

This International Student Edition is for use outside of the U.S.

exploring Earth Science

THIRD EDITION

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Stephen J. Reynolds

Julia K. Johnson

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About the Cover

The cover photograph by well-known photographer Michael Collier features the North Cascade Mountains and in the distance Mount Baker, all in northwestern Washington. You could spend a lifetime learning all of the earth science stories packed within this photograph. In the image, nearby slopes of the North Cascade Mountains are greening up, but snow does linger into summer atop these rugged peaks. Ninety-five feet of snow fell here during the winter of 1998–99, a record amount for a single season in the United States. Snow that doesn't melt can compress into ice to form the glaciers that peek around the corners of glacially carved mountainside depressions called cirques. Eighty inches of rain arrives here most years, so the jagged crests are constantly being chiseled by erosion.

Mount Baker looms on the horizon. It is an active stratovolcano that last erupted in 1880; it ominously belched sulfurous gases as recently as 1975. Two hundred lava flows have spilled down Mount Baker's flanks in the last 40,000 years, building the mountain to a height of 10,781 feet above sea level. A string of similar volcanoes adorns the west coasts of British Columbia, Washington, Oregon, and northern California. The magma that constructed Mount Baker was generated from melting in the mantle above the small Juan de Fuca tectonic plate that dives beneath the western edge of North America in what is called the Cascadia subduction zone.

This corner of the North Cascades consists of a wide variety of metamorphic and sedimentary rocks — already as much as three hundred million years old when they were plastered onto the western edge of North America during a series of tectonic collisions about a hundred million years ago. This time of collision and associated compression gave way to a period of extension fifty million years ago when deep rocks were uplifted to the surface, erosion prevailed, and valleys filled with the debris eroded from the mountains. As tectonic movement continued, the terrane was torn into fragments along a web of faults that persist to this day. Seaward of this part of the North Cascades, huge earthquakes occur about every three hundred years along the Cascadia subduction zone. The last one occurred in the year 1700. You do the math.

Michael Collier received his B.S. in geology at Northern Arizona University, M.S. in structural geology at Stanford, and M.D. from the University of Arizona. He rowed boats commercially in the Grand Canyon in the 1970s and '80s, then practiced family medicine in northern Arizona. Collier published books about the geology of Grand Canyon, Death Valley, Denali, and Capitol Reef national parks. He has done books featuring the Colorado River basin, glaciers of Alaska, climate change in Alaska, and a three-book series on American mountains, rivers, and coastlines as viewed from the air. As a special projects writer with the USGS, he produced books about the San Andreas fault, the downstream effects of dams, and climate change. Collier's photography has been recognized with awards from the USGS, National Park Service, American Geosciences Institute, and National Science Teachers Association.

