Journey Through the Past:
A Geologic Tour

The Big Picture

The jagged Teton Range dominates the skyline of Grand Teton National Park. Ancient and on-going geologic forces created this stunning landscape. The rocks found in the core of the mountains are some of the oldest in North America, but the Teton Range is one of the youngest in the world. Up to a dozen mountain ranges may have come before today's Teton Range.

More recently, inland seas covered this area for hundreds of millions of years. Even the magma beneath Yellowstone National Park plays a role. Ice Age glaciers sculpted the peaks, and erosion continues today. Our journey through the past explores these stories of the Teton Range.

Rock Formation

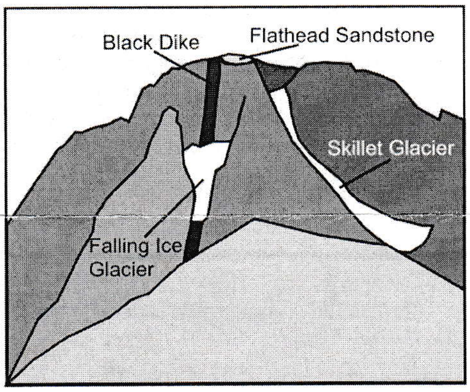


Figure 1: Mount Moran

The geologic history of the Teton Range began more than 2.7 billion years ago. Sand and volcanic sediment fell into an ancient sea. The collision of sections of the Earth's crust called "tectonic plates" 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 or magma squeezed into weak zones and cracks in the gneiss. The magma slowly cooled to form crystals found in an igneous rock called granite. These bodies of rock are inches to hundreds of feet thick. 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, magma squirted into vertical cracks in the granite and gneiss to form bands of rock called dikes. The igneous rock forming these dikes is dark-colored diabase. The "Black Dike" on **Mount Moran** is roughly 150 feet wide and continues west for six or seven miles. This dike sticks out from the face of **Mount Moran** because diabase is harder than gneiss.

The dike on the face of the **Middle Teton**, however, forms a slot because granite is harder than diabase. (Figure 1)

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

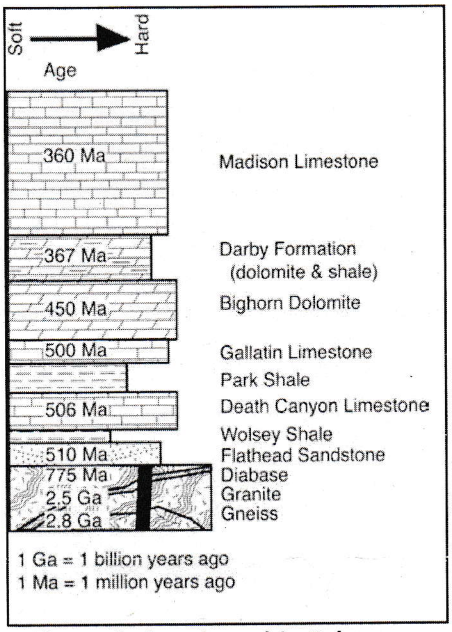
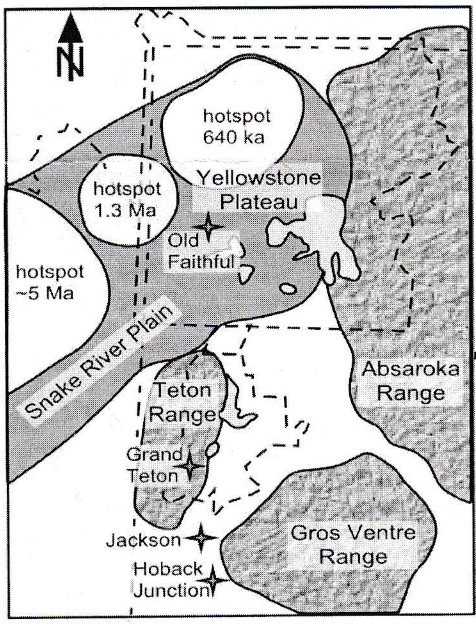


Figure 2: Stratigraphic Column



1 Ma = 1 million years ago
1 ka = 1 thousand years ago

Figure 3: Regional Map

Mountain Building

Starting 120 million years ago, two tectonic plates collided along the west coast of North America. This collision built mountains by crumpling the Earth's surface. Around 70 million years ago, mountain building shifted eastward. During this time, large blocks of gneiss and granite pushed skyward to form the Rocky Mountains and the **Gros Ventre Range**. (Figure 3)

As the building of the Rocky Mountains 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 bedrock broke and slipped past each other along faults such as the Teton fault.

Teton Fault

The Teton fault accounts for the dramatic Teton Range. Starting 10 to 13 million years ago, a series of massive earthquakes triggered by movement on the fault caused the mountain block to tilt skyward and the valley block to drop. Each of these earthquakes, up to magnitude 7.5, breaks or offsets the Earth's surface by 5 – 10 feet. Today, the total offset on the Teton fault may approach 30,000 feet.

