EARTHQUAKES IN WYOMING

Wyoming State Geological Survey
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by
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Introduction

Earthquakes are common in Wyoming. Historically, earthquakes have occurred in every county in Wyoming over the past 120 years, with some causing significant damage. Figure 1 shows the generalized distribution of historical earthquakes in Wyoming.

The first recorded earthquake in the state occurred in the area now known as Yellowstone National Park on July 20, 1871. During the early geologic investigations of Yellowstone, Ferdinand V. Hayden of the U.S. Geological Survey reported that "on the night of the 20th of July we experienced several severe shocks of an earthquake, and those were felt by two other parties, fifteen or twenty-five miles distant, on different sides of the lake." Yellowstone National Park is now known as one of the more seismically active areas in the United States.

Causes of Earthquakes

Earthquakes in Wyoming occur because of movements on existing or newly created faults, movements of the magma chamber beneath Yellowstone National Park, and from man-made processes such as blasting at mines, mine collapses, or explosions. Most historical earthquakes have occurred as a result of movements on faults not exposed at the surface. These deeply buried faults, which are not expected to generate earthquakes with magnitudes greater than 6.5, have not been studied in detail. A series of faults exposed at the surface in Wyoming, however, have activated and generated earthquakes from hundreds to thousands of years ago. Future earthquakes with magnitudes from 6.75 to 7.5 are expected to occur along those exposed faults. Known active faults, which are present in western and central Wyoming, are shown in red on Figure 2. The suspected active faults shown in green are those for which activity has not been confirmed due to Quaternary (within the last 65 million years).

Earthquakes can originate at various depths, usually depending on the depth and orientation of faults. The initial zone of rupture on a fault that results in the generation of seismic waves is called the earthquake hypocenter or focus. The point on the ground surface directly above the hypocenter is the epicenter. Earthquakes are associated with faults that rupture near the surface as well as those that are many miles deep.

Earthquake Measurements

There are many ways to describe the size and strength of an earthquake and its associated ground shaking. The most familiar classifications are the Richter Magnitude Scale, developed in 1935, and the Modified Mercalli Intensity Scale, developed in 1931.

Magnitude is an instrumentally determined measure of the size of an earthquake and the total energy released. Each one step increase in magnitude equals to a 32 times increase in associated seismic energy. In other

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Cover photograph: "Crescent Beach on Yellowstone Lake," from a stereographic negative by Joshua Crismann of Bozeman, Montana, originally published by W.I. Marshall of Pittsfield, Massachusetts as stereopti 855. Stereo photographs taken by Crismann are the first publicly available images of Yellowstone. Crismann photographs were taken during the Hayden survey of the Yellowstone area. This photograph was taken between July 15 and August 8, 1871, probably within days of the first reported earthquake in Wyoming (Territory). Photograph from the personal collection of Lance Cook.

Publications of interest:

How to make your Wyoming home more earthquake resistant – Wyoming State Geological Survey Information Pamphlet 5.


Words in italics indicate a new, more modern standard.

Modified Mercalli Intensity Scale

<table>
<thead>
<tr>
<th>Intensity</th>
<th>Description</th>
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<tbody>
<tr>
<td>1</td>
<td>Not felt except by very few.</td>
</tr>
<tr>
<td>2</td>
<td>Felt only by a few persons at rest.</td>
</tr>
<tr>
<td>3</td>
<td>Felt noticeably indoors. Vibration like passing of truck.</td>
</tr>
<tr>
<td>4</td>
<td>Felt indoors by many. Sensation like heavy truck striking building.</td>
</tr>
<tr>
<td>5</td>
<td>Felt by nearly everyone. Some dishes and windows broken. Cracked plaster in a few places. Pendulum clocks stop.</td>
</tr>
<tr>
<td>6</td>
<td>Felt by all, many frightened and run outdoors. A few instances of fallen plaster and damaged chimneys.</td>
</tr>
<tr>
<td>7</td>
<td>Everybody runs outdoors. Damage negligible in well-designed and well-built structures, slight to moderate damage in poorly built ordinary structures, considerable damage in poorly built structures.</td>
</tr>
<tr>
<td>8</td>
<td>Damage slight in specially designed structures, considerable in ordinary buildings with partial collapse, great in poorly built structures.</td>
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Scales are in multiples of 2.5. On maps, the intensity range is 0 to 12 units.
June 12, 1930. An estimated magnitude 5.8, intensity VI event occurred near Grover in the Star Valley of western Wyoming. A brick building in a mining camp was damaged, and numerous plaster walls in homes were cracked. Numerous aftershocks occurred.

March 26, 1932. An intensity VI event in the Jackson area broke plaster on walls and cracked the foundations in several local homes and businesses. There were a number of aftershocks.

August 17, 1959. A magnitude 7.5, intensity X event occurred just outside of Yellowstone National Park, near Hobgen Lake in Montana. The event triggered a landslide that dammed the Madison River, eventually creating Earthquake Lake. Twenty-eight people lost their lives, most of them were buried in the campground located directly beneath the landslide. Numerous aftershocks, with some as large as magnitude 6.5, occurred within or near Yellowstone National Park.

