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Subject: Seismic Safety Margins Research Program Review, January 29-30, 1981

Dear Dr. Okrent:

I will limit my comments to the probabilistic approach to earthquake hazard determination, both regionally and at a specific site. Mr. Bernreuter's presentation gave a good overview of the undertainties involved in correlating the various kinds of magnitude determinations with intensity assignments, and combining this data with regional and local analysis to estimate maximum accelerations and return periods for a specific site. A major problem involves the feasibility of using magnitude-intensity-acceleration relationships derived from the western United States for the area east of the Rocky Mountains.

It is generally agreed that, in seismically active areas, by far the greater amount of seismic energy is dissipated through a relatively small number of large earthquakes. The frequency and distribution of large earthquakes, therefore, is a reasonable measure of the rate of build-up and release of strain energy. To contrast the western and eastern United States, my student assistant and I collected what data we could on the position, time, and magnitude or intensity of large earthquakes in the United States and immediately adjacent areas. Earthquakes of M=7 or greater, or MM=X or greater, were included; we did not attempt to distinguish between the various types of magnitude determinations, and no extensive effort was made to check for more modern interpretations of older published results. It is quite possible that we have missed one or two large earthquakes in the western area; furthermore, the record for the West goes back only 180 years, whereas that along the east coast extends back for about 300 years.

Nevertheless, within historic times, something over four times as many major earthquakes have been noted in the western one-third as compared to the eastern two-thirds of continental United States. This relationship may reflect, perhaps quantitatively, the rate of build-up and release of strain in the western Cordillera as compared to the Central Plains and eastern Appalachian and coastal plain provinces. The geology also rather accurately reflects the rate and intensity of stress application. The continuing development of local vertical and horizontal strains in the western Cordillera is reflected in the rugged, youthful topography. By contrast, the plains and rolling topography east of the Rockies attest to the long absence or extreme rarity of strong local deformation.

Determination of the state of stress in the crust, published by Zoback and Zoback (Journal of Geophysical Research, November 10, 1980, p. 6148) show graphically the vastly larger number of faults or active structural features from which stress may be determined or inferred in the Cordillera as compared to the eastern portion of the continent. The stress provinces so defined might logically be a basis for division of the continent for the phase II and III SSMRP studies.

The four large earthquakes east of the Rockies are those at New Madrid, Charleston, and the two in the northern St. Lawrence Valley tectonic zone. All three of these areas have recorded numerous smaller earthquakes and seem to be centers of continuing activity. They are obviously sub-provinces which deserve special analysis. For the New Madrid zone at least, recent work by the USGS and consultants seems to have defined the controlling faults and, from reflection seismograph and drill hole data, determined changes in thicknesses of strata across the fault. From these data the average slip rate, and hence a fair approximation of the return period for a large displacement capable of generating a major earthquake, may be estimated. The Charleston and St. Lawrence Valley seismic areas are not yet so well understood. Nevertheless, the areas of concentration of felt earthquakes within historic time are relatively limited, as illustrated by the enclosed map taken from MOSAIC, July-August, 1977. The three areas marked by large earthquakes noted above are among those represented. The kinds of data cited above seem to

provide a basis for a probabilistic approach to evaluating seismic risk, including eventually reasonable estimates of recurrence periods for larger earthquakes in specific areas in the eastern United States.

We were asked to comment on how the SSMRP might make an early input into the licensing process. The very large difference in rate and quantity of seismic energy released in the western one-third as compared to the eastern two-thirds of the nation would seem to provide a basis for separate minimum magnitude requirements for the two areas. The individual areas marked by differing stress regimes indicated by Zoback and Zoback might also be recognized as distinct provinces and sub-provinces for which probabilistic maximum earthquake and return period could be satisfactorily established. If so, the choice of a reasonable SSE would be simplified through much of the eastern two-thirds of the Uni ates, and perhaps eventually for each of the regime provinces.

Respectfully submitted:

John Maxwell

John C. Maxwell

Principal References Used for Identifying Large Earthquakes:

"Earthquakes Information Bulletin", United States Dept. of the Interior, Geological Survey.

"Preliminary Determination of Epicenters", Monthly Listing, U. S. Dept. of the Interior, Geological Survey.

"United States Earthquakes", edited by J. L. Coffman, C. A. von Hake & W. K. Cloud, U. S. Dept. of Commerce, Coast & Geodetic Survey.

B. Gutenberg and C. Richter, 1949, Seismicity of the Earth, Princeton University Press.

EARTHQUAKES IN USA EXCEEDING MAGNITUDE 6.9 OR INTENSITY IX

ROCKIES AND WEST

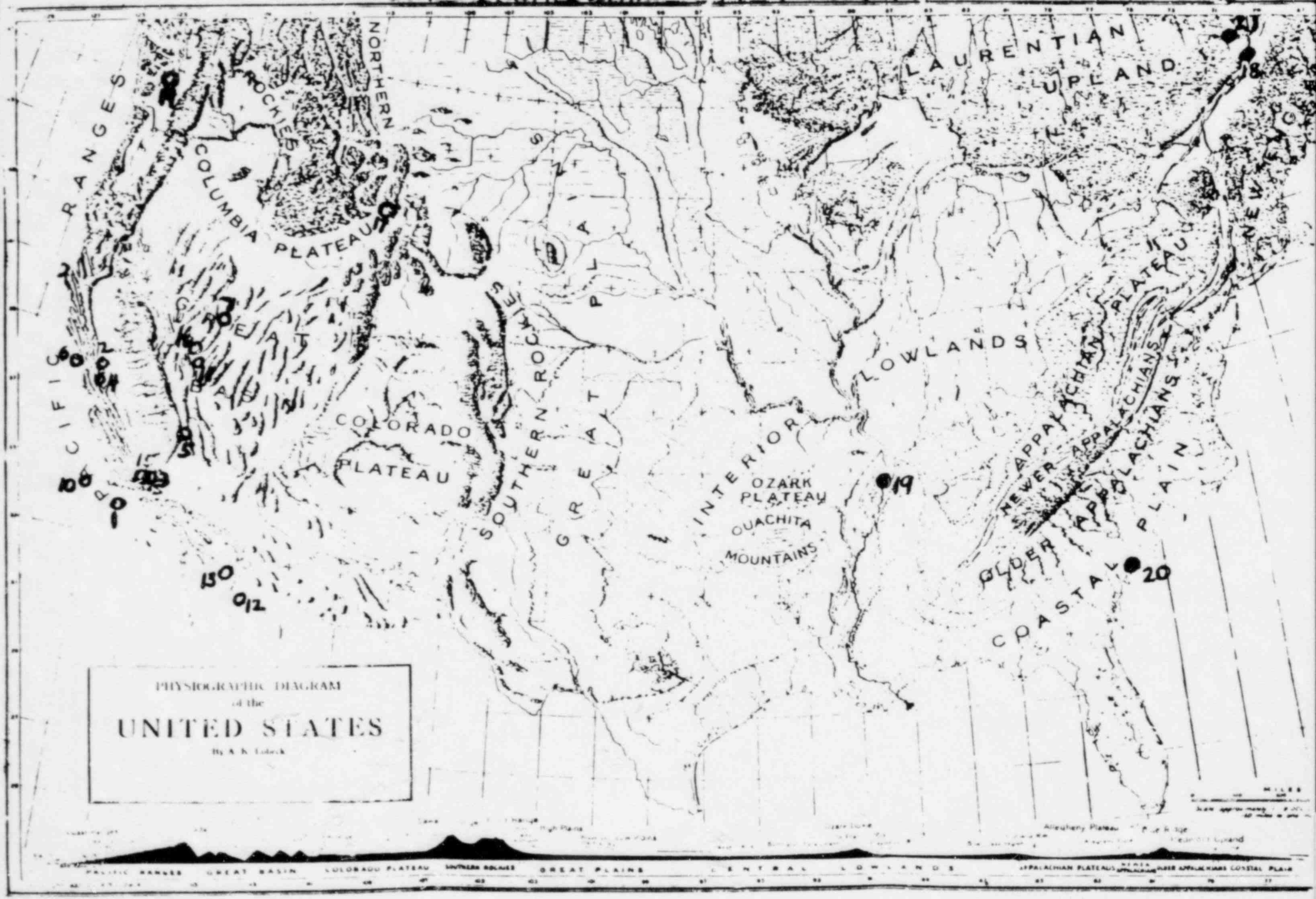
	DATE	LATITUDE / LONGITUDE	MAGNITUDE	INTENSITY
1	12-21-1812	34 N 120W		X
2	6-10-1836	34 N 122 W		IX-X
3	1-9-1857	35 N 119 W		X-XI
4	10-21-1868	37.5 N 122 W		IX-X
5	3-26-1872	36.5 N 118 W		X-XI
6	4-19-1906	34 N 123 W	8.25	
7	10-3-1915	40.5 N 117.5 W	7.75	
8	12-6-1918	49.5 N 126.5 W	8	
9	1-22-1923	40.5 N 124.5 W	7.2	
10	11-4-1927	34.5 N 121.5 W	7.3	
11	12-21-1932	39.5 N 118 W	7.2	
12	12-31-1934	32 N 114.5 W	7.0	
13	5-19-1940	32.7 N 115.5 W	7.1	X
14	4-13-1949	47.1 N 122.7 W	7.1	
15	7-21-1952	35 N 119 W	7.7	
16	12-16-1954	39.3 N 118 W	7.1	
17	8-17-1959	44.9 N 111.1 W		X

EAST OF ROCKIES

18	2-5-1663	47.6 N 70.1 W		X
19	12-16-1811	36.6 N 89.6 W		XII
20	5-31-1886	32.9 N 80 W		IX-X
21	3-1-1925	45.3 N 70.8 W	7.0	

08

HISTORIC EARTHQUAKES M≥7 MM7 IX



