

***BORAH PEAK
EARTHQUAKE***

COMPILED BY

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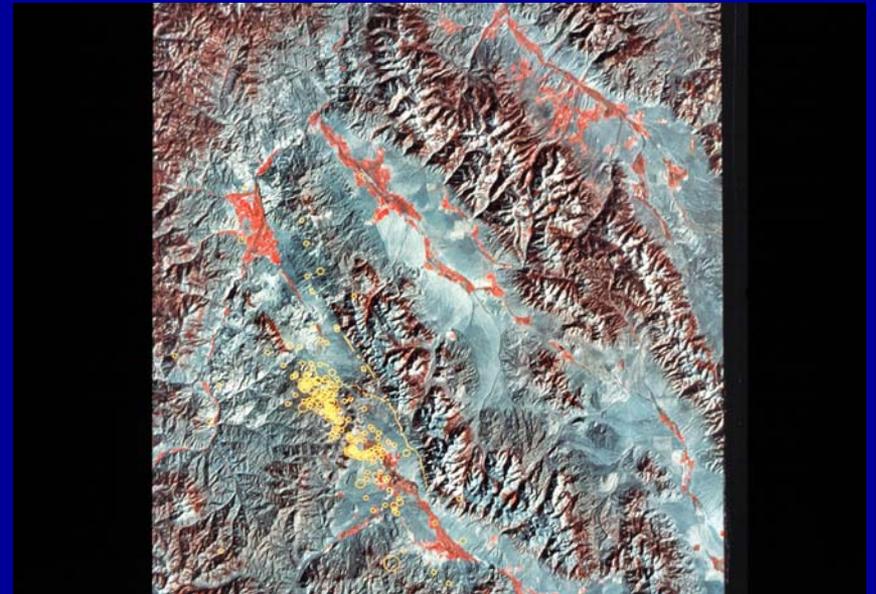
and

Roy M. Breckenridge

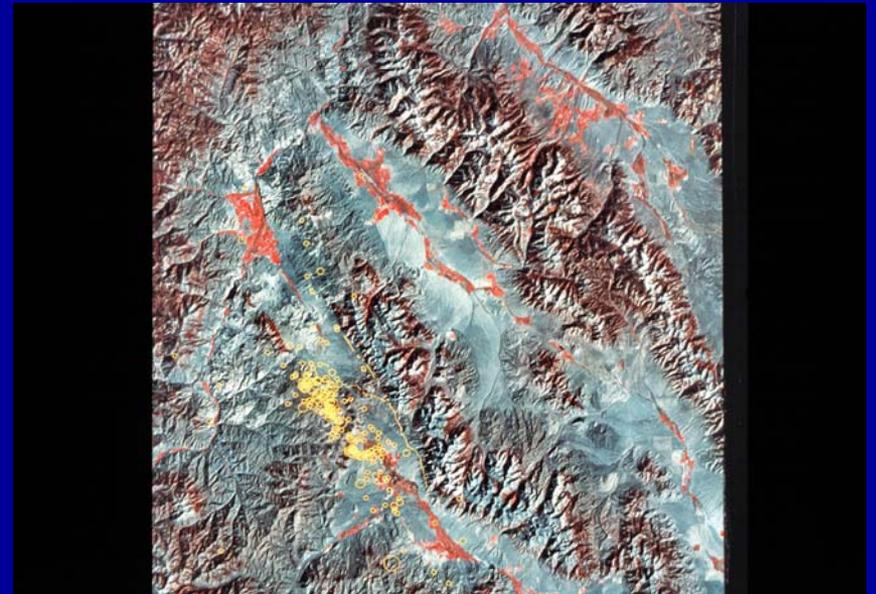
Idaho Geological Survey

Satellite Image

- False-color IR satellite view of basins and ranges north of Snake River Plain
- Lost River Range-lower center
- Lemhi Range-upper center



