*Additional information on earthquakes, earthquake preparedness, and earthquake response can be obtained from:*


*Wyoming State Geological Survey*
*P.O. Box 3008*
*Laramie, WY 82071-3008*
*Phone: (307) 766-2286*
*Fax: (307) 766-2605*
*Email: wsgs@wsgs.uwyo.edu*
*jcase@wsgs.uwyo.edu*
*Agency Web: http://wsgsweb.uwyo.edu*
*Earthquake Web: http://www.wrds.uwyo.edu*

*Wyoming Emergency Management Agency*
*5500 Bishop Blvd.*
*Cheyenne, WY 82009-3320*
*Phone: (307) 777-4900*
*Fax: (307) 635-6017*
*Email: wema@wy-arng.ngb.army.mil*
*Agency Web: http://132.133.10.9*
*FEMA Web: http://www.fema.gov*


*Publications of interest:*

*Draft directory of earthquake-related human resources for Wyoming – Wyoming State Geological Survey Preliminary Hazards Report PHR 95-1.*

*Earthquake epicenters and suspected active faults with surficial expression in Wyoming – Wyoming State Geological Survey Preliminary Hazards Report PHR 97-1.*

*Earthquakes and active faults in Wyoming – Wyoming State Geological Survey Preliminary Hazards Report PHR 97-2.*

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

*Wyoming Geo-notes – Wyoming State Geological Survey quarterly publication contains general and specific articles about Wyoming earthquakes.*

*Interpreting the landscapes of Grand Teton and Yellowstone National Parks – Recent and ongoing geology, by J.M. Good and K.L. Pierce, 1996: published by Grand Teton Natural History Association.*

*Windows into the Earth – The geologic story of Yellowstone and Teton National Parks, by R.B. Smith and L.J. Siegel, in preparation: Oxford University Press.*

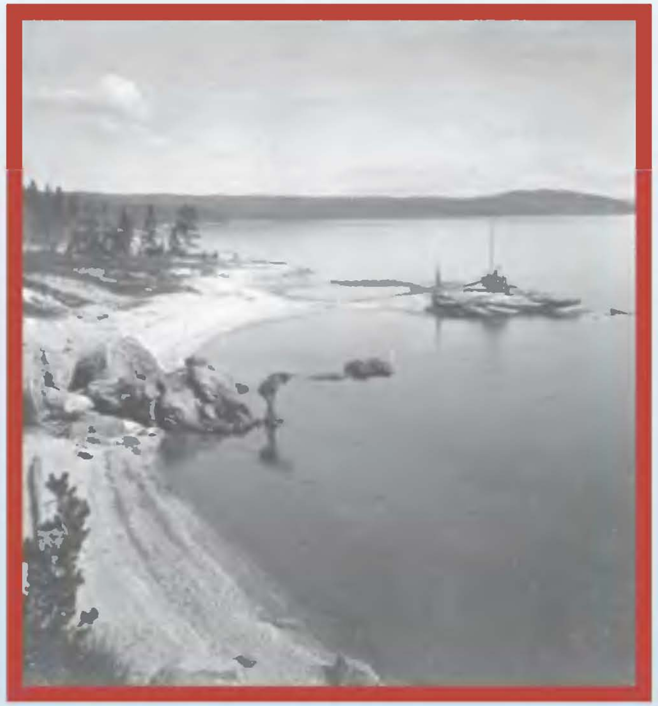
*Traveler's guide to the Geology of Wyoming, by D.L. Blackstone, Jr., 1988, Wyoming State Geological Survey Bulletin 67.*

*Snoke, A.W., Steidtmann, J.R., and Roberts, S.M., editors, 1993, Geology of Wyoming: Wyoming State Geological Survey Memoir 5, 937 p., 2 volumes, map pocket.*

