>LBM</i> London–Brabant Massif, <i>Mo</i> Moldanubian, <i>Rh</i> Rhenohercynian, <i>Sa</i> Saxothuringian. Topographic base map from Blakey (2011). Modified after Ziegler (1990) and Kombrink et al. (2010)	80
Fig. 10.17	Schematic representation of a typical cyclical sedimentary sequence of Late Carboniferous molasse deposited in the Subvariscan Foredeep. These sequences were previously described as cyclothemes (diagram compiled from various sources)	81
Fig. 10.18	Coal seam exposed in the Rauhen quarry, near Witten. These are the oldest coal-bearing beds of Late Carboniferous (latest Namurian) age that occur in the Ruhr area [N 51°25'18"/E 07°21'23"]	82
Fig. 10.19	Overview of the Central European Variscides. Modified after Dallmeyer et al. (1995).	84

Fig. 10.20	Location of the Gießen-Werra-Harz Nappes at the boundary between the Rhenohercynian and Saxothuringian. Modified after Franke and Żelaźniewicz (2000) and Katzung (2001)	85
Fig. 10.21	a Schematic reconstruction of allochthonous units at the southern edge of the Rhenohercynian; b tectonic relationship between the Rhenohercynian, Northern Phyllite Zone, and Mid-German Crystalline Zone. The Siluran and Devonian magmatic arc represents an early stage of the Rhenic Suture Zone with a northward-dipping suture zone (compare Fig. 10.1). Modified after Franke (2000)	86
Fig. 10.22	Generalized geological map of the Rheinisches Schiefergebirge showing the distribution of Paleozoic sequences. Modified after Walter (2007) and the 1:200,000 generalized geological map of the BGR (1981)	87
Fig. 10.23	Cross-section of the Rhenohercynian along a line following the left bank of the Rhine River from Bad Kreuznach to Düren (after Oncken et al. 2000)	87
Fig. 10.24	Distribution of Middle and Late Devonian limestone, basalt, basaltic breccia, and tuffaceous rock (diabase and schalstein, Box 8: Diabase and Schalstein) in the Rheinisches Schiefergebirge	88
Fig. 10.25	Cut section of a rock wall from the former Unica quarry of Villmar. The wall of the quarry is a protected site and national geotope where the structure of a limestone reef of Givetian age (transition from Middle to Late Devonian) is well preserved. It shows layered stromatoporoids, corals, echinoderm remnants, carbonate debris, and sedimentary-filled fissures (not seen in the photo). The dark, very fine, and jagged lines on the block represent stylolite surfaces formed by pressure solution during compression of the rock, with the accumulation of insoluble components appearing as dark seams [N 50°23'39"/E 08°11'03"]	89
Fig. 10.26	The “Sutrop diamonds.” These are authigenically formed double-ended crystals of quartz that crystallized in the cap layers of the massive Devonian limestone. Located at Sutrop near Warstein, in the Sauerland area [N 51°26'57"/E 08°22'50"]	89
Fig. 10.27	Balanced (unfolded and unfaulted) cross-section across the Rhenohercynian following the line of the right bank of the Rhine River from Frankfurt (SSE) to Münster in Westphalia (NW). The schematic profile in the center corresponds to the upper profile. The diagram illustrates the 50% shortening of the Rhenohercynian that occurred during Variscan deformation (after Oncken et al. 2000) . . .	90
Fig. 10.28	Steeply dipping, northwest-vergent fold developed in Early Devonian (Pragian) shale, siltstone, and sandstone lithologies at Teufelsley in the Kall Valley, lying south of Vossenack (northern Eifel). The northwest direction is toward the right side. The shear strain that caused the folding of the beds during the Variscan Orogeny was directed toward the north [N 50°40'28"/E 06°22'32"]	90
Fig. 10.29	Subsurface geological map of the Rhenish–Westphalian coal-mining area and adjacent regions, together with a geological cross-section through the southern part. Modified after Walter (2007), Drozdowski and Wrede (1994)	91
Fig. 10.30	Upright fold developed in sandstones and siltstones of the Sprockhövel Formation (Namurian age) at Pastoratsberg in Essen, Ruhr area [N 51°23'05"/E 07°00'24"]	92

Fig. 10.31	Geological cross-section of the Sutan Thrust in the area of the old Carl Funke coal pit, shaft I (closed down in 1973). Modified from the information board of the Geopark Ruhrgebiet located at the exposure of the Sutan Thrust; Geological Survey of North Rhine-Westphalia (2003) [N 51°24'18"/E 07°02'49"]	92
Fig. 10.32	Schematic overview of the occurrence and formation of ore deposits placed in their plate tectonic context (not to scale)	94
Fig. 10.33	Generalized geological map of the Harz area. Blue capitals (A, B) mark the location of the cross-section shown in Fig. 10.34. Simplified after the 1:200,000 generalized geological map of the BGR (1981). The nappe concept is after Engel et al. (1983) and Walliser and Alberti (1983)	96
Fig. 10.34	NW-SE oriented geological cross-section of the northwestern Harz area. Modified after Franzke (2012)	96
Fig. 10.35	Formation of olistostromes along the Central Harz Fault Zone: A transform fault that was initiated during Early Devonian rifting in the area of the extensional Rhenohercynian Basin and reactivated as a right-lateral strike-slip fault during the Early Carboniferous. Horizontal displacement resulted in a steep relief in the area of the continental margin, leading to the formation of debris and mudflows. The drawing was provided by Heiko Hüneke (Greifswald) and is based on the work of Hüneke and Ruchholz (2004).	97
Fig. 10.36	Cross-section of the ore deposit at the Rammelsberg, near Goslar. Modified after Walther (1986).	98
Fig. 10.37	Geological map and cross-section of the Elbingerode Complex (simplified after Weller 2012)	99
Fig. 10.38	Folded Ordovician phyllites of the Northern Phyllite Zone exposed in a road-cut section through rocks of the Wippra Zone, southeastern Harz, east of Wippra [N 51°34'07"/E 11°17'46"]	100
Fig. 10.39	Geological map of the Odenwald area. Modified after the 1:200,000 generalized geological map of the BGR (1981)	101
Fig. 10.40	Geological map of the Spessart area. Modified after the 1:200,000 generalized geological map of the BGR (1981).	101
Fig. 10.41	Dioritic gneiss containing leucogranite dikes in the Kyffhäuser Crystalline complex, exposed in an abandoned quarry in the Oberes Steintal [N 51°25'22"/E 11°04'08"]	102
Fig. 10.42	Geological map of the Ruhla Crystalline. Simplified after Zeh (2005) and Zeh and Wunderlich (2003).	103
Fig. 10.43	Geological map showing the Paleozoic sequences of the Thuringian Slate Mountains (s.l.). Modified after Seidel et al. (2002) and the generalized geological map 1:200,000 of the BGR (1981)	104
Fig. 10.44	Cut section in the roof slate quarry at Schmiedebach, near Lehesten (Thuringia). The Early Carboniferous (Middle Tournaisian to Middle Viséan) slates split along their cleavage fabric, although the original bedding is still partly visible as fine-laminated stratification [N 50°29'19"/E 11°28'05"]	104
Fig. 10.45	Geological map of the Saxon Granulite Massif. Modified after Berger et al. (Berger et al. 2008)	105
Fig. 10.46	Uplift of a metamorphic core complex, based on the simple shear model of Wernicke (1985). In this model, the rapid uplift of a high-grade metamorphic complex from the deep lower crust results from the extension of the lithospheric plate (<i>blue arrows</i>)	105