- Challis, Idaho is left of center
- Epicenter of 1983, magnitude 7.3, Borah Peak Earthquake and aftershocks shown in yellow



Borah Peak

- Lost River Range looking east from Thousand Springs
- Borah Pk (12,662 ft) left of center skyline
- Fault scarp of 1983 earthquake near base of sunlit slope
- Rock Cr valley on left



Helicopter view of scarp in bedrock at Rock Creek



Graben near Willow Creek

- Helicopter view of fault looking southeast
- Ground in center dropped creating a graben
- Note road offset
- People and vehicles for scale



Road offset-left lateral movement

- Helicopter view looking northeast along Doublespring Road across fault scarp
- Willow Cr to the right
- Note offset in road
- Vehicles and people for scale



Doublespring Road

- View northeast from Doublespring Road showing road offset
- People and helicopter for scale



Multiple Scarps

- View from graben showing multiple scarps in Doublesprings Road area
- Person for scale



Damage along fault scarp

- Northwest side of Rock Creek valley showing fault displacement of irrigation aqueduct



Displacement along scarp

- View north from Arentson Creek showing fault scarp displacing a ridge



Landslide at Birch Springs

- Headwall of scarp at top
- New movement initiated by 1983 earthquake
- Slide flows downslope across fault trace



Landslide at Birch Springs

- Headwall and rotational blocks in upper part of landslide
- Note sag ponds impounded by the blocks



Water Discharge at Chilly Buttes

- Aerial view of Chilly Buttes, upper right, shortly after earthquake
- Crevasses discharging large volumes of water onto Thousand Springs valley



Close-up of spring discharging from Chilly Buttes



Sand boils near Chilly Buttes

- Shaking during earthquake caused eruption of ground water and sand through alluvium
- Liquefaction phenomenon associated with earthquakes



Earthquake Damage to IGA store in Mackay, Idaho



Earthquake damage to Custer Motel in Mackay



Car damaged by debris from earthquake damaged building in Mackay



Geologists study trench excavated across fault scarp near Doublespring Road



Headwall of scarp near Doublespring Road

- Note offset of layer alluvial deposits exposed in trench
- Ladder for scale



Borah Peak Earthquake

Name _____

Date _____

Per _____

Task: Use the Modified Mercalli Scale provided to determine the intensity of the Borah Peak Earthquake at selected locations in Idaho.

Materials:

- Modified Mercalli Scale
- Map of Idaho showing location of selected cities

Background: When an earthquake occurs, its size is usually reported using the Richter Magnitude or Moment Magnitude Scale. The damage created by an earthquake, its intensity, is measured using the Modified Mercalli Scale. Knowing the intensity of previous earthquakes may help engineers and builders design and build structures to better withstand future earthquakes.

Procedure: Below is a list of some Idaho cities. To the right of the cities are descriptions of the effects caused by the Borah Peak earthquake that occurred in 1983. Look at the description for each city and compare it with the Modified Mercalli Scale. Record the earthquake intensity for each city in the blank provided.

Results:

Challis: Noticed by persons driving motor cars. Everybody runs outdoors.
 Considerable damage in poorly built or badly designed structures.

Mackay: Slight to moderate damage in well-built ordinary structures. Some
 chimneys broken. Noticed by people driving or riding in cars or buses.

Sun Valley: Slight damage such as fallen plaster and cracked chimneys. Many
 people were frightened and some were observed running outdoors.