*Cover photograph: "Cresent Beach on Yellowstone Lake," from a stereographic negative by Joshua Crissman of Bozeman, Montana, originally published by W.I. Marshall of Fitchburg, Massachusetts as stereopair #55. Stereo photographs taken by Crissman are the first publically available images of Yellowstone. Crissman 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.*


**WYOMING STATE GEOLOGICAL SURVEY**
Lance Cook, State Geologist


# EARTHQUAKES IN WYOMING




**by**

**James C. Case and J. Annette Green**



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**Information Pamphlet 6**

**LARAMIE, WYOMING**
**2000**


## 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 these 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.*

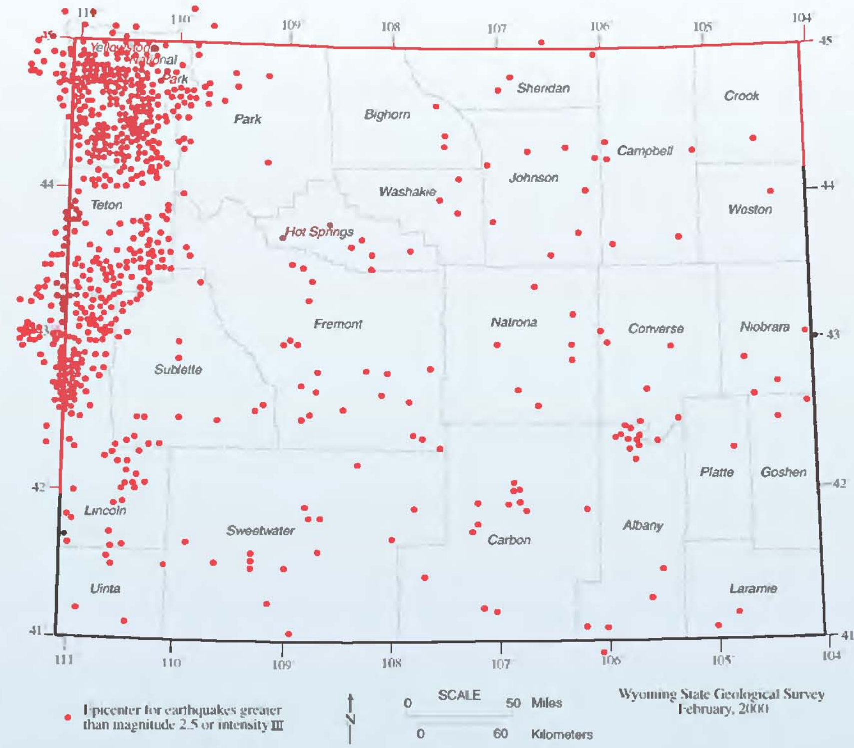


**Figure 1.** Generalized historical earthquake epicenter map for Wyoming

## Causes of Earthquakes

*Earthquakes in Wyoming occur because of movements on existing or newly created faults, movements of (or in) the magma chamber beneath Yellowstone National Park, and from man-made events 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 during the Quaternary (within the last 1.65 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 can be 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 equates to a 32 times increase in associated seismic energy. In other words, a magnitude 7.5 earthquake releases approximately one thousand times more energy than a magnitude 5.5 earthquake. A magnitude 7.5 earthquake releases about as much energy as a one Megaton hydrogen bomb, and a magnitude 6.5 earthquake releases about as much energy as a Hiroshima-type atomic bomb.*

*Intensity is a qualitative measure of the degree of shaking an earthquake imparts on people, structures, and the ground. For a single earthquake, intensities can vary depending upon the distance from the hypocenter and epicenter. A much simplified twelve level intensity scale is shown below.*

*Modified Mercalli Intensity Scale*

*I* Not felt except by very few.

*II* Felt only by a few persons at rest.

*III* Felt noticeably indoors. Vibration like passing of truck.

*IV* Felt indoors by many. Sensation like heavy truck striking building.

*V* Felt by nearly everyone. Some dishes and windows broken. Cracked plaster in a few places. Pendulum clocks stop.

