GeoNote 05

Borah Peak Earthquake

The Borah Peak earthquake was the largest earthquake ever recorded in Idaho. At magnitude 7.3 it was the strongest earthquake in the lower 48 states since the 7.5 magnitude event at Hebgen Lake, Montana, in 1959. Moderate earthquakes are not unusual in Idaho. Residents of Cascade, Stanley, Pocatello, and Malad City may feel several a year, and scores of other tremors too small to be felt are recorded annually. The Borah Peak earthquake shook residents of eight western states and two Canadian provinces, and its consequences have made Idahoans dramatically aware of the seismic setting of the state.

The Borah Peak event occurred on a known fault along the eastern margin of the Lost River Range, which is southwesternmost of three major parallel "basin and range" structures north of the Snake River Plain. Although the quake was centered in a relatively unpopulated part of the state, falling masonry took the lives of two children and injured a woman in towns nearby. Mackay (population 541), the nearest town, sustained the most damage to schools, homes, and businesses. Farther away in Challis (population 758), buildings were affected to a lesser extent, but rockfalls posed a significant hazard.

The Borah Peak earthquake is the best documented and most studied of all previous quakes in the intermountain west. It is also being used as a seismic model for potential earthquakes along the heavily populated Wasatch Front in Utah. Geologic effects such as ground rupture, ground-water discharge, liquifaction, mass movements, and ground shaking have seldom been better displayed. Studies of the seismic waves and aftershocks are revealing more about the crustal structure of this area and are leading to new tectonic interpretations of the Basin and Range region.

Earthquake Statistics

Date and Time: Friday October 28, 1983
8:06 a.m. Mountain Daylight Time
(7:06 a.m. Pacific Daylight Time in northern Idaho)

Magnitude: 7.3 M_s Richter scale, 6.9 M_b

Epicenter: 44.046 degrees north latitude, 113.887 degrees west longitude

Depth: 16 $\pm$ 4 kilometers

Strongly Felt Area: Intensity VI over 55,000 square kilometers

Intensity Modified Mercalli Scale:
VII Mackay, Challis
VI Boise
V Pocatello, Moscow, Libby (MT), Spokane (WA)
IV-II Seattle (WA), Salt Lake City (UT), Portland (OR)

Foreshocks: No earthquakes greater than magnitude 2 for two months prior to event

Aftershock Sequence: Five earthquakes, magnitude 5.8 within 48 hours. Hundreds of smaller aftershocks in the following months. Area still experiencing an above average number of minor shocks.

Geologic Effects

Faulting

Name: Lost River Fault, named in 1951

Surface Rupture in 1983: 36 $\pm$ 3 kilometers long

Maximum Offset: 3 meters scarp height

Relative Movement (throw): 2.7 meters

Motion: normal fault; sinistral (left) motion dip of fault plane: 45-53 degrees southwest.

Absolute Uplift: 0.3 meter elevation gain at fault Borah Peak rose about 0.2 meter

Last Movement: Recurrent over last million years; latest probably 15,000 years ago

Eyewitnesses at Scarp: Four elk hunters: Lawana Knox, Bill Knox, John Turner, and Don Hendriksen

Hydrology and Liquifaction

- Eruption of 30 sand spouts and numerous springs at Chilly Buttes
- Formation of temporary "Thousand Springs Lake"
- Mine level 1100 at the Clayton Silver Mine flooded temporarily
- Challis Hot Springs dried up, and later returned to three times normal flow
- One cubic kilometer of excess ground water estimated in Big Lost River drainage
- Changed eruption of Old Faithful in Yellowstone National Park
- Water levels in wells fluctuated throughout interstate region

(over)

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Landslides and Rockfalls

- Birch Springs landslide, a 100,000-cubic-meter mudflow formed at fault scarp
- Lupine Creek mudflow, a 200,000-cubic-meter flow, formed three days later due to increased pore pressure
- Several large boulders in Challis rolled into residential area
- Boulder hit Clayton school and rocks littered school area
- Numerous rockfalls on highways and roads
- Rockfall damaged the concrete spillway at Mackay Dam

Damage Reported

Buildings and Structures

- 12.5 million dollars to buildings and structures
- 11 businesses and 39 homes with major damage
- 200 homes with moderate damage
- 90% of chimneys in Mackay cracked or toppled
- Four schools damaged and rebuilt: Mackay Junior and Senior High, Challis High, Arco High, and the State School for the Blind at Gooding
- Disruption to recreation facilities, trails, roads, and range in Challis National Forest estimated at $255,000
- Mackay City Hall and jail damaged
- Ground motion triggered reactor shut-downs at Idaho National Engineering Laboratory
- Challis Irrigation Company tunnel caved in

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