UNITED STATES DEPARTMENT OF THE INTERIOR
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Map Showing Number of Earthquakes per 1,000 Square Kilometres (400 Square Miles) for Southeast Idaho and Adjoining States, 1960-1969

by
David Schleicher and H.R. Covington

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This map has not been reviewed and processed in conformity with U.S. Geological Survey standards. Furthermore, the map shows distribution of earthquake epicenters over only a 10-year period. Future earthquakes may occur in areas different from those of past earthquakes, however. Please note that this map is <u>not</u> meant to imply that future earthquakes will occur <u>only</u> inside the zero earthquake contour.

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This map shows the concentration of earthquake epicenters[1/]

[1/] The epicenter of an earthquake is the point on the ground surface directly above the source of the shock waves.

reported by NEIS (National Earthquake Information Service[2/]) for the

[2/] NEIS was formerly called National Earthquake Information Center (NEIC).

decade 1960-69. The map area was chosen because it seems to include a fairly well defined part of the Rocky Mountain seismic belt. The period 1960-69 was chosen because an increase in the number of seismic stations about 1960 made it possible to locate quakes that could not have been located before 1960. Each contour represents the number of epicenters per 1,000 km^2 (400 mi^2).

Richter magnitudes of these earthquakes were not always reported in the NEIS data; those that were reported ranged from 3.0 to 5.8; (the 5.8 magnitude was for the quake of October 21, 1964). Maximum intensities (modified Mercalli) near the epicenters of such quakes would range from about III to VIII (see Richter, 1958). The smallest of such quakes might be felt 15 km (10 mi) away from the epicenter, the largest more than 200 km (120 mi) away. Near the epicenters of the largest of such quakes--especially if foundation conditions are poor--ordinary masonry would be damaged and even reinforced masonry might be cracked; thus, some concrete irrigation ditches would be damaged and poorly built chimneys would probably fall. As much as 30 cm (1 ft) of ground breakage might occur along faults that break the ground surface (Bonilla, 1967), and small landslides might occur in weak materials.

The contours on this map are not entirely accurate, because the current seismological techniques could not locate the epicenters exactly; their true locations may be as much as 40 km (25 mi) away from the locations at which they were reported, although most epicenters are probably reported within 10-20 km (5-10 mi) of their true locations. The clusters of epicenters shown on the map are probably real, but very possibly they should be shifted 10 km (5 mi) or so in some unknown direction. This possibility of mislocation arises because seismological techniques for locating epicenters are fairly reproducible (precise), but some of the data used to calculate locations are not accurately known--notably, the velocity of earthquake waves through different parts of the Earth's crust. Thus, several attempts by seismological laboratories to locate an epicenter would probably lead to nearly the same point--but that point might not be in exactly the right place.

WHAT THE MAP MEANS

Southeast Idaho and parts of adjoining States are included by Algermissen (1969) in Zone 3--the zone of highest seismic risk, where major destructive earthquakes may occur. That area is part of a belt of frequent earthquakes that extends northward through the Rocky Mountains from north-central Arizona almost to the Canadian border. But it is apparent in examining NEIS's earthquake epicenter map (1970) that epicenters are not uniformly distributed throughout this earthquake-prone area.

This map shows where earthquakes of small and moderate magnitude were centered during a recent decade. The map pattern may change somewhat during future decades. For example, some of the quakes centered just outside the northwest corner of Wyoming are almost certainly aftershocks of the 1959 Hebgen Lake earthquake. Thus, the number of future quakes in that area will probably be smaller than the number shown here. Because epicenters are not uniformly distributed across this generally seismic[3/] area, it follows that certain parts of the

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[3/] "Seismic," as used here, means simply "having earthquakes"; "aseismic" means free of earthquakes.

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area are more likely than others to feel quakes.

We emphasize that the map cannot be used to predict which areas are most likely to experience earthquake damage; that depends not only on the distance from the epicenter and the magnitude of the quake, but also on such additional factors as foundation conditions and construction techniques. Perhaps the most serious limitation of the map is that it cannot be used to predict where great earthquakes will be centered. Great quakes are likely in the general area, but opinion is currently divided as to whether they are more likely in parts of the area that now have many small and moderate quakes or in parts that now have no small and moderate quakes. Lastly, the map cannot be used to predict where quakes will be concentrated in the distant future, say, thousands or tens of thousands of years from now. Such a question might arise, for example, in considering disposal sites for radioactive wastes. It is probably best answered by studying the pattern of geologically young faulting in the area.

In short, this map is somewhat like a highway map that shows pedestrian crossings as places where accidents are relatively likely to happen. Such a map would be valid only for the present highway net. And it could not be used to anticipate the hazard of a group of children unexpectedly darting into the road at some point other than a regular pedestrian crossing.

Because the epicenter map is based only on the distribution of earthquake epicenters during a recent decade, it does not directly show the pattern of geologically young faults. Where the pattern of faulting is expressed, it is likely to be generalized because the epicenter locations are not accurately known, and because the epicenters and the faults, as seen at the surface, are related at depth in an incompletely known way.

HOW THE MAP WAS MADE

All epicenters reported by NEIS for the period 1960-69 were plotted on the base map. A circle 35.7 km (22.2 mi) in diameter, and thus enclosing an area of 1,000 km^2 (400 mi^2), was drawn on clear plastic film. The circle was centered in turn on each intersection of 0.1^o latitude and 0.1^o longitude lines on the map, and the number of epicenters inside the circle was counted and plotted at the intersection. These numbers were then contoured.

A "zero contour" outlines areas where no epicenters were reported for quakes of Richter magnitude 3.0 or larger from 1960 to 1969. This contour can be visualized as the "shoreline" for seismic "islands" in an aseismic "sea." Note that in those areas where no epicenters were reported, shocks may still have been felt or damage sustained from nearby earthquakes. Circular or near-circular zero contours just over 35 km (22 mi) across enclose areas with only one epicenter for 1960-69.

There are two reasons for the size of the counting circle:

1. The number of epicenters counted in each position of the circle can be directly compared with the numbers of epicenters per 1,000 km^2 (400 mi^2) determined elsewhere in the Rocky Mountains by Smith (1972) and by Ryall, Slemmons, and Gedney (1966).
2. The radius of the counting circles (about 18 km or 11 mi), by coincidence, indicates the accuracy with which most of the epicenters are located. Thus, the area outside the "zero contour" very likely has not had any epicenters for quakes of Richter magnitude 3.0 or more during the period 1960-69. This concept applies as well for the area outside the circular zero contours that surround isolated single epicenters.

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