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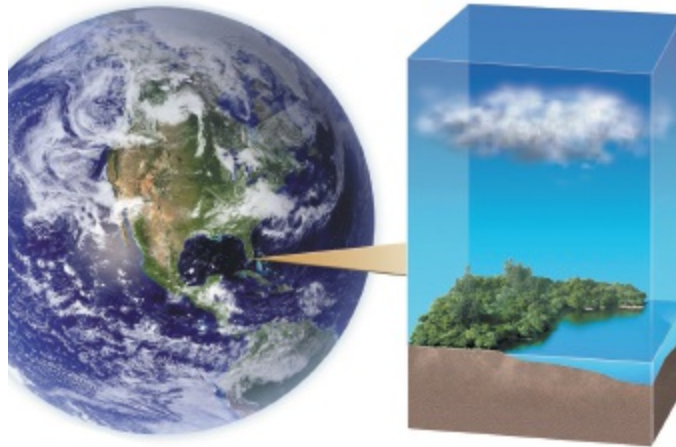
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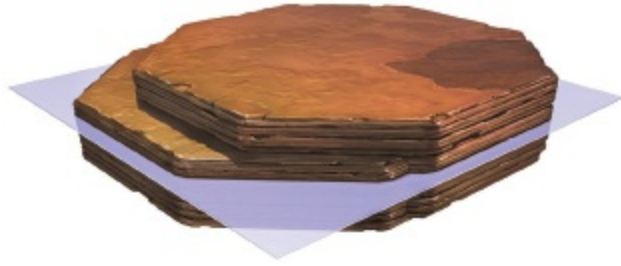
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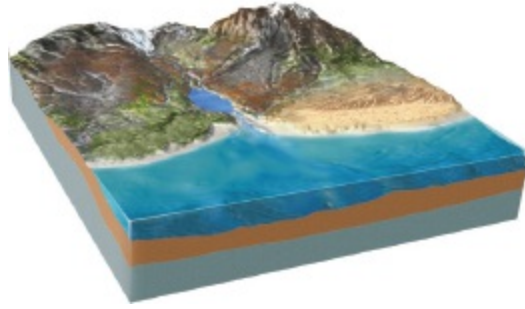
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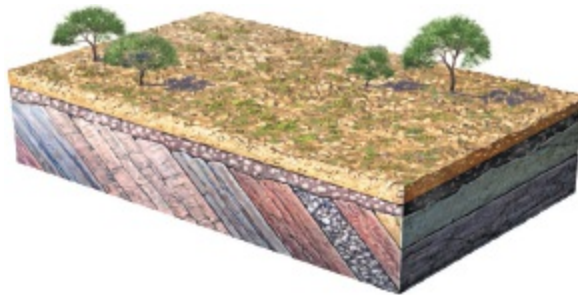
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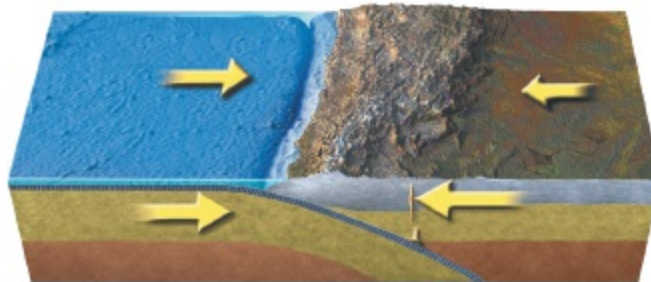
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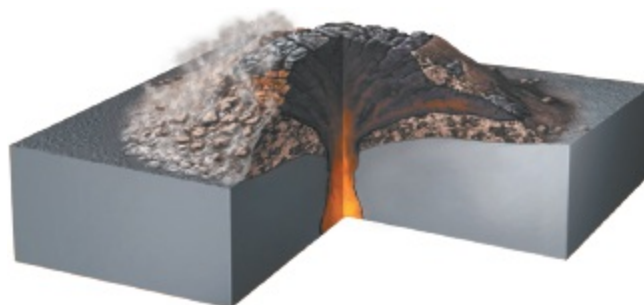
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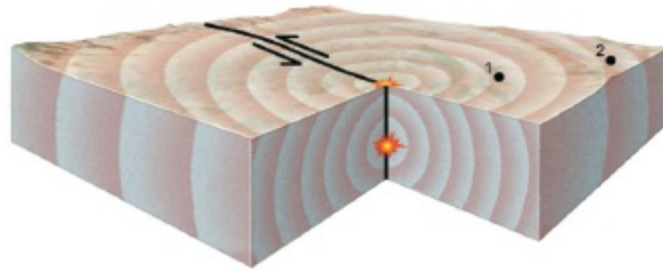


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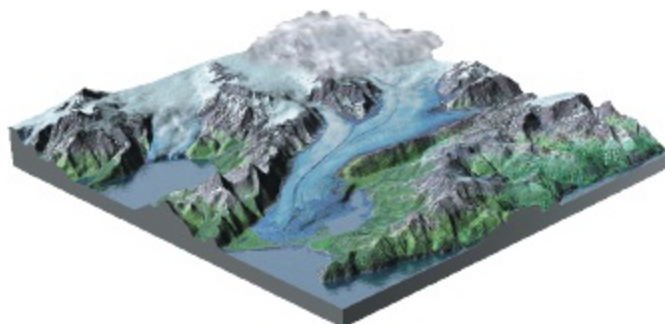
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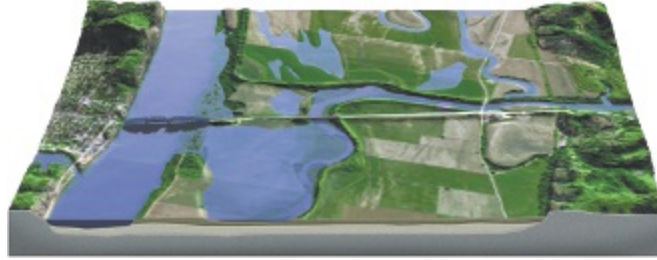
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