Grand Teton

National Park Service
U.S. Department of the Interior

Grand Teton National Park
John D. Rockefeller, Jr.
Memorial Parkway

Journey Through the Past: A Geologic Tour

The Big Picture

When visitors catch their first glimpse of the Teton Range, the jagged skyline sparks wonder. What natural forces shaped this magnificent landscape? Some of these forces began and ended long ago, but some of these forces are still changing the landscape today.

The rocks found in the core of the mountains are some of the oldest in North America; whereas, the forces that lifted the Teton Range and formed the Jackson Hole valley began very recently in geologic time. Our journey through the past explores these stories of the Teton Range.

The Rocks

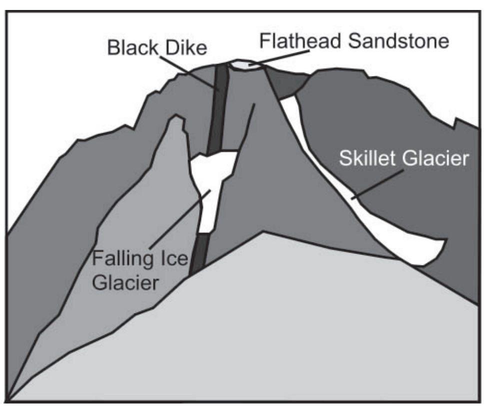

Figure 1. Mount Moran is composed of metamorphic gneiss, igneous granite and diabase, and sedimentary sandstone. The summit is flanked by five glaciers.

The geologic story of the Teton Range began more than 2.7 billion years ago. Sand, mud and volcanic sediment sank into an ancient sea. The collision of tectonic plates, moving sections of the Earth's crust, buried these sediments up to 20 miles deep. Heat and pressure changed these sediments into a metamorphic rock called gneiss. In this rock, light and dark minerals separated into layers as seen along the trail to **Inspiration Point**, or sometimes into "eyes" as seen in **Death Canyon**.

Around 2.5 billion years ago, molten rock called magma squeezed into weak zones or cracks in the gneiss. Crystals grew as the magma slowly cooled to form an igneous rock called granite. These bodies of granite are inches to hundreds of feet thick slicing through the gneiss. Granite appears speckled in contrast to the layers seen in gneiss. Granite is harder than gneiss and forms the jagged summits of the Cathedral Group such as the **Grand Teton**.

Roughly 775 million years ago, iron-rich magma similar to basalt squeezed into vertical cracks in the granite and gneiss and cooled to form dikes. These igneous dikes are made of a rock called diabase. The "Black Dike" on **Mount Moran** is roughly 150 feet wide, sticks out from the face of the mountain 200 feet and continues west for six or seven miles before being buried under younger sedimentary rocks. This dike sticks out from the face of **Mount Moran** because diabase is harder than gneiss. (Figure 1)

The dike on the face of the **Middle Teton**, however, forms a slot because granite is harder than diabase.

Inland seas flooded the region about 510 million years ago, depositing sand, mud, and forming coral reefs during the next 400 million years. With burial, these sediments compressed into layered sedimentary rocks such as sandstone, shale, limestone and dolomite. These rocks flank the Teton Range to the south, west, and north and outcrop on **Blacktail Butte**. (Figure 2)

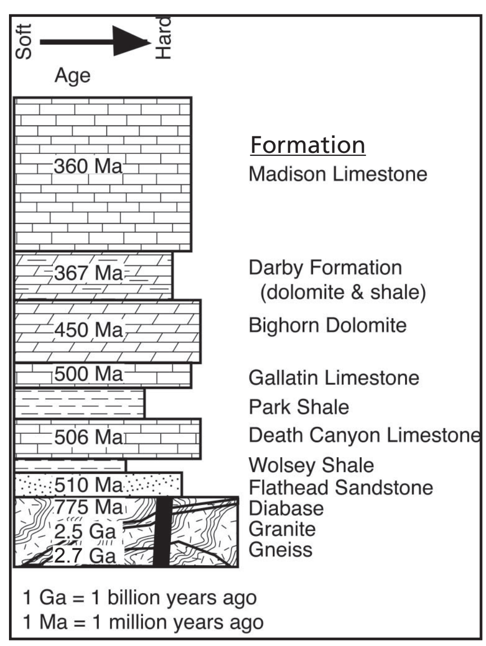

Figure 2. Stratigraphic column shows the age, relative thickness and hardness of rocks found in the core of the Teton Range.