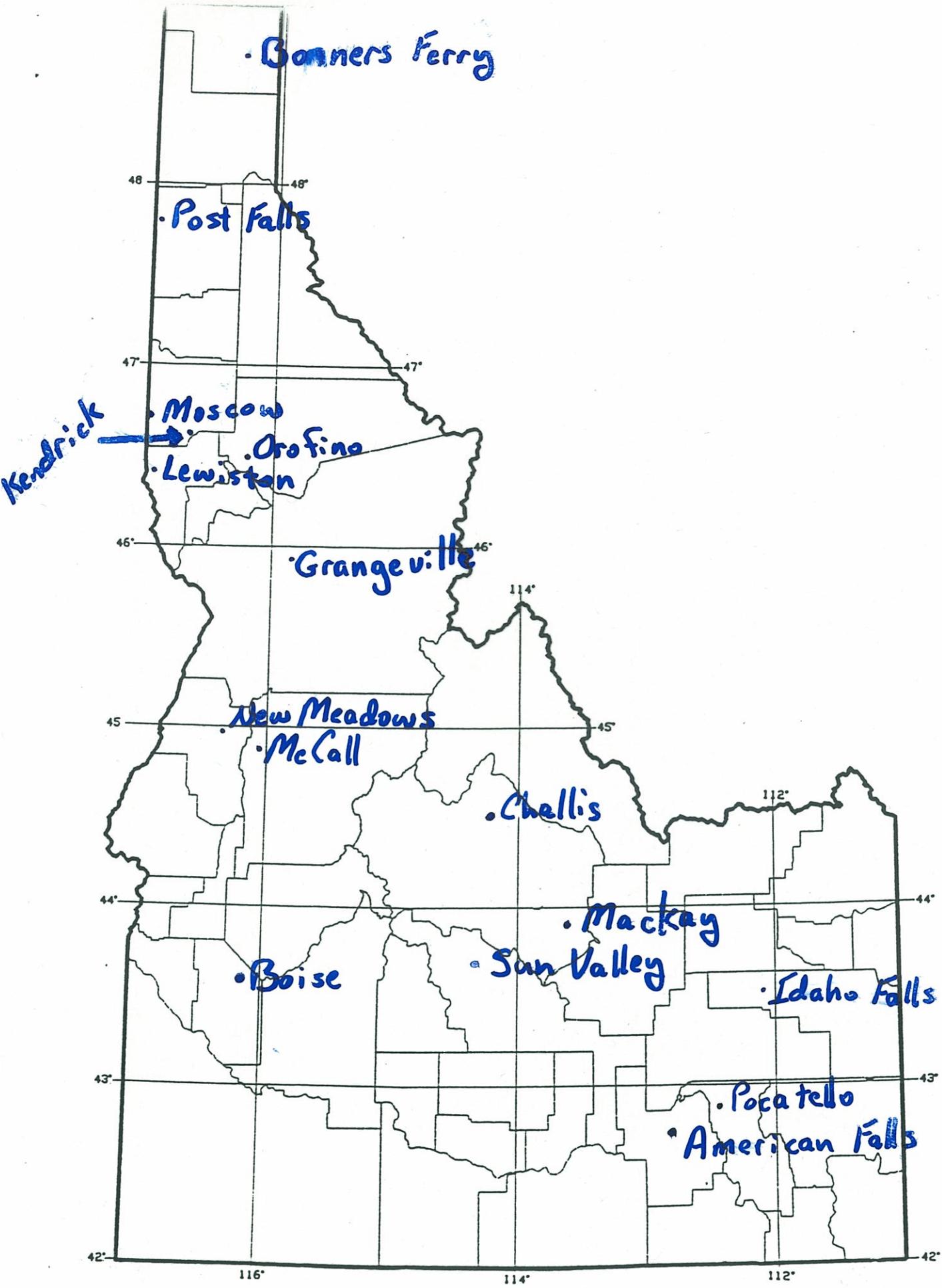
American Falls: Many people were awakened. Trees and stop signs were observed
 shaking.