Fig. 10.47	Geological map of the eastern part of the Saxothuringian, showing the Saxon Granulite Massif, the Erzgebirge, and Lusatia. Simplified after Goth et al. (2001)	106
Fig. 10.48	Late Devonian pillow basalts from the Saxothuringian exposed at the entrance to the spa gardens of Bad Berneck [N 50°03'02"/E 11°40'37"]	107
Fig. 10.49	Geological map of the Variscan rocks of the Bohemian Massif. KTB Continental Deep Drilling Program of the Federal Republic of Germany. Simplified after Franke (2000)	108
Fig. 10.50	Geological map of the Münchberg Gneiss Massif and adjacent regions. Simplified after the 1:200,000 of the generalized geological map the BGR (1981).	110
Fig. 10.51	Geological map of the Black Forest crystalline rocks. Simplified after Hann and Zedler (2008)	111
Fig. 10.52	Randgranite exposure, near Gschwendt, ca. 4 km south of Todtnau (Black Forest). The mylonitic overprint is clearly marked by a distinct schistose foliation and the alignment of large feldspar crystals [N 47°48'28"/E 07°56'09"]	112
Fig. 10.53	Evolution of the Moldanubian suture in the Badenweiler–Lenzkirch Zone of the southern Black Forest. Modified after Hann et al. (2003a) and Frisch and Meschede (2013).	113
Fig. 10.54	Partial melt textures (anataxis) in a migmatite rock within the Wiese–Wehra Nappe of the Southern Black Forest, exposed in a road-cut section north of Todtmoos [N 47°44'58"/E 07°59'56"]	114
Fig. 11.1	Distribution of continents and oceans during the Late Permian (260 Ma). G—approximate location of Germany. The topographic base for the paleogeographic map was made available by Ron Blakey, Flagstaff, Arizona (Blakey 2003).	116
Fig. 11.2	Conceptual model for the development of the Variscan lithosphere from the Late Carboniferous to the Late Cretaceous along a cross-section from northern Germany to the French and Swiss Jura (not to scale). Adapted from Ziegler and Dèzes (2006).	117
Fig. 11.3	Graben structure of the basement in Northern Germany that lies beneath a thick cover of Mesozoic and Cenozoic sedimentary rock. Modified after Gast (1988).	118
Fig. 11.4	Paleogeographic reconstruction of Central Europe (a) and Germany (b) at the time of the Rotliegend. Topographic base map from Blakey (2011), modified after Ziegler (1990).	118
Fig. 11.5	Distribution of Rotliegend volcanic rocks in the North German Basin and adjacent areas to the south. Modified after Breitzkreuz and Kennedy (1999); Timmermann (2008)	119
Fig. 11.6	Rhomb porphyry from the Oslo Graben. Location ca. 20 km northwest of Oslo at Krogsbogen Hill [N 60°03'17"/E 10°19'35"]	120
Fig. 11.7	Development of O ₂ and CO ₂ concentrations in the atmosphere during the last 600 Myr compared to today's actual values (<i>dashed lines</i>). Redrawn and modified after Berner (1990), Berner et al. (2000), Berner and Kothavala (2001), Brenchley and Harper (1998).	121
Fig. 11.8	The Rotliegend "Petrified Forest" on display inside the Chemnitz Museum of Natural History. The logs originally exhibited in the open air were found in the urban area surroundings of Chemnitz (photograph by courtesy of the Chemnitz Museum of Natural History) [N 50°49'51"/E 12°55'26"]	122

Fig. 11.9	Flattened trees located above Spirit Lake on the Mount St. Helens volcano in Washington, USA. Traces of the volcanic eruption can be observed even 30 years later in the form of broken and frayed tree branches that lay in the line of the blast [N 46°16'18"/W 122°06'37"].	123
Fig. 11.10	Exposure of a Rotliegend fanglomerate at the entrance of the Wartburg Castle, near Eisenach [N 50°57'58"/E 10°18'22"].	123
Fig. 11.11	Cross-section through the Central European Basin from the Harz Mountains to the Baltic Sea (strong vertical exaggeration). Redrawn and modified after Krawczyk et al. (2008).	124
Fig. 11.12	Evolution of playa sediments under arid climatic conditions characterized by high evaporation rates, sporadic water supply and the formation of ephemeral, cyclically occurring playa lakes. Modified after Eugster and Hardy (1975)	125
Fig. 11.13	Rotliegend stratigraphy of the North German Basin and adjacent regions. Modified after Menning et al. (2002), and the Deutsche Stratigraphische Kommission (2016).	126
Fig. 11.14	Rotliegend sedimentary rocks near Hettstedt (Mansfeld area) in the <i>Tal der Heiligen Reiser</i> . Late Carboniferous red shales are discordantly overlain by Late Rotliegend sandstones and conglomerates forming the Saalian unconformity. The hiatus represents about 40 Myr of erosion [N 51°38'59"/E 11°31'24"]	127
Fig. 11.15	Cross-section through the Halle Volcanic Complex After Breitzkreuz and Kennedy (1999)	127
Fig. 11.16	Evolution of the Halle Volcanic Complex marked by several phases of eruption and erosion. After Breitzkreuz et al. (2009)	128
Fig. 11.17	Geological map of the Ilfeld Basin at the southern edge of the Harz Mountains. Simplified after the 1:1.000.000 geological map of the Federal Republic of Germany, BGR (1993).	129
Fig. 11.18	Geological map of the Saar-Nahe Basin between Mainz and Saarbrücken Simplified after the 1:1.000.000 geological map of the Federal Republic of Germany, BGR (1993); cross-section modified after Walter (2007)	130
Fig. 11.19	Rotliegend basalt from the Saar-Nahe Basin with chalcedony-filled vesicles, formerly known as mandelstein (location in the Fischbach Valley near Idar-Oberstein, Juchem quarry) [N 49°45'26"/E 07°20'23"]	131
Fig. 11.20	Agate geode from a welded ignimbrite (rhyolite) of the Vorerzgebirge Basin. Photograph with the kind permission of the Chemnitz Museum of Natural History [N 50°49'51"/E 12°55'26"]	132
Fig. 11.21	Geological map of the Thuringian Forest Simplified after the 1:1.000.000 geological map of the Federal Republic of Germany, BGR (1993)	133
Fig. 11.22	Stratigraphic column of the Zechstein series in the North German Basin and adjacent regions. Modified after Menning et al. (2002, 2011), Menning and Hendrich (2005), Peryt et al. (2010), and the Deutsche Stratigraphische Kommission (2016).	134
Fig. 11.23	Paleogeographic reconstruction of Central Europe (a) and Germany (b) at the time of the Zechstein. Late Permian; topographic base map from Blakey (2011), modified after Ziegler (1990), and Peryt et al. (2010).	135