June 30, 1975. A magnitude 6.4, intensity VII event occurred in the central part of Yellowstone National Park. Landslides closed 12 miles of road between Norris Junction and Madison Junction. Collapses in the ground to 4 feet deep, and 15 to 20 feet long were found in the Virginia Cascades area.


November 3, 1984. A magnitude 5.1, intensity VI event occurred 10 miles northwest of Atlantic City. The earthquake cracked foundations, walls, and windows in Lander and Atlantic City. It was felt also in Casper and Dubois.

February 3, 1994. A magnitude 5.9, intensity VII event occurred at Draney Peak, Idaho, near Wyoming's Aubum Fish Hatchery in the Star Valley. The earthquake damaged the fish hatchery and a home near Aubum had cracks in the foundation and ceiling. It was felt in Rock Springs, Salt Lake City, Utah, and Grand Junction, Colorado. There were hundreds of aftershocks, with the largest being a magnitude 5.3, intensity VI event on February 11, 1994.

February 3, 1995. A magnitude 5.3, intensity V event occurred near Little America. The earthquake was associated with the collapse of a 3000-foot-wide by 7000-foot-long portion of a trona mine. One miner lost his life as a result of the collapse. Although the earthquake was felt as far away as Rock Springs and Salt Lake City, only minor damage was reported to buildings in Green River and Little America.

It is important to remember that earthquakes occurring outside the boundaries of Wyoming can also cause damage within the state. Examples include the Hobgen Lake, Montana event in 1959, and the Draney Peak, Idaho event in 1984.

Wyoming's Earthquake Potential

In general, earthquakes do not result in ground surface rupture unless the magnitude of the event is greater than magnitude 6.5. Because of this, areas of the state that do not have active faults exposed at the surface are thought to be capable of having earthquakes with magnitudes up to 6.5. The historical record in and around Wyoming supports the fact that earthquakes that large can occur. Most of Wyoming, therefore, can have a magnitude 6.5 earthquake, which can cause significant damage. Even though such events occur infrequently, residents should be prepared for such an event.

The earthquake potential is quite different in areas where active faults are exposed at the surface. A series of faults in western Wyoming (Figure 2.) are capable of magnitude 7.2 to 7.5, intensity X earthquakes. These include the Teton fault, at the base of the Teton Range; the Star Valley Fault, bounding the east side of the Star Valley; the Gros Ventre fault in northeastern Lincoln County; the Rock Creek Fault in southwestern Lincoln County, and the Bear River fault system, southeast of Evanston. Based upon recent studies, many of these fault systems are thought to be overdue for activation. It is not known, however, when any of these systems may activate.

There are a number of active faults exposed in Yellowstone National Park (Figure 2.) Many of these faults are related to volcanic eruptions, volcanic explosions, and caldera-forming collapses that helped to form the present day Park. Much of the present and future earthquake activity in the Park is still related to the underlying magma chamber, although large earthquakes related to other regional factors are possible. Based upon recent studies and the seismic history of the Park, earthquakes in the magnitude 6.5 to 7.5 range are possible, and should be expected in the future.

What to Do During an Earthquake

If you are outside, do the following:

- Stay outside.
- Stay away from buildings, chimneys, fences, trees, and power lines.
- If you are in a car, stay in it. Pull over and stop, away from high structures, power lines, overpasses, and trees.

If you are inside, do the following:

- Stay inside, unless conditions warrant otherwise.
- Duck, cover, and hold. Duck under a sturdy table or desk, sit with your back against a strong inside wall, or stand under a doorway.
- Stay away from windows and glass doors.
- Stay away from heavy standing objects such as bookcases.

Figure 2. Known and suspected active faults in Wyoming


X Some well-built wooden structures and most masonry and frame structures destroyed. Ground badly cracked. Rails bent. Landslides.

XI Few structures remain standing. Bridges destroyed. Broad fissures in ground.

XII Damage total.

Top Ten Earthquakes in Wyoming

There have been a number of earthquakes that have caused damage or concern among Wyoming residents. The top ten earthquakes that have occurred in or near Wyoming are described below in chronological order. The list is rather subjective, and does not include some earthquakes that have caused damage. Detailed information on all Wyoming earthquakes can be obtained from the Wyoming State Geologic Survey.

November 7, 1882. A magnitude 6.2 to 6.5, intensity VII event occurred between Laramie and Estes Park, Colorado. It was felt throughout the southern half of Wyoming, in northeastern Utah, and over most of Colorado. Plaster was cracked in Laramie.

November 14, 1887. An intensity VI to VII event occurred near Casper and was one of the largest events recorded in central and eastern Wyoming. The Grand Central Hotel in Casper was considerably damaged by the earthquake.

Figure 3. The spectacular eastern front of the Teton Ranges rises abruptly from the floor of Jackson Hole. The Teton Range formed as a result of movement on an active fault, the Teton fault, which is present at the base of the Range in this picture. View southeast from Snake River Overlook. Photograph by WRN, June, 1979.