

CHANGES TO THE THIRTEENTH EDITION

Chapter One

We expanded upon the Box on the Trans-Alaska Pipeline to describe how the pipeline survived displacement of fault motion during an earthquake of the same magnitude as the disastrous 2008 earthquake in China which killed over 87,000 people. We added a photo and website information to explain why the portion of the pipeline straddling the fault did not rupture thanks to specially designed bends in the pipeline riding along teflon shoes sliding along rails. In the box we point out that because of diminishing output of oil from Alaska's North Slope oil fields and increasing demands, Americans are importing more foreign oil than before the giant Alaskan oil fields were put into production in the 1970s. The chapter now includes information on accessing video clips of the disastrous 2004 tsunami that originated in Indonesia.

Chapter Two

We have rewritten the introduction so that it begins with the definition of a mineral which puts our discussion of crystallinity and chemical composition in the context of a clearly stated definition. We added a new section entitled "Rocks and Minerals" which more clearly defines the differences (and connections) between rocks, minerals and elements. Figure 2.1 has been changed to better illustrate the relationship between elements, rocks and minerals. The discussion of atomic structure, ionization, bonding and crystalline structures has been reorganized so that the reader can progress logically from the structure of an atom to ionization and the driving forces behind bonding and finally to the crystalline structures that result from bonding. Figure 2.15 has been replaced with a photomicrograph of a plagioclase crystal that has not been stained.

Chapter Three

The section on the varieties of granite has been removed to keep the discussion of different igneous rock types simple. The "How Magma Forms" section has been rewritten. It now discusses the conditions within the mantle under normal circumstances followed by descriptions of the circumstances that can lead to melting. New figures have been added to this section to accompany the new text.

Chapter Four

A new In Greater Depth box that discusses the Volcanic Explosivity Index has been added to this chapter.

Chapter Five

Chapter 5 includes new photos of differential weathering, rills, and splash erosion as well as a revised figure on frost wedging. A new figure more clearly illustrates the difference between residual and transported soils. We also emphasize the importance of soils as the life-supporting interface between spheres in Earth Systems.

Chapter Six

We have updated the box, "Sedimentary Rocks: The Key to Mars' Past" to include the important new discoveries by the Phoenix Mars Lander—such as the presence of frozen water in the soil under the landing site and the results of the first wet chemical analyses done on any planet other than Earth which revealed the presence of evaporites and carbonate. These results support the interpretation of water-deposited rocks on Mars and the possibility of extraterrestrial life. There is a new figure that illustrates the importance of sedimentary rocks and materials that are used in everyday living and the importance of commodities that are sedimentary in origin. The figure illustrating transgression and regression has been revised to more clearly show this important process. We have also integrated photos with the figure on sorting to more realistically show how a river can sort sediment. In addition, we have rewritten the sections on Earth Systems and turbidity currents to improve clarity for the introductory student. Websites at the end of the chapter were updated.

Chapter Eight

We describe recently achieved accuracy for isotopic dating. Because of the greater accuracy the dating of the Mesozoic-Cenozoic boundary has been tentatively changed from 65.5 to 66.0 million years ago and the Paleozoic-Mesozoic boundary from 251.0 to 252.5 m.y. These new dates place the boundaries closer to the times during which there were huge basalt floods and suggest a greater role for vulcanism in Earth's two greatest mass extinctions (which characterize the boundaries between the eras). As reported by scientists in 2008, the oldest rock found on Earth is now 4.28 billion years (the previous oldest rock dated is 4.03 b.y.). The origin of names for the periods have been added to the Geologic Time Scale. A link to a website that focuses on international cooperation among geochronologists has been added.

Chapter Nine

We clarified what a "landslide trigger" is and added a discussion of landslides triggered by China's May, 2008, earthquake. A new paragraph describes the dating of 740,000 year old ice in Canadian permafrost and the implications regarding ongoing global warming. Also, a new URL refers the reader to a website that discusses the effects of climate warming on permafrost. The discussion of Italy's Vaiont dam's disastrous landslide was placed in a box.

Chapter Ten

We have rearranged chapter 10 so that stream processes lead to the discussion of flooding; it was previously placed near the end of the chapter. This new edition includes the devastating floods that struck the Midwestern United States during May and June of 2008 and a comparison with the Great Flood of 1993. It also includes the devastation of Irrawaddy tidal delta and the tremendous loss of life caused by Hurricane Nargis, which was the Hurricane Katrina of Asia. The box on the controlled floods in the Grand Canyon has been updated to include the March 2008 experiment to rebuild sandbars and beaches along the Colorado River below the Glen Canyon Dam. The "Consequences of Controlling the Mississippi River and the Flooding of New Orleans after Hurricane Katrina" box has been updated to include the progress that has been made to protect New Orleans since Katrina; also, the near miss from Hurricane Gustav in September of 2008. We have also rewritten the box on "Stream Features on the Planet Mars" to include the exciting new discovery of a delta with distributary

channels in the Jezero Crater taken by the Compact Reconnaissance Imaging Spectrometer for Mars (CRISM) aboard the Mars Reconnaissance Orbiter. The CRISM also determined that the delta and the crater contain clay minerals and that the crater was probably once occupied by a lake slightly larger than California's Lake Tahoe. We have also updated websites at the end of and throughout the chapter.