Fig. 11.24	<i>Palaeoniscum freieslebeni</i> , the “Permian herring” recovered from the Copper Slate Formation (Late Permian) at the southern edge of the Harz Mountains next to the “Lange Wand” (German: long wall) near Ilfeld [N 51°34′06″/E 10°47′04″]	136
Fig. 11.25	Waste dump from Copper Slate mining, east of Mansfeld [N 51°34′58″/E 11°33′40″]	137
Fig. 11.26	Occurrence of Zechstein salt and sedimentary rocks in the area of the North German and Polish basins Modified after Peryt et al. (2010)	138
Fig. 11.27	Reef structures and the distribution of sedimentary facies at the southern edge of the North German Basins during the Late Permian (Zechstein, Werra cycle). The fossil reefs are located north of the Thuringian Slate Mountains in the Orla depression, near Pössneck. After Paul and Huckriede (2004)	138
Fig. 11.28	Zechstein limestone of lagoonal facies discordantly overlying folded Carboniferous graywackes of the Variscan basement. Locality is directly below the Totensteinriff (Zechstein limestone) at the Harrasmühle near Lausnitz, Orla depression [N 50°43′08″/E 11°41′56″]	139
Fig. 11.29	The “Lange Wand” (German: long wall) near Ilfeld. Bedded Zechstein limestone discordantly overlies rhyolites of the Rotliegend that are partly bleached in the upper part. At this location, the Copper Slate is tectonically thinned out but occurs in the neighborhood of the Lange Wand, only a few meters from this exposure [N 51°34′06″/E 10°46′59″]	139
Fig. 11.30	The salt content of seawater calculated for a 1 km long column with a 1 cm ² base area. If such a water column is completely evaporated, a 17 m high pillar of salt remains with minerals precipitated in their ideal evaporative sequence. In natural evaporates, carbonates and gypsum are the most abundant mineral phases formed.	140
Fig. 11.31	Simplified presentation of a typical evaporation sequence that was formed at the beginning of the Zechstein series (Werra and Stassfurt sequence)	141
Fig. 11.32	Evolution of salt pillows, domes, and walls that result from lateral migration of the salt caused by the overburden pressure of denser sedimentary rocks. Modified after Trusheim (1960).	142
Fig. 11.33	Salt pillow and diapir structures in the upper crustal levels of the North Sea, Northern Germany, and Poland. The greatest thickness of salt occurs beneath the North Sea and Schleswig-Holstein where salt diapirs are connected to prominent salt walls. After Lokhorst (1998) and Pharaohet et al. (2010)	142
Fig. 11.34	Evolution from a salt pillow to a dome, such as the well-studied Gorleben salt dome. Modified after Zirngast (1991), Bornemann et al. (2008)	143
Fig. 11.35	Cross-section through the salt dome of Ronnenberg near Hannover. In the flank of the dome, on top of the Benther Berg, the Buntsandstein strata are tilted vertically. A subsrosion depression with a diameter of several kilometers developed above the salt dome. Modified after Ahlborn and Richter-Bernburg (1953).	144
Fig. 11.36	Schematic reconstruction of the possible sites of oil and gas traps near a salt dome	145

Fig. 11.37	Formation conditions of a) oil and natural gas, and b) coal, showing their dependence on the depth of burial and temperature. The range where oil and gas are formed (a) is known as the oil window and natural gas window, respectively. The vitrinite reflectance parameter (b) provides a measure of the degree of coalification attained by a rock. It is based on photometric measurement of the degree of green light reflected by the vitrinite maceral, which is the organic matter in coal derived from woody tissue.	147
Fig. 11.38	Late Triassic (220 Ma) distribution of continents and oceans. Ap—Apulian Plate, G—approximate location of Germany. The topographic base for the paleogeographic map was provided by Ron Blakey, Flagstaff, Arizona (Blakey 2003).	149
Fig. 11.39	Stratigraphic sequence of Triassic sedimentary rocks in the North German Basin and adjacent regions. Modified after Menning et al. (2002, 2011, 2012), Menning and Hendrich (2005); Peryt et al. (2010), and the Deutsche Stratigraphische Kommission (2016)	151
Fig. 11.40	Rogenstein from the Early Buntsandstein of the Hesseberg, near Jerxheim, located at the northern edge of the Harz Mountains. The diameter of single ooids is about 5 mm [N 52°05'01"/E 10°51'22"]	152
Fig. 11.41	Early Buntsandstein stromatolite colony from Benzingerode, located on the northern edge of the Harz Mountains. The stromatolite colony was supposedly found in a nearby disused rogenstein quarry between Heimburg and Benzingerode [N 51°49'31"/E 10°53'14"]. The specimen is today located in a front garden of a house in the village of Benzingerode [N 51°50'01"/E 10°51'35"]	152
Fig. 11.42	Early Buntsandstein stromatolite colony in the wall of a disused quarry at the Hesseberg near Jerxheim, located at the northern edge of the Harz Mountains. This is the type locality for stromatolites where they were first described (Kalkowsky 1908) [N 52°05'03"/E 10°51'55"]	152
Fig. 11.43	The “ <i>Teufelstisch</i> ” (devil’s table) composed of silicified sandstone beds of the Early Buntsandstein near Hinterweidenthal in the Palatinate Forest [N 49°11'41"/E 07°44'37"]	153
Fig. 11.44	Paleogeographic reconstruction of Central Europe at the time of Buntsandstein sediment deposition. Topographic base map from Blakey (2011) modified after Ziegler (1990), Hiete et al. (2006) and Bachmann et al. (2010)	154
Fig. 11.45	Cross-section through the island of Helgoland showing the distribution of Middle Buntsandstein strata. The Helgoland dune is underlain by layers of Muschelkalk, which 250 years ago was exposed in a white cliff section. Modified after Grafenstein et al. (1991)	155
Fig. 11.46	Mesozoic evolution of the dinosaurs. After Sereno (1999)	155
Fig. 11.47	Stratigraphic and facies subdivision of the Muschelkalk in northern and southern Germany modified after Hagdorn and Simon (2005), Menning and Hendrich (2005), and the Deutsche Stratigraphische Kommission (2016).	157
Fig. 11.48	Paleogeographic reconstruction of the Muschelkalk in Central Europe. Topographic base map from Blakey 2011; facies relations modified after Ziegler (1990) and Bachmann et al. (2010)	158
Fig. 11.49	<i>Ceratites nodosus</i> from the Late Muschelkalk Meißner Formation, found at Erkerode in the area of the Elm, near Braunschweig [N 52°12'17"/E 10°42'26"]	159