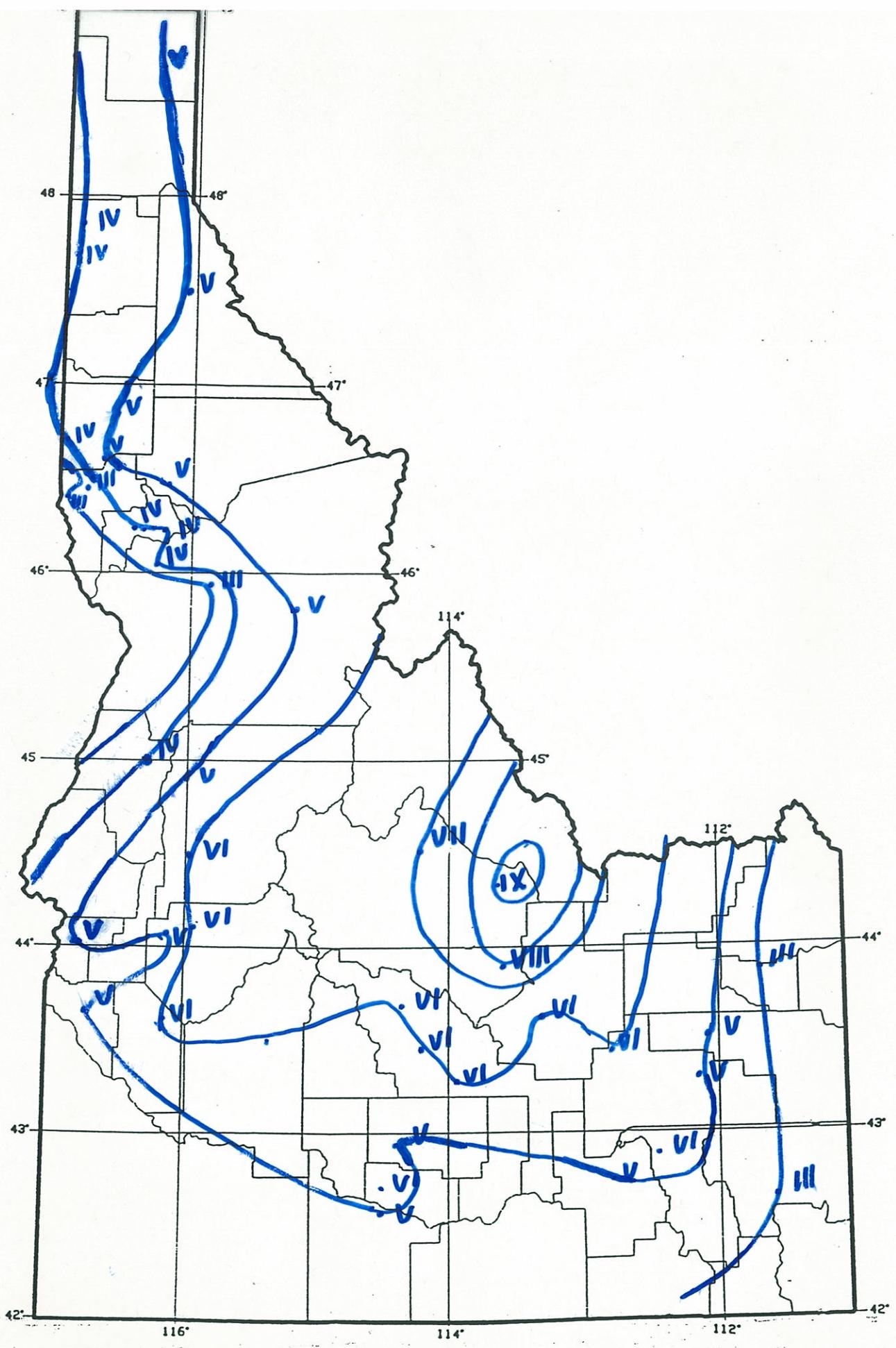
Pocatello: Some heavy furniture was moved. Damage slight, but everyone felt it.