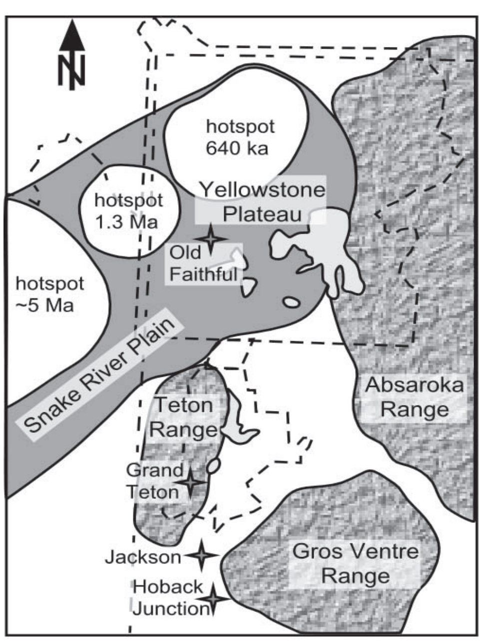

Figure 3. Regional map tracing the path of the magma hotspot that lies under Yellowstone National Park today.

Mountain Building

Starting 120 million years ago, a tectonic plate under the Pacific Ocean collided into the west coast of North America. This collision built mountains by crumpling the Earth's surface from the west coast progressing eastward. Mountain building reached the Rocky Mountains and Gros Ventre Range around 70 million years ago by thrusting large blocks of bedrock skyward. (Figure 3)

As the Rocky Mountain uplift ended, lava erupted from volcanoes across the region. Layers of lava and volcanic debris deposited to form the **Absaroka Range**. Lingering heat from this molten rock left the Earth's crust hot and bulged up like a hot-air balloon. In places, the crust stretched past the breaking point. Huge blocks of the Earth's crust broke and slipped past each other along faults such as the Teton fault.

Teton Fault

Movement on the Teton fault accounts for the dramatic uplift of the Teton Range. Starting 10 million years ago, a series of massive earthquakes triggered by movement on the Teton fault tilted the mountain block skyward and dropped the valley block. Each of these earthquakes, up to magnitude 7.5, broke or offset the Earth's surface by up to ten feet.

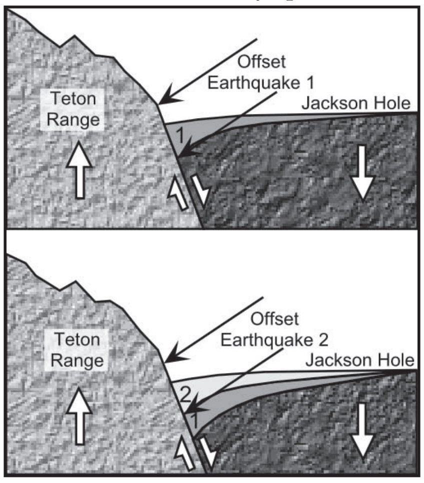

Figure 4. Each major earthquake breaks the Earth's crust forming a vertical face of raw dirt and rock called a scarp.

Today, the total offset on the Teton fault approaches 30,000 feet. The **Flathead Sandstone** caps **Mount Moran** 6,000 feet above the valley floor. This same sandstone layer lies buried more than 20,000 feet beneath the valley floor.

The best view of the **Teton fault** is from the **Cathedral Group Turnout** along the Jenny Lake Scenic Loop. From this vantage point, the fault "scarp" or break in the Earth's crust represents up to a dozen earthquakes since the end of the Pleistocene Ice Age. (Figure 4 ; Figure 5)

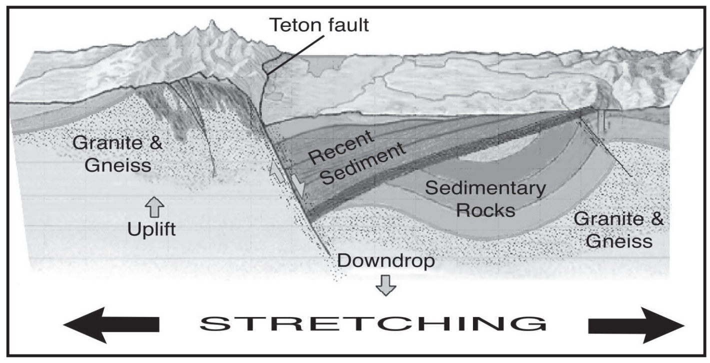

Figure 5. Regional stretching has generated thousands of earthquakes over the past ten million years; tilting the mountains skyward and hinging the valley down.

Every day seismic instruments record earthquakes up to magnitude 5 in the Teton – Yellowstone region. Few if any of these earthquakes occur on the Teton fault. Geoscientists discovered that the last two major earthquakes were around 4,800 and 8,000 years ago. Each of these earthquakes offset the Earth's surface by 4 – 10 feet. Someday another major earthquake will shake the ground, break the Earth's surface, and lift the mountains skyward once more.