Fig. 11.50	Rollover anticline developed in Late Muschelkalk limestones at the northeastern edge of the Freudenstadt Graben, near Dornstetten [N 48°28'16"/E 08°30'53"]	159
Fig. 11.51	Geological map of the Thuringian Basin. Simplified after Seidel et al. (2002), without Cenozoic formations	160
Fig. 11.52	Lithofacial transitions between the Muschelkalk and the Keuper in the Germanic Basin. <i>T.F.</i> Trochitenkalk Formation, <i>M.F.</i> Meißner Formation, <i>W.F.</i> Warburg Formation, <i>Anis.</i> Anisium. Modified after Szulc (2000)	161
Fig. 11.53	Interaction of tidal forces (gravity of the Moon, centrifugal force) during rotation of the Earth and Moon around a common center of mass	163
Fig. 11.54	a Formation of the tidal motion of water related to the gravitation pull of the Moon and the Earth's rotation. b Tidal cycles, with the formation of spring and neap tides related to the different positions of the Earth, Moon, and Sun relative to each other	162
Fig. 11.55	Distribution of continents and oceans at the Triassic/Jurassic boundary (200 Ma). CAMP—Central Atlantic Magmatic Province. The topographic base for the paleogeographic map was provided by Ron Blakey, Flagstaff, Arizona (Blakey 2003). The contour of the CAMP province is modified after McHone and Puffer (2003)	164
Fig. 11.56	Jurassic stratigraphy of northern and southern Germany. Fm—Formation, Wiehengeb. Qu—Quartzite from the Wiehengebirge. Modified after Menning et al. (2002); and Mönnig (2005), Deutsche Stratigraphische Kommission (2016)	166
Fig. 11.57	Early Jurassic paleogeographic reconstruction of Central Europe. Topographic base map from Blakey (2011); modified after Ziegler (1990)	167
Fig. 11.58	<i>Schwabens Medusenhaupt</i> (the Swabian head of Medusa), the largest ever prepared block of the gigantic sea lily <i>Seirocrinus subangularis</i> , which was fossilized in the state of growing on a large piece of driftwood. The sample was recovered from the Black Jurassic of Ohmden/Holzmaden and is exhibited in the Urweltmuseum Hauff (museum of the primeval world) in Holzmaden (http://www.urweltmuseum.de), who kindly provided the photograph [N 48°38'06"/E 09°31'41"]	168
Fig. 11.59	Paleogeographic reconstruction of Central Europe during the Middle Jurassic. Topographic base map from Blakey (2011); modified after Ziegler (1990)	171
Fig. 11.60	Late Jurassic paleogeographic reconstruction of Central Europe. Topographic base map from Blakey (2011); modified after Ziegler (1990) and Schmidt-Kaler (2003)	172
Fig. 11.61	Sponge reefs of the Altmühltal nature park exposed in the <i>Zwölf Apostel</i> rock formation (twelve apostles) near Solnhofen [N 48°53'38"/E 11°01'05"]	172
Fig. 11.62	Late Jurassic distribution of lagoonal lithographic limestone lithologies (“ <i>Wannen</i> ”, vat) and reef limestones in the Franconian Alb area. Modified after Röper et al. (2000)	173
Fig. 11.63	<i>Archaeopteryx lithographica</i> (Eichstätt specimen) of the Jurassic Museum in the Willibaldsburg, Eichstätt. (Photograph with the kind permission of the Jurassic Museum Eichstätt) [N 48°53'31"/E 11°10'11"]	174

Fig. 11.64	Lithographic plate of Solnhofen limestone used for printing a topographic map—sheet Hahausen (northwestern edge of the Harz Mountains), which was published in 1878 by the Königlich-Preußische Landesaufnahme. The photograph was kindly provided by the geoscientific collection of the Federal Institute for Geosciences and Natural Resources (BGR) in Berlin; © BGR	175
Fig. 11.65	Phanerozoic sea-level changes. 600 Ma until today; modified after Haq et al. (1987), and Haq and Al-Qahtani (2005).	176
Fig. 11.66	Middle Cretaceous distribution of continents and oceans (90 Ma). Ap—Apulian Plate, G—approximate location of Germany. The topographic base for the paleogeographic map was provided by Ron Blakey, Flagstaff, Arizona (Blakey 2003).	177
Fig. 11.67	Early Cretaceous paleogeographic reconstruction of Central Europe. Topographic base map from Blakey (2011); modified after Ziegler (1990), and Scheck-Wenderoth et al. (2008).	178
Fig. 11.68	Facies distribution in the Lower Saxony Basin during the Berriasian. Early Cretaceous; modified after Kemper (1976), and Richter (2007).	179
Fig. 11.69	Dinosaur tracks of the genus <i>Iguanodon</i> fossilized in a sandstone bed of the Obernkirchen sandstone [N52°15'54"/E 09°12'32"]	179
Fig. 11.70	<i>Crioceratites</i> sp., a heteromorphic (partly unrolled) ammonite of the Early Cretaceous preserved in Barrêman clay deposits. The fossil was found in a clay pit of the former brick factory of Moorberg, near Sarstedt, which has since been backfilled [N 52°14'48"/E 09°52'57"]	180
Fig. 11.71	Geological cross-section through the horst structures of the Schafberg area near Osnabrück, which forms part of the Ibbenbürener Bergplatte. The high-rank coalification of the Late Carboniferous coal seams mined in the <i>Ostfeld</i> (East field) mining shaft was for a long time considered to result from the intrusion of a pluton (Bramscher Pluton). However, new investigations favor deep burial of the coal during Mesozoic transtension. Modified after RAG Anthrazit Ibbenbüren GmbH (2002).	181
Fig. 11.72	Late Cretaceous paleogeographic reconstruction of Central Europe. Topographic base map from Blakey (2011); modified after Ziegler (1990) and Vejrbæk et al. (2010).	182
Fig. 11.73	a Fault systems and uplifted basement in Central Europe; b section (A–B; for the location of the section see Fig. 11.73a) through the continental crust from the Harz Mountains to the Tornquist zone based on deep seismic investigations of the DEKOPP BASIN research group (1999). Sections C–D, E–F, and G–H in Fig. 11.74. Modified after Kley and Voigt (2008)	183
Fig. 11.74	Cretaceous reverse and thrust faults in the Central European Basin formed during inversion tectonics (normal faults reactivated as reverse faults) in the Lower Saxony Basin, and b uplifted basement blocks linked to thrust faulting Modified after Kley et al. (2008).	184
Fig. 11.75	Geological cross-section across the Northern Harz Boundary Fault, near Blankenburg. Modified after Franzke et al. (2004)	184
Fig. 11.76	Middle Coniacian to the Campanian tectonic and sedimentary evolution of the Northern Harz Boundary Fault in the area of Blankenburg. Modified after Voigt et al. (2006).	185
Fig. 11.77	Devils Wall between Neinstedt and Weddersleben showing steeply tilted and silicified quartz sandstone of the Heidelberg Formation of Santonian age [N 51°45'27"/E 11°04'58"]	186