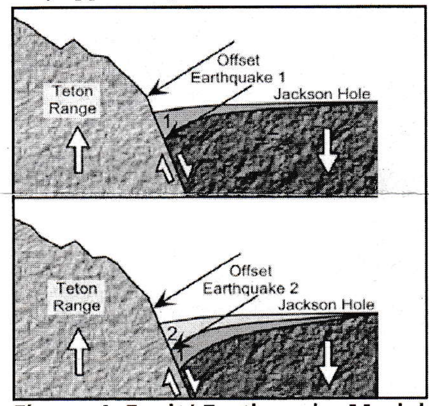


Figure 4: Fault/ Earthquake Model

The **Flathead Sandstone** caps **Mount Moran** about 6,000 feet above the valley floor. This same sandstone layer lies buried about 20,000 feet or more 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 surface represents up to a dozen earthquakes since the end of the Ice Age. (Figure 4 ; Figure 5)

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 earthquake will cause the ground to shake, the Earth's surface to break, and the mountains to lift skyward once more.

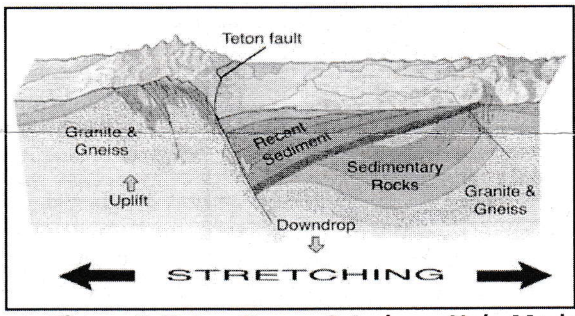


Figure 5: Teton Range & Jackson Hole Model

The Teton/Yellowstone Connection

Today a plume of magma or "hotspot" lies beneath the **Yellowstone plateau**. The hotspot heats the overlying rock to generate the spectacular hot springs and geysers found in Yellowstone National Park. Around 5 million years ago, the hotspot erupted west of the Teton Range sending clouds of volcanic ash into Jackson Hole. Heat from the hotspot caused the area to stretch more rapidly that triggered a large number of earthquakes on the Teton fault and increased uplift of the Teton Range.

Between 2 million and 640 thousand years ago, the Yellowstone hotspot erupted three times. These eruptions destroyed entire mountain ranges and sent fiery clouds of gaseous lava southward along both sides of the Teton Range. Remnants of these eruptions cap **Signal Mountain** and the north end of the Teton Range.

Glaciation

Ice sculpting carved the stunning Teton Range. The Ice Age began almost 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 away from the high plateau. At the same time, alpine glaciers flowed toward the valley floor. As the climate warmed, glaciers melted and retreated and the cycle repeated again.

Today's landscape preserves signs of the last two glacial advances. The most recent glacial advance, the Pinedale age, lasted from about 50,000 to 14,000 years ago. This ice sheet reached **Signal Mountain** and **Jackson Lake.** The older glacial advance, the Bull Lake age, buried the town of **Jackson** under almost 2,000 feet of ice and pushed south toward **Hoback Junction.**

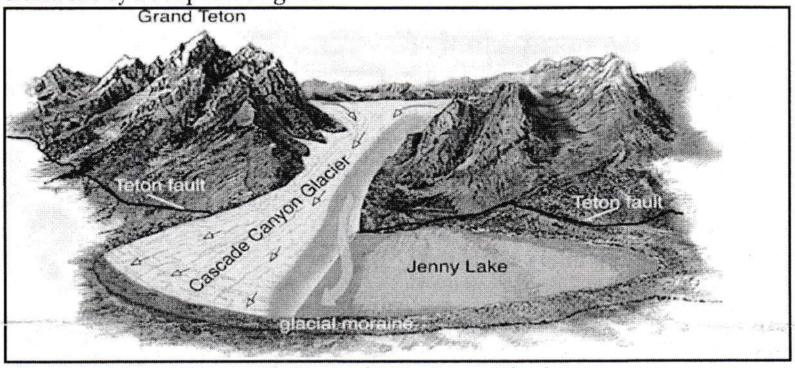


Figure 6: Cascade Canyon Glacier

While ice sheets flowed from the north, alpine glaciers flowed eastward from the high peaks. These glaciers slid on a thin layer of melt-water and picked up rocky debris in their bases. This 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 the glacier's flow and form natural dams for valley lakes such as **Phelps, Taggart, Bradley, Jenny, Leigh, and Jackson.** (Figure 6)

Today the Teton Range hosts a dozen small glaciers. These glaciers are not remnants of the Ice Age but formed during a cool period called the Little Ice Age that lasted from 1400 to 1850 AD. Today, **Skillet** and **Falling Ice Glaciers** continue to carve **Mount Moran,** and **Teton Glacier** flows down the **Grand Teton.** Even as gravity causes these glaciers to flow, melting causes them to shrink and retreat.

Today's Landscape

Ice Age glaciers melted and flooded Jackson Hole. The melt water 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, arrow-leaf balsamroot, and scarlet gilia have adapted to thrive in this sandy dry soil. Silt in glacial moraines holds rainwater to support conifer forests. Today, these forests cover moraines such as **Timbered Island, Burned Ridge,** and around **Jenny Lake.**

Thus, 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 wear the mountains down as part of a never-ending story.

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