Twin Falls:	A few people reported windows and other glassware had broken. Telephone poles and other signs were seen moving.
Boise:	Felt by all. A few instances of fallen plaster or damaged chimneys.
Idaho Falls:	One lady reported that a power pole swayed enough to dent her parked car. People complained of broken dishes.
McCall:	Power poles were observed whipping through the air. Some windows were shattered.
New Meadows:	Some people reported that their windows and dishes shook. A few people reported that their walls creaked.
Orofino:	Disturbances of trees, poles, and other tall objects sometimes noticed. A few instances of cracked plaster. Unstable objects overturned.
Moscow:	During the day felt indoors by many, outdoors by a few. Some awakened from their sleep.
Lewiston:	Duration estimated. Felt like vibration of a passing truck.
Kendrick:	Many awakened. Felt by nearly everyone during the day. Some people complained of cracked plaster in their houses.
Grangeville:	Felt like sensation of a heavy truck striking the building. Walls made a creaking sound.
Post Falls:	Standing motor cars rocked noticeably. Dishes, windows, and glasses rocked noticeably. Walls made a creaking sound.
Bonnors Ferry:	Some people reported broken dishes. It was felt by nearly everyone.

THE MODIFIED MERCALLI SCALE

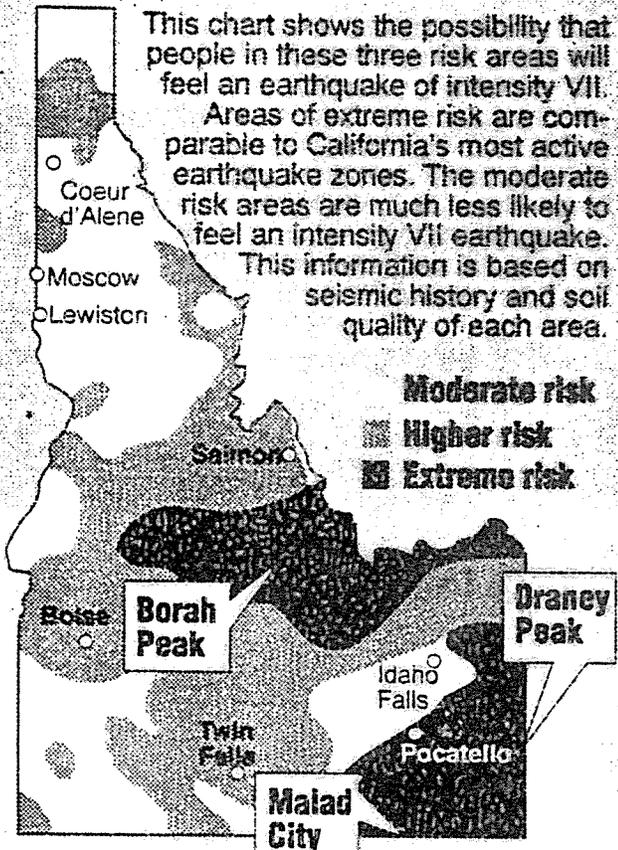
- I. Not felt except by a very few under especially favorable circumstances.
- II. Felt only by a few persons at rest, especially on upper floors of buildings. Delicately suspended objects may swing.
- III. Felt quite noticeably indoors, especially on upper floors of buildings, but many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibration like passing truck. Duration estimated.
- IV. During the day felt indoors by many, outdoors by a few. At night some awakened. Dishes, windows, doors disturbed; walls make creaking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.
- V. Felt by nearly everyone; many awakened. Some dishes, windows, etc., broken; a few instances of cracked plaster; unstable objects overturned. Disturbances of trees, poles, and other tall objects sometimes noticed. Pendulum clocks may stop.
- VI. Felt by all; many frightened and run outdoors. Some heavy furniture moved; a few instances of fallen plaster or damaged chimneys. Damage slight.
- VII. Everybody runs outdoors. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable in poorly built or badly designed structures; some chimneys broken. Noticed by persons driving motor cars.
- VIII. Damage slight in specially designed structures; considerable in ordinary substantial buildings, with partial collapse; great in poorly built structures. Panel walls thrown out of frame structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. Sand and mud ejected in small amounts. Changes in well water. Disturbs persons driving motor cars.
- IX. Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb; great in substantial buildings, with partial collapse. Buildings shifted off foundations. Ground cracked conspicuously. Underground pipes broken.
- X. Some well-built, wooden structures destroyed; most masonry and frame structures destroyed with foundations; ground badly cracked. Train rails bent. Landslides considerable from riverbanks and steep slopes. Shifted sand and mud. Water splashed over banks.
- XI. Few, if any (masonry) structures remain standing. Bridges destroyed. Broad fissures in ground. Underground pipelines completely out of service. Earth slumps and land slips in soft ground. Train rails bent greatly.
- XII. Damage total. Waves seen on ground surfaces. Lines of sight and level distorted. Object thrown upward into the air.