The Teton/Yellowstone Connection

Today a plume of magma or "hotspot" lies beneath the **Yellowstone Plateau** (Figure 3). The magma heats the overlying rock and water to generate spectacular hot springs and geysers found in Yellowstone National Park. Five million years ago, the hotspot erupted west of the Teton Range sending clouds of volcanic ash into Jackson Hole. This heat caused the area to stretch more rapidly triggering earthquakes on the Teton fault and continuing to uplift the Teton Range.

Between two million and 640 thousand years ago, the Yellowstone hotspot exploded three times. These eruptions destroyed mountain ranges and sent fiery clouds of gaseous lava south along both sides of the Teton Range. Deposits from these eruptions cap **Signal Mountain** and the north end of the Teton Range.

Glaciation

Ice, water and wind sculpted the stunning Teton Range. The Pleistocene Ice Age began 2 million years ago as the Earth's climate cooled. Snow accumulated across the high **Yellowstone Plateau** and compressed into ice. Gravity caused the large ice sheet, up to 3,500 feet thick, to flow down from the high plateau. As the climate warmed, glaciers melted and retreated and the cycle repeated.

Today's landscape preserves evidence of the last two glacial advances. The most recent glacial advance, called the Pinedale, lasted from about 50,000 to 14,000 years ago. This ice sheet wrapped around **Signal Mountain** and dug out **Jackson Lake**. The older glacial advance, called the Bull Lake, buried the town of **Jackson** under 1,500 feet of ice and pushed south toward **Hoback Junction**.

While ice sheets flowed from the north, alpine glaciers flowed eastward from the high peaks. Glaciers slid on a film of meltwater picking up rocky debris in their bases. Debris acted as a belt-sander to polish and groove the bedrock. Glaciers also broadened V-shaped stream drainages into U-shaped valleys as seen in **Cascade Canyon**. When the glaciers reached the valley floor, they bulldozed out depressions and left behind ridges of rocky debris called moraines. Terminal moraines mark the furthest extent of a glacier's flow and form natural dams for valley lakes such as **Phelps, Taggart, Bradley, Jenny, Leigh and Jackson**. (Figure 6)

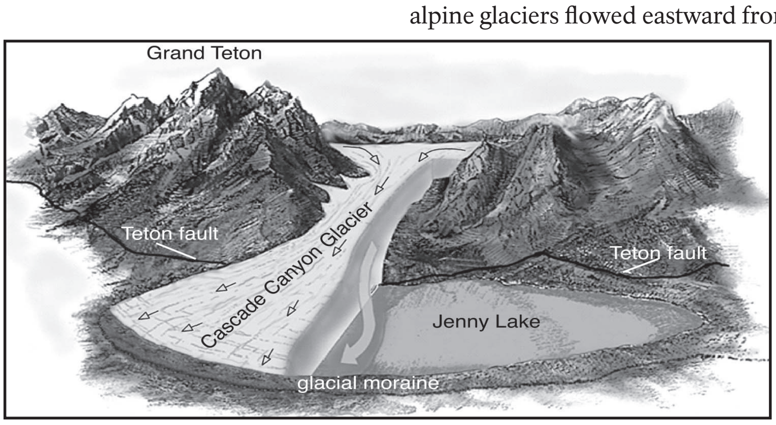

Figure 6. A glacier flowed out of Cascade Canyon gouging out a depression and depositing a terminal moraine forming Jenny Lake today.

Today the Teton Range hosts a number of small glaciers. These glaciers are not remnants of the Pleistocene Ice Age but formed during a cool period called the Little Ice Age, 1400 to 1850. Today, **Skillet** and **Falling Ice glaciers** continue to carve **Mount Moran**, and the **Teton Glacier** flows down the north flank of the **Grand Teton**. Even as these glaciers flow down due to gravity, warming temperatures cause them to shrink and retreat. During the past 40 years, these glaciers have retreated 20 to 25 perscent.

Today's Landscape

Ice age glaciers melted and flooded Jackson Hole. The meltwater carved channels across the valley floor, washed away soil, and deposited glacial outwash plains of sand, gravel, and cobbles. As time passed, the **Snake River** cut through these plains leaving behind benches or terraces that step down to today's channel. On the outwash plains, sagebrush, arrowleaf balsamroot and scarlet gilia have adapted to thrive in this sandy dry soil. Silt in glacial moraines holds rainwater to support lodgepole pine forests. Today, these forests cover moraines such as **Timbered Island, Burned Ridge**, and around **Jenny Lake**. Geology influences the vegetation and in turn, the wildlife found here.

As you enjoy the scenic beauty of the Teton Range and Jackson Hole, remember that geologic forces are still at work. Mountains continue to rise, while wind, water and ice erode the mountains as part of a never-ending story.

Park law prohibits collecting. Please leave rocks where you find them so that others may enjoy this geologic story.