Chapter Eleven

Chapter 11 includes minor rewrites of porosity and permeability and the movement of ground water sections to improve clarity for the introductory student. We have also included new photos of geysers and ground-water pollution, and updated the websites throughout and at the end of the chapter.

Chapter Twelve

Discussion of the role of glaciation relative to ongoing global warming was expanded. We note that continuing shrinking of glaciers is progressively reducing the amount of meltwater available for agriculture and other human needs. We added website links to the boxes on glaciers as a water resource and on lakes beneath the East Antarctic Ice Sheet. Since our last edition, many more lakes beneath the East Antarctic Ice Sheet have been discovered. The photo of an iceberg has been replaced by one of a grounded iceberg offshore from Palmer Station, Antarctica. In the background is the steep face of a glacier where iceberg calving takes place. For the box "Global Warming and Glaciers," we have replaced the photo of an ice core with two photos: one shows a core being removed from the barrel of an ice corer; the other is a one-meter section of ice core that shows pronounced layering inherited from the original layers of snow. The satellite image showing glacially scoured terrain in northern Canada was replaced with a better image.

Chapter Thirteen

We have updated the box on "Expanding Deserts" with new information on the desertification of the Aral Sea and attempts to restore the northern part of the sea. The box includes links to the United Nations website that provide dramatic before and after photos of the shrinking of the southern Aral Sea. We have also included a new diagram that more clearly illustrates how global air circulation affects the distribution of deserts, and we replaced photos illustrating deserts and sand dunes.

Chapter Fourteen

The box on "Coasts in Peril – The Effects of Rising Sea Level" has been updated with the latest estimates of past and future sea level rise; the box now introduces the process of barrier rollover. We have also updated the hurricane box to include the details of Hurricanes Gustav and Ike and showcase the devastation caused when the storm surge from Hurricane Ike struck Galveston and nearly completely demolished towns to the north on the Bolivar Peninsula. In addition, the process of wave refraction was rewritten to improve clarity for the introductory student. New photos of coastal processes have been added. Websites were updated throughout the chapter.

Chapter Fifteen

We rewrote the box on the San Andreas Fault to include the exciting research being done at the San Andreas Fault Observatory at Depth where geologists drilled into an active, plate boundary fault to test hypotheses about how earthquakes are generated and to evaluate the rolls of fluid pressure, rock friction, and chemical reactions in controlling fault strength. The box includes new diagrams and new websites where students can take a virtual field trip along the entire length of the fault and also view the rock cores brought up from the depth where earthquakes occur along the fault. To help students better visualize the different types of folds, we have expanded the definitions of anticline, syncline, dome, basin, and open fold; the definition of a tight fold has been added. Questions at the end of the chapter reflect these changes.

Chapter Sixteen

Chapter 16 has been updated to include the magnitude 7.9 earthquake that struck the Sichuan province in China on May 12, 2008. The tragic loss of life, particularly of children trapped as almost 7,000 schools collapsed, is discussed in the box on "Earthquake Engineering." The box on "How to Prepare for and Survive an Earthquake" has also been rewritten and illustrated based on the latest earthquake research and safety information. The "Waiting for the Big One in California" box has been revised and updated to include the 2007 Uniform California Rupture Forecast (UCERF) that estimates the chance of a magnitude 6.7 earthquake in California to be 99.7% over the next 30 years. The discussion of tsunamis now includes a website that describes tsunami warnings for the Pacific Ocean and anywhere else in the world. Of note is our discussion of the new tsunami warning system in the Indian Ocean that should be fully operational by 2010. Finally, the section on earthquakes in the United States has been updated to include the most recent earthquakes that have struck the east coast and the Midwest.

Chapter Seventeen

We updated information on the use of energy generated by tidal friction, ocean waves, and storms to gain an even more detailed image of the crust and upper mantle. We also introduce how seismic tomography studies indicate the mantle is more heterogeneous than previously thought, probably due to variations in temperature, composition, and density. The box on "Earth's Spinning Inner Core" incorporates new data from additional earthquake records that suggest the inner core is rotating even slower than the original model predicted, and may take 900 years for the inner core to gain a full lap on the rest of the planet because of 'clumps' in the high-velocity pathways in the inner core.

Chapter Nineteen

China's Sichuan earthquake of 2008 was added to the box on "Indentation Tectonics and 'Mushy' Plate Boundaries" to show how some earthquakes occur far from plate boundaries. We added new websites and revised several figures to help students better visualize plate tectonics.