*VI* Felt by all, many frightened and run outdoors. A few instances of fallen plaster and damaged chimneys.

*VII* Everybody runs outdoors. Damage negligible in well-designed and well-built structures, slight to moderate damage in well-built ordinary structures, considerable damage in poorly built structures.

*VIII* Damage slight in specially designed structures, considerable in ordinary buildings with partial collapse, great in poorly built structures.

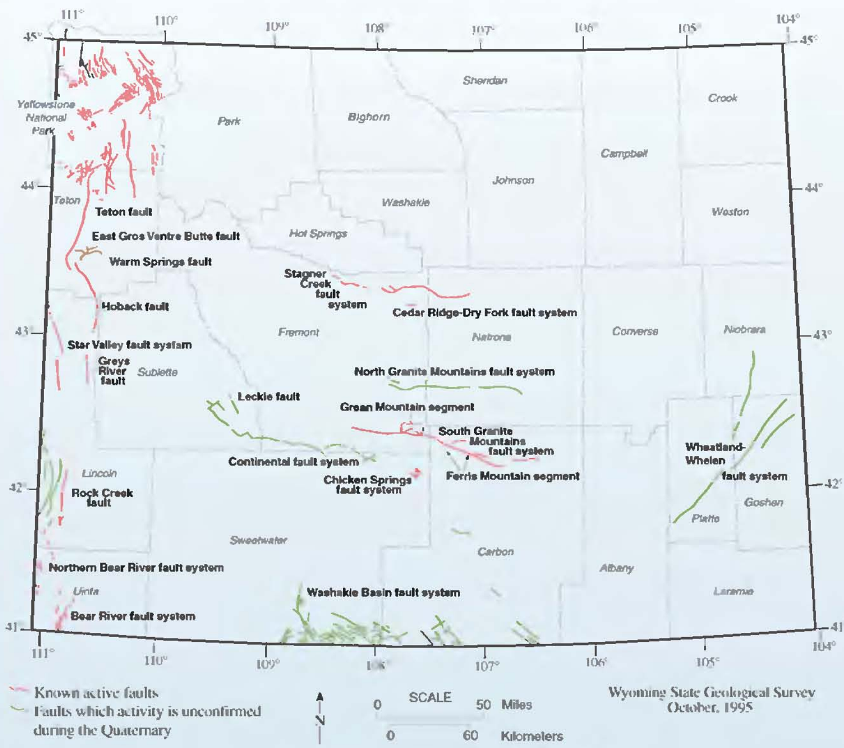

**Figure 2.** Known and suspected active faults in Wyoming.

*IX Damage considerable in specially designed structures, and great in substantial buildings, with partial collapse. Buildings shifted off foundations. Underground pipes broken.*

*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 an all Wyoming earthquakes can be obtained from the Wyoming State Geological 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, 1897 . 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.*

*June 12, 1930 . An estimated magnitude 5.8, intensity VI event occurred near Grover in the Star Valley of western Wyoming. A brick building, swimming pool, and numerous plaster walls in homes were cracked. Numerous aftershocks occurred.*

*March 26, 1932 . An intensity VI event in the Jackson area broke the 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 Hebgen 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. Cracks in the ground 3 to 4 feet deep, and 15 to 20 feet long were found in the Virginia Cascades area.*

*October 18, 1984 . A magnitude 5.5, intensity VI event occurred approximately 4 miles west-northwest of Toltec in northern Albany County. The earthquake was felt in Wyoming, South Dakota, Nebraska, Colorado, Utah, Montana, and Kansas. It cracked buildings in Douglas and Medicine Bow and cracked chimneys in Casper, Douglas, Guernsey, Lusk, and Rock River.*

*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 also felt in Casper and Dubois.*

*February 3, 1994 . A magnitude 5.9, intensity VII event occurred at Draney Peak, Idaho, near Wyoming's Auburn Fish Hatchery in the Star Valley. The earthquake damaged the fish hatchery, and a home near Auburn 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 Hebgen Lake, Montana event in 1959 and the Draney Peak, Idaho event in 1994.*

## 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 Greys River 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 those 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.*

*There are a series of active faults along the northern and southern margins of the Wind River Basin. The Stagner Creek fault system, near Boysen Reservoir in northern Fremont County is capable of generating a magnitude 6.75 earthquake. The South Granite Mountains fault system, in southeastern Fremont County and northwestern Carbon County, is composed of a number of segments that are each capable of generating a magnitude 6.75 earthquake. In addition, the exposed Chicken Springs fault system in northeastern Sweetwater County is thought to be capable of generating a magnitude 6.5 earthquake.*

## 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.*

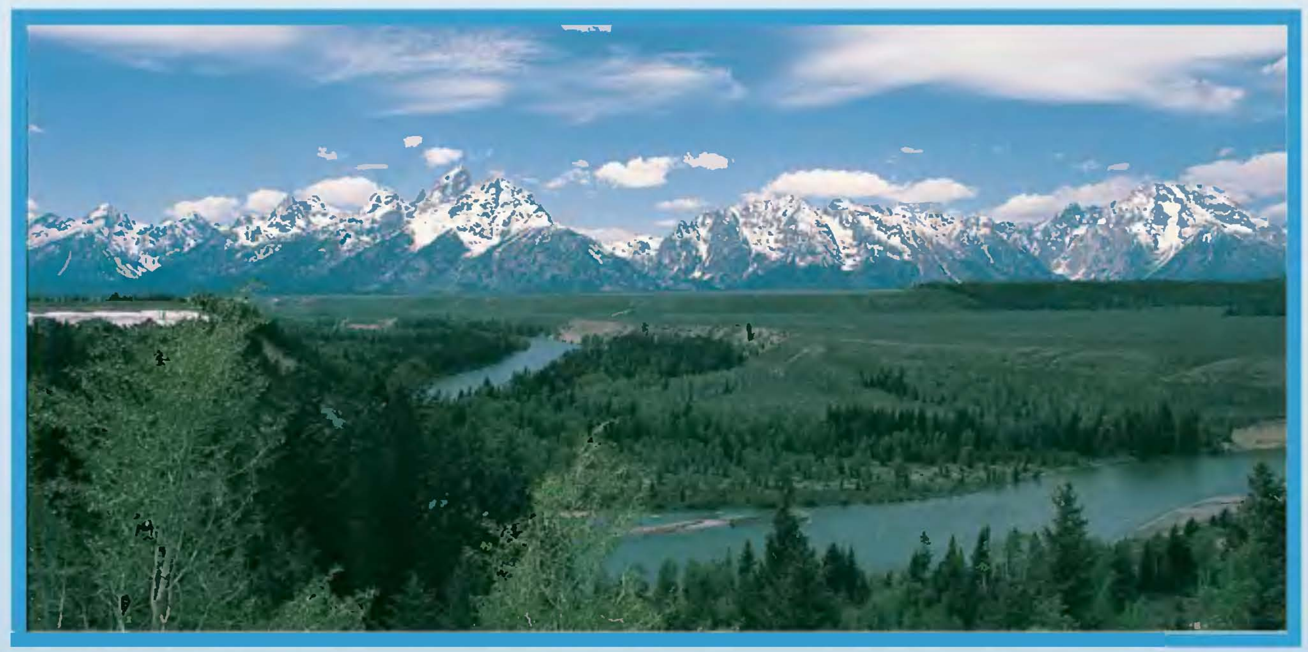

**Figure 3.** The spectacular eastern front of the Teton Range rises abruptly from the floor of Jackson Hole. The Teton Range formed as a result of movement on an active fault, the Teton fault, which is present at the base of the Range in this picture. View southwest from Snake River Overlook. Photograph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