Fig. 11.78	Quarry in R�uthen Green Sandstone of Cenomanian age (Essen Greensand Formation). The enlargement shows worm traces in glauconite-bearing sandstone. Quarry Kirsch, R�uthen on the river M�ohne, Mildental (Milde Valley) [N 51°30'03"/E 08°25'19"].	187
Fig. 11.79	Fractured sandstones of the Coniacian exposed in the Schrammsteine of the Elbsandsteingebirge. Horizontal layers and vertical fractures arranged at a right angle to each other result in the cube-shaped weathering forming high rock towers, steep walls, and ledges [N 50°54'40"/E 14°12'01"]	187
Fig. 11.80	Evolution of the Prignitz–Lusatian Basin showing the Late Cretaceous tectonic inversion of the Prignitz–Lusatian Modified after Voigt (2009)	188
Fig. 11.81	Geological cross-section through the Elbsandsteingebirge crossing the area of the Schrammsteine from the Elbe to the Lusatian Thrust Modified after Richter (1999); scale not exaggerated	188
Fig. 11.82	R�ugen chalk (Maastrichtian) exposed beneath the K�onigsstuhl on the Jasmund peninsula of R�ugen. Sedimentary layers bearing flintstones were folded during the glacial deformation of the last ice age [N 54°34'50"/E 13°38'41"]	189
Fig. 11.83	Flintstone containing a silicified sea urchin from the Cretaceous chalk of R�ugen [N 54°31'43"/E 13°40'30"]	189
Fig. 12.1	Overview of the tectonic structure of the Alps with a schematic representation of the original tectonic positions of the Alpine units. Ad Adamello, AM Aar Massif, AR Aiguilles-Rouge Massif, Be Bergell, Bi Biella, BM Belledonne Massif, Bohemian M. Bohemian Massif, DB Dent Blanche, DM Dora-Maira Massif, EW Engadine Window, GP Gran Paradiso, IL Insubric Line, IZ Ivrea Zone, JL Judicarie Line, MB Mont Blanc, MAM Mercantour-(Argentera-)Massif, MR Monte Rosa, NCA Northern Calcareous Alps, URG Upper Rhine Graben, PAL Periadriatic Lineament, PM Pelvoux Massif, Po Pohorje, Pr Prealps, RW Rechnitz Window, Ri Rieserferner, Se Sesia Nappe, BF Black Forest, TW Tauern Window, TL Tonale Line, CEA central Eastern Alpine. Modified after Bousquet et al. (2012)	192
Fig. 12.2	Late Triassic plate tectonic reconstruction of the northern region of the Neotethys. AM Armorican Massif, BM Bohemian Massif, LBM London-Brabant Massif, VL Vindelician Land, CM Central Massif. Topographic base map from Blakey (2011), modified after Frisch (1979), Dercourt et al. (2000), and Ziegler (1990)	195
Fig. 12.3	Facies development in the Northern Calcareous Alp during the Norian and Rhaetian. Simplified after Gawlick (2000)	196
Fig. 12.4	Middle Jurassic plate tectonic reconstruction of the surrounding areas of the Mediterranean region. AM Armorican Massif, BM Bohemian Massif, LBM London-Brabant Massif, CM Central Massif. Topographic base map from Blakey (2011), modified after Frisch (1979), Dercourt et al. (2000), Handy et al. (2010), and Missoni and Gawlick (2011)	197
Fig. 12.5	Early and Late Cretaceous plate tectonic reconstruction of the surrounding areas of the Mediterranean region. The changing directions of the African and European plates led to inversion tectonics in Central Europe. AM Armorican Massif, Br Brian�onnais, Di Dinarides, Hel Hellenides, Ca Carpathians, NP North Penninic Ocean, AA Austroalpine, PO Pyrenees Ocean, RBM Rhenish-Bohemian Massif, SA Southern Alpine, CM Central Massif. Modified after Kley and Voigt (2008) and Handy et al. (2010), topographic base map from Blakey (2011)	197

Fig. 12.6	Evolution of the Alpine region in the sense of the supercontinent Wilson Cycle; modified after Frisch and Meschede (2013) and Frisch and Gawlick (2003)	198
Fig. 12.7	Subdivision of a turbidite into the five typical units (A to E) of a Bouma sequence. Its deposition results from a suspension current. Modified after Kuhlemann et al. (2009)	200
Fig. 12.8	a Effects of mountain building (crustal thickening) and discharge of rocks (erosion) on the state of isostatic equilibrium (floating balance). A theoretical compensation area is assumed in the asthenosphere (here at 200 km depth) at which the pressure per unit area (here in kg/cm ²) is everywhere the same. The thickening of the crust (here from 30 to 60 km) leads to the uplift. Although erosion leads to a lowering of the Earth's surface relief, it results in further uplift of the lithosphere. b, c effects of erosion and relief on uplift and shaping of the topographic surface. While the average height is lowered by erosion, the incision of valleys leads to a rise in the height of the summits. With a uniform erosion of 1000 m (b), together with the same erosion volume forming valleys and peaks (c), the surface or the average height in this theoretical example is lowered by 138 m and the rocks and thus the summit ascends to 862 m. Modified from Frisch and Meschede (2013)	202
Fig. 12.9	Tectonic map and a schematic sketch of overthrusts in the Eastern Alpine region. Modified after Frisch and Gawlick (2003)	204
Fig. 12.10	Geological cross-section through the western part of the Northern Calcareous Alps. Location of the cross-section shown in Fig. 12.7. Modified after Eisbacher (1990)	204
Fig. 12.11	Nappe formation and folding in the Alps resulting from the collision between the Adriatic-Apulian Plate and the European Plate. Schematic sketch showing the evolution of the Alpine Orogeny along a cross-section through the eastern Central Alps. Modified after Schmid et al. (1996, 2004), Froitzheim et al. (2003)	205
Fig. 12.12	Tectonic map of the Eastern Alps and its subdivision in tectonic blocks. The lower map displays the reconstructed position of the blocks relative to each other in the Oligocene prior to displacement. Modified after Frisch et al. (1998)	207
Fig. 12.13	Slab breakoff affecting subducted oceanic lithosphere following collision. Basaltic rocks of the lithosphere are metamorphosed to dense eclogite that enhances downward movement. The slab breakoff supports the buoyant uplift of the thickened continental lithosphere and the formation of a high mountain range at the surface. Slightly modified after Frisch and Meschede (2013)	208
Fig. 13.1	Eocene paleogeographic reconstruction of Central Europe. Topographic base map from Blakey (2011); modified after Ziegler (1990)	210
Fig. 13.2	Amber recovered from Quaternary sediments, Greifswald (with the kind permission of the Staatliche Landessammlung Mecklenburg-Vorpommern, Greifswald, Germany)	211
Fig. 13.3	Oligocene paleogeographic reconstruction of Central Europe. Topographic base map from Blakey (2011); modified after Ziegler (1990)	211
Fig. 13.4	The geological age of brown coals in Germany Simplified after Henningsen and Katzung (2006), Deutsche Stratigraphische Kommission (2016)	213
Fig. 13.5	Miocene paleogeographic reconstruction of Central Europe. Topographic base map from Blakey (2011); modified after Vinken et al. (1988) and Ziegler (1990)	214

Fig. 13.6	Cross-section through the northern part of the basalt flow at the Hoher Meissner. Modified after Finkenwirth (1978)	215
Fig. 13.7	Isostatic adjustment of an ascending mantle diapir composed of hot asthenospheric material. A theoretical compensation plane in the asthenosphere is assumed (here at 200 km depth) at which the pressure per unit area (here in kg/cm ²) is universally the same. The thinning of the lithospheric mantle (here from 70 to 20 km) leads to uplift since the asthenosphere with $\rho = 3.25 \text{ g/cm}^3$ is slightly lighter than the lithospheric mantle with $\rho = 3.3 \text{ g/cm}^3$. The resulting deficiency in mass is replaced from below by the inflowing asthenosphere	215
Fig. 13.8	Graben structures form either by active rifting related to an ascending mantle diapir or passive rifting caused by extension and drift of the continental plate along a fracture zone. A bulge caused by isostatic adjustment evolves with a graben structure developed in its apex region (Fig. 13.7)	216
Fig. 13.9	Geological overview map of the Upper Rhine Graben in southwest Germany. Simplified after the 1: 1,000,000 geological map of the Federal Republic of Germany, BGR (1993)	217
Fig. 13.10	Block diagram of the Upper Rhine Graben near the Kaiserstuhl. The upper part of the continental crust is characterized by normal faulting, whereas the deeper crust is dominated by ductile deformation. After Frisch and Meschede (2013)	218
Fig. 13.11	Cave ceiling with stalactites in the Bärenhöhle (German: bear's cave) near Erpfingen in the Swabian Alb. [N 48°22'14"/E 09°12'54"]	219
Fig. 13.12	Illustration of possible karstification features developed in fissured limestone.	219
Fig. 13.13	Distribution of uplift and subsidence across the Upper Rhine Graben including the graben shoulders. Red zones indicate the subsided areas, blue zones the uplifted areas of the erosional peneplain (in meters above present sea-level). Dotted lines indicate the depth to the base of the crust (Moho; in km below sea-level; after Frisch and Meschede 2013)	220
Fig. 13.14	Eocene to present evolution of the southern Upper Rhine Graben in the area of the Kaiserstuhl. Modified after Schreiner (1977)	222
Fig. 13.15	Meanders in the Upper Rhine Valley around Karlsruhe showing old branches of the river that were straightened in the 19th century. Modified after Thürach (1912)	224
Fig. 13.16	Cross-section through the Eastern Alps from the Po Basin to the Swabian Alb. Modified after Schmidt et al. (2004) and Pfiffner (2010)	225
Fig. 13.17	Stratigraphy of the Alpine foreland molasse with a schematic representation of the facies changes from west to east. LMM Lower Marine Molasse, LFM Lower Freshwater Molasse, UMM Upper Marine Molasse, BM Brackish Water Molasse, UFM Upper Freshwater Molasse Modified from Lemcke (1988), Kuhlemann and Kempf (2002), Menning et al. (2002), and the Deutsche Stratigraphische Kommission (2016); sea-level curve after Haq et al. (1988)	225
Fig. 13.18	Block diagram of the Northern Alpine Foreland Basin in the area of Munich. Modified after Wellnhofer (1983) and Glaser et al. (2008)	227
Fig. 13.19	Oligocene to Miocene stages of molasse evolution. See text for further explanation. Modified after Kuhlemann and Kempf (2002), Bayerisches Geologisches Landesamt (1996)	228

Fig. 13.20	The Heldenfingen cliff in the village of Heldenfingen. A paleo-Tertiary surf zone is exposed in the form of a wave-cut section developed in Late Jurassic limestone that is riddled with notches and paddock shaped holes. This erosional feature is of Early Miocene (Burdigalian to Ottnangian) age and was formed when waves crashed against the steep cliff from the south. [N 48°36'23"/E 10°04'25"].	229
Fig. 13.21	a Profile section along the Wutach River from the Feldberg to the junction with the Rhine. The Aitrach dry valley represented the continuation of the Feldberg-Danube until 25,000 years ago. b Course of the Feldberg-Danube before the Wutach River became active. c Present stage of the deeply incised Wutachschlucht. Profile section modified after BNL (2004)	231
Fig. 14.1	Tertiary and Quaternary volcanic areas in Germany and its surroundings. Modified after Henningsen and Katzung (2006); base of lithosphere after Plomerová and Babuška (2010); location of shear zones after Bankwitz et al. (2003)	234
Fig. 14.2	Distribution of Laacher See tephra in Central Europe. After Schmincke (2008, 2013)	235
Fig. 14.3	Extent of a lake in the Rhine Valley after a dam formed at the end of the Brohl Valley by large pyroclastic flows from the Laacher See volcano eruption. The level of the lake was about 25 m above the Rhine. Modified after Schmincke (2009), and Park and Schmincke (2009)	235
Fig. 14.4	Evolution of a maar when groundwater and ascending magma come into contact	236
Fig. 14.5	Cross-section through a maar funnel after the termination of volcanism and development of a maar lake. Modified after Lorenz (2000)	237
Fig. 14.6	Tephra deposits of the Laacher See volcano at the Wingertsberg, near Mendig, forming the Wingertsberg Wall. In the center of the image, dunes can be seen within the tephra layers that testify to the high wind velocities during deposition. [N 50°23'31"/E 07°16'30"]	238
Fig. 14.7	Trass caves in the Brohl Valley, north of the Laacher See. [N 50°27'37"/E 07°17'48"]	238
Fig. 14.8	CO ₂ mofettes (gas release from the lake floor) at the edge of the Laacher See. [N 50°24'46"/E 07°17'08"]	238
Fig. 14.9	Quaternary und Tertiary eruption centers in the volcanic areas of the Rhine-Moselle region. Western Eifel, eastern Eifel, Siebengebirge and Westerwald; modified after Schmincke (2008); extent of the Eifel plume after Bräuer et al. (2013)	239
Fig. 14.10	The maars of Schalkenmehren and their relation to a ESE-WSW directed feeder channel. Modified after Büchel and Krawczyk (1986)	240
Fig. 14.11	The mantle (the Eifel-Plume) beneath the volcanic fields of the Eifel based on seismotomographic investigations. Modified after Ritter (2004)	241
Fig. 14.12	Cross-section through the trachytic cryptodome of the Drachenfels and the latitic chimney of the Wolkenburg in the Siebengebirge, near Bonn. Modified after Wunderlich (1968)	242
Fig. 14.13	Formation of the oil shale pit at Messel during Tertiary maar volcanism and the subsequent development of a lake in the maar crater. The lake bottom developed an anoxic zone where organic residues were preserved. Modified after Harms et al. (1999a), and Bunes et al. (2005); map section after Harms et al. (1999b)	244

Fig. 14.14	Contact between White Jurassic limestone and a volcanic vent filling of Tertiary age at the Neuffener Steige, Swabian Alb, between Reutlingen and Kirchheim/Teck. [N 48°32'17"/E 09°24'25"]	246
Fig. 14.15	Occurrence of Tertiary magmatic rocks in the area of the Eger Graben. Modified after Pfeiffer and Suhr (2008); location of the shear zone and maar structures after Nickschick et al. (2014)	247
Fig. 14.16	Vertical columnar basalt within a lava flow at the Scheibenberg, southwest of Annaberg in the Erzgebirge. [N 50°32'22"/E 12°55'25"]	247
Fig. 14.17	Pennate columnar basalt developed within a cryptodome (subvolcanic intrusion at several tens to hundreds of meters depth) at the Hirtstein, east of Annaberg in the Erzgebirge. [N 50°32'11"/E 13°11'36"]	248
Fig. 14.18	Curved columnar structures in a basaltic intrusion at the Parkstein, near Weiden in the Upper Palatinate, Fichtel Mountains. [N 49°43'42"/E 12°04'12"]	248
Fig. 14.19	Vertical columnar basalt at the Stolpener Burgberg in Lusatia, near Dresden. [N 51°02'53"/E 14°05'02"]	249
Fig. 15.1	Nördlinger Ries and the Steinheim Basin. The circular asteroid craters in the Swabian Alb of southern Germany are clearly visible in a digital terrain model (about 5 times exaggerated in vertical scale). The central elevation in the Steinheim Basin is also clearly visible	252
Fig. 15.2	Reconstruction of the first ten minutes of the asteroid impact in the Nördlinger Ries. Modified after the website of the Geopark Ries: www.geopark-ries.de/index.php/de/entstehung_rieskrater	253
Fig. 15.3	Cross-section through the Nördlinger Ries and geological map of the Nördlinger Ries and Steinheim Basin area. Modified after the 1: 200,000 geological survey map, BGR (1981), Rothe (2005), and Pösges and Schieber (1994).	254
Fig. 15.4	Striations on the surface of the White Jurassic limestone plateau at the rim of the Nördlinger Ries crater exposed in a quarry, near Gundelsheim. The striations were formed immediately after the impact due to ejected material that sheared over the floor. [N 48°54'27"/E 10°49'52"]	254
Fig. 15.5	Moldavites from South Bohemia, Czech Republic. Collection of Stefan Meng (University of Germany) who kindly provided the photographs.	254
Fig. 15.6	Occurrence of moldavites from the Ries impact crater across central Middle Europe (southeast Germany, Czechia, Lower Austria). They are distributed in the form of an ENE oriented emission fan with an aperture angle of about 60°. Modified after Skála et al. (2009).	255
Fig. 15.7	Suevite in the Nördlinger Ries collected from the entrance to the village of Zipplingen about 10 km northwest of Nördlingen. [N 48°55'40"/E 10°24'34"]	255
Fig. 15.8	Conglomerate pebble fractured by the asteroid impact of the Nördlinger Ries. The photograph shows a specimen from the archive of Wolf Jürgen von Engelhardt (1910–2008), Tübingen, Germany.	255
Fig. 15.9	The Ries and Rezat-Alt Mühl lakes formed because of the asteroid impact of the Nördlinger Ries. Modified after Eberle et al. (2010)	256
Fig. 15.10	Bioherm of green algae from the Tertiary Ries Lake located beneath the castle of Wallerstein, north of Nördlingen. [N 48°53'21"/E 10°28'35"]	256
Fig. 15.11	Radiant limestone (<i>Strahlenkalk</i> , shatter cones) in the Steinheim Basin was formed during shock wave metamorphism as the asteroid impacted the White Jurassic limestone. Figure with the kind permission of the Steinheim meteor crater museum. [N 48°40'39"/E 10°04'07"]	256

Fig. 15.12	Fossil-rich limestone of the Miocene sedimentary filling of the Steinheim Basin with numerous snail shells from the Pharion sand quarry, near Steinheim am Albuch. [N 48°41'12"/E 10°28'35"]	257
Fig. 16.1	Maximum ice coverage of the northern hemisphere during the last Quaternary glaciation phase (light yellow) compared with the extent of today's ice (purple). Blue arrows indicate the assumed ice movement direction during glacial advance. The maximum ice extent was not attained at the same time in all locations: in the east of Eurasia, the maximum was reached about 90,000 years ago, but in the west, it was achieved only about 24,000–22,000 years ago. Modified after Ehlers and Gibbard (2007)	260
Fig. 16.2	Temperature changes and glaciation phases derived from the oxygen isotope ratios ($\delta^{18}\text{O}$) of fossils and from measurements on ice cores across different time periods. Compiled and modified from Veizer et al. (1999), Petit et al. (1999), Alley (2000), and Lisiecki and Raymo (2005)	261
Fig. 16.3	Cyclic changes of the Earth's orbital parameters and fluctuations in the intensity of solar radiation: eccentricity, obliquity, and precession. Modified after Zachos et al. (2001)	262
Fig. 16.4	Milanković cycles over the last 400,000 years compared to temperature variations obtained from the study of ice cores. Modified after Petit et al. (1999)	263
Fig. 16.5	Geological map of the Quaternary sedimentary cover of northern Germany showing the margins of the inland ice and the arrays of terminal moraines that was formed during the last three-glaciation phases. A strongly exaggerated N-S section across the Quaternary deposits through the eastern part of northern Germany shows the filling of deeply eroded valleys formed during the Elster glaciation phase. Map modified after BGR (1993) and the section modified after Eissmann and Litt (1994)	264
Fig. 16.6	Stratigraphic table showing glacial and interglacial periods since the Middle Pleistocene with a correlation of the nomenclature of Northern Germany with the Alpine region. H. Holocene. Modified after Cohen and Gibbard (2010), and Deutsche Stratigraphische Kommission (2016)	265
Fig. 16.7	Extent and assumed thickness (m) of the ice sheet of the last three glacial periods in Central Europe. The older margins of the ice sheet (Elster- and Saale-, resp., Riss- and Mindel-glacial periods) are shown as lines. The topography of the map shows the shape of Europe with a sea-level stand lowered by 100 m. The margin of the ice sheet is modified after van Husen (1987) and Walter (2007)	266
Fig. 16.8	Pleistocene trench systems formed during glacial periods and their depths in the subsurface of Northern Germany. Modified after Stackebrandt (2009)	267
Fig. 16.9	Scanning electron microscope images of diatoms: a <i>Biddulphia reticulata</i> , b <i>Eupodiscus radiatus</i> , c <i>Diploneis sp.</i> , d <i>Melosira varians</i> . Photographs from Mary Ann Tiffany, San Diego State University; in: Bradbury (2004)	268
Fig. 16.10	Ice coverage of the Münsterland Cretaceous Basin during the Saale glacial period. The ice margin of the Elster glacial period is marked by a line. Modified after Liedtke (2007), and Thome (1990)	269
Fig. 16.11	Origin of various index rocks in the glacial deposits of northern Germany. Modified after Fraedrich (1996)	271

Fig. 16.12	Overview of different sedimentary and erosive features of a glacial series. Modified from various sources	272
Fig. 16.13	The end moraine ridge of the Muskau Arch formed during the Elster glacial period. Modified after Kupetz et al. (2004), and the 1:1.000.000 geological map of Germany, BGR (1993).	274
Fig. 16.14	Glacial tectonics on the Jasmund peninsula, Rügen. (a) morphologically visible structures on Jasmund viewed in a digital elevation model, based on data obtained using a laser scanning method (by determination of the last echoes, for further explanation, see Sect. 16.2, dunes, loess), (b) stacked Cretaceous sheets (named by earlier workers as <i>Streifen</i> , stripes) in the glacially deformed complexes of Jasmund, here stripe XII to XVI; (c) model showing the evolution of the glaciotectonic complex; (d) detailed view of the thrust zone of stripe IV. The digital elevation model [a] was kindly made available by the Mecklenburg-Vorpommern office of internal administration: © GeoBasis-DE/M-V 2013, stripe numbering [b] according to Steinich (1972); [d] modified after Steinich (1972), Herrig (1995), and Niedermeyer et al. (2010).	275
Fig. 16.15	The esker of Rühlow, near Neubrandenburg (Mecklenburg-Vorpommern). Satellite data: Esri Digital Globe GeoEye, i-cubed, USDA, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS user). [N 53°33'50"/E 13°25'5"]	276
Fig. 16.16	Kettleholes formed by dead ice at a farmland west of Bergen, Rügen Island (view toward the north). [N 54°24'24"/E 13°23'12"]	277
Fig. 16.17	Glacial valleys formed during the Vistula glacial period between Brandenburg and Frankfurt/Odra. Modified after the 1:100.000 geological map of Germany, BGR (1993).	277
Fig. 16.18	The inland dune of Schmölen, near Dömitz, along the Elbe. It is the largest preserved inland dune formed at the edge of the Elbe glacial valley during the Vistula glacial period. [N 53°07'26"/E 11°18'14"].	278
Fig. 16.19	a Parabolic dunes from the Vistula glacial period, today covered by woodland north of Reichwalde, near Görlitz (satellite data: Esri Digital Globe GeoEye, i-cubed, USDA, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS user) [N 53°33'50"/E 13°25'05"]. b Digital elevation model of the parabolic based on elevation data obtained by laser scanning (determination of the last echo, for further explanation, see text; figure with kind permission by MILAN Geoservice GmbH/AG: Vattenfall)	279
Fig. 16.20	Development stages of the Baltic Sea after the last glaciation period. Modified after Björk (1995)	280
Fig. 16.21	Isostatic adjustment in Scandinavia. a It is assumed that the pressure per unit area (here given in kg/cm ²) is equal at a depth of 200 km along a hypothetical compensation plane in the asthenosphere. Caused by the mass of the ice, the lithosphere is pushed down until equilibrium is reestablished. The depth of downward motion does not correspond to the thickness of the ice, but to the weight equivalent of the asthenospheric material. By taking away the mass of the ice, the process is reversed. b The present rate of uplift and subsidence in Scandinavia and northeastern Central Europe. Modified after Harff and Meyer (2011)	281

List of Tables

Table 4.1	Half-life times (in years) of the most important radioactive isotopes used for geological age dating	22
Table 8.1	Comparison of the momentum magnitude and the Mercalli intensity scales for describing the intensity of earthquakes	43
Table 11.1	German coal classification	146
Table 13.1	German and English subdivisions used for the North Alpine Molasse	226

List of Boxes

Box 1	Granite	11
Box 2	Basalt	13
Box 3	Ammonites	19
Box 4	Radiometric age dating	20
Box 5	Ophiolites	30
Box 6	Earthquake magnitude scales	43
Box 7	Cuesta landscape	51
Box 8	Diabase and Schalstein	73
Box 9	Karstification in Germany	74
Box 10	Silicate weathering	77
Box 11	Ore deposits	92
Box 12	Playa sediments	125
Box 13	Agate	132
Box 14	Coal, oil, natural gas—the cornerstones of our modern industrial society . . .	146
Box 15	Kaolin	154
Box 16	Tides	162
Box 17	Euxinian Milieu	168
Box 18	Oolite	170
Box 19	Oceanic anoxic events	180
Box 20	Turbidites	200
Box 21	Isostatic adjustment and mountain uplift	202
Box 22	Slab breakoff	208
Box 23	Karstification	219
Box 24	Maars	236
Box 25	Fluctuations in Earth’s Orbital Parameters	262
Box 26	Kieselguhr—Diatomaceous Earth	268