Chapter Twenty

We describe the relationship of faulting in China associated with the disastrous earthquake of 2008 to the regional pattern of deformation (shown in figure 20.15) in and around the Himalaya and Tibetan Plateau. A new box

describes recent multi-disciplinary research into the growth of the Andes. Subduction of the oceanic plate under the continental South American Plate began around fifty million years ago. The resulting, still ongoing, orogeny resulted in slow growth during most of the past 50 million years. However, about ten million years ago the Andes began rising more rapidly, attributed to the foundering of dense lower crust and lithospheric mantle into the less dense underlying mantle. The figure showing exotic terranes traveling from the southern hemisphere and becoming part of Alaska was deleted from this edition.

Chapter Twenty-One

This chapter has been extensively reorganized and rewritten. All units are now SI units (with British units in parentheses). The discussion of reserves and resources has been moved to the beginning of the chapter and is now in a single section. The section on energy resources has been divided into non-renewable and renewable sources. The coal and petroleum sections have been shortened for the sake of clarity. The renewable energy resources discussion has been expanded to include more information on solar energy, wind power, hydropower, wave energy, and biofuels. New figures have been added for solar and wind power. The Some Important Metals section has been removed and the information has been summarized within a single table showing important metals, their ore minerals and common uses.

Chapter Twenty-Two

Minor updates were made to chapter 22. Information on the main asteroid belt and the trans-Neptunian region was added to the Solar System section. Discussion of recent research showing that diamonds may be “raining” on Uranus was added to the Uranus section. References back to the internal and external heat engines discussed in chapter one were made in appropriate places as book ends for the entire text.

Key Features

- Chapter Introductions—Each chapter begins with a “Purpose Statement,” and an explanation of how the chapter relates to the Earth systems and how the material relates to the concepts in other chapters.
- Environmental Geology Boxes—Discuss topics that relate the chapter material to environmental issues, including impact on humans (e.g., *Radon—A Radioactive Health Hazard*).
- In Greater Depth Boxes—Discuss phenomena that are not necessarily covered in a geology course (e.g., *Precious Gems*) or present material in greater depth (e.g., *Calculating the Age of a Rock*).
- Earth Systems Boxes—Highlight the interrelationships between the geosphere, the atmosphere, and other Earth systems (e.g., *Oxygen Isotopes and Climate Change*).
- Planetary Geology Boxes—Compare features elsewhere in the solar system to their Earthly counterparts (e.g., *Stream Features on the Planet Mars*).
- Animations—Key concepts are further enhanced by animations that are located on the website. These are identified in the text by the icon.



- Integration of the World Wide Web—The Internet has revolutionized the way we obtain knowledge, and this book makes full use of its potential to help students learn. We have URLs for appropriate websites throughout the book—within the main body of text, at the end of many boxes, and at the end of chapters. We have made the process student-friendly by having all websites that we mention in the book posted as links in this book’s website. (We also include all URLs in the textbook for those who wish to go directly to a site.)
- Internet Exercises—These are located on the text’s website and allow students to investigate appropriate sites as well as raise interest for further, independent exploration on a topic. The website also includes additional readings and video resources. By placing these on the website, we can update them after the book has been published. We expect to add more sites and exercises to our website as we discover new ones after the book has gone to press. In addition, it features online quizzes, flashcards, animations, and other interactive items to help a student succeed in a geology course.
- Study Aids are found at the end of each chapter and include:
 - *Summaries* bring together and summarize the major concepts of the chapter.
 - *Terms to Remember* include all the boldfaced terms covered in the chapter so that students can verify their understanding of the concepts behind each term
 - *Testing Your Knowledge Quizzes* allow students to gauge their understanding of the chapter (The answers to the multiple choice portions are posted on the website.)
 - *Expanding Your Knowledge Questions* stimulate a student’s critical thinking by asking questions with answers that are not found in the textbook.
 - *Exploring Web Resources* describe some of the best sites on the web that relate to the chapter.

Supplements

Dedicated to providing high-quality and effective supplements for instructors and students, the following supplements were developed for *Physical Geology*.

For Instructors

The screenshot shows the McGraw-Hill Connect website. At the top left, there is a sign-in form with fields for Email and Password, and a 'Sign In' button. Below the form are links for 'New User?' and 'Forgot your password?'. To the right of the sign-in form, the text reads 'Powerfully simple to use' and 'Introducing Connect from McGraw-Hill. Making coursework simple and learning easy.' Below this text are links for 'About Connect' and 'Customer Support'. The main content area features three boxes: 'Get Valuable Classroom Time Back' with a clock icon and the text 'Spend less time grading assignments and more time teaching.'; 'Interactive Content' with a tablet icon and the text 'Engaging interactive content connects students directly with the learning objective.'; and 'Automatic Grading' with a document icon and the text 'Instructors can allow students to get automatic feedback, or view their grades later.' At the bottom of the page, there is a copyright notice: '© 2009 The McGraw-Hill Companies. All rights reserved. Customer Support | Troubleshooting | Terms of Use | Privacy Notice'.