Risk of earthquakes in Idaho

Idaho is ranked fifth highest in the nation for earthquake risk. The entire state has at least a moderate risk to feel a significant earthquake in the next 50 years. Here is a look at Idaho's most susceptible earthquake areas:



Earthquake intensity

- I. Only detectable by instruments.
- II. First noticeable shaking.
- III. Hanging objects swing.
- IV. Objects rattle, some outdoor ground shaking.
- V. Objects fall. Sleeping people awakened.
- VI. Trouble walking. Damage to poorly built buildings.
- VII. Difficulty standing. Considerable damage to poorly built buildings.
- VIII. Difficulty driving. Chimneys may fall.
- IX. Considerable damage to all buildings. Underground pipes broken.
- X. Most buildings destroyed. Dams seriously damaged. Large landslides.
- XI. Structures and underground utilities destroyed.
- XII. Almost everything destroyed.

The intensity of some major earthquakes

1. 1812, New Madrid, Missouri Intensity XII
2. 1906, San Francisco, California Intensity XI
3. 1964, Anchorage, Alaska Intensity X
4. 1983, Borah Peak, Idaho Intensity IX
5. 1992, Los Angeles, California Intensity IX
6. 1975, Malad City, Idaho Intensity VIII
7. 1994, Draney Peak, Idaho Intensity VII

SOURCES: U.S. Geological Survey, Idaho Bureau of Disaster Statistics, University of Idaho

Staff graphic:
Charles Waltmire

Teacher Notes for Borah Peak Activity

Do this activity after students have completed the faults activity so they are already somewhat familiar with stress types and the basic fault types. Begin this activity with a series of slides which show some of the local faults. If possible, have them identify the hanging and foot walls, have them examine the relative motion of the blocks, and determine the possible stress type that was applied to create this type of movement. None of these slides is included in this activity but it would be beneficial to show some of your own which illustrate local examples of afore mentioned features. Follow this up with a slide show that was produced by Kurt Othberg and Roy Breckinridge which takes viewers through the setting, movement, and effects produced by the Borah Peak Earthquake in 1983. The original slide show and script have been modified into a Power Point presentation. It has been converted to a PDF file to ease the electronic transfer. This sets the stage well for the activity that follows.

After viewing the slides (Power Point), take the students through the difference between an earthquakes magnitude (a measure of the size of the earthquake) and its intensity (a reflection of the damage produced by ground motion created by the earthquake). At this point, introduce students to the Modified Mercalli Scale. After highlighting the scale, show them an overhead with a map of the state of Idaho with selected locations highlighted. Then give them the list of accounts from these same cities. Their task is to match the observations up with the Mercalli Scale and record the intensity rating. This is a modification of an activity originally presented at a summer workshop at Mt. Borah by Kurt Othberg. This can be completed in a 47 min. class period.

The following day, go over the results in class. By connecting points of equal seismic intensity, isoseismal lines (lines of equal seismic intensity) can be created. Then display for them an isoseismal map created with the data given. This allows geologists another view of the effects of an earthquake and insurance companies a way of flagging unusual reports of damage (not that anyone would ever be dishonest). End the follow-up activities by showing the "Risk of earthquakes in Idaho" overhead which ties them back into the Risk Map they created at the beginning of the unit (see "Risk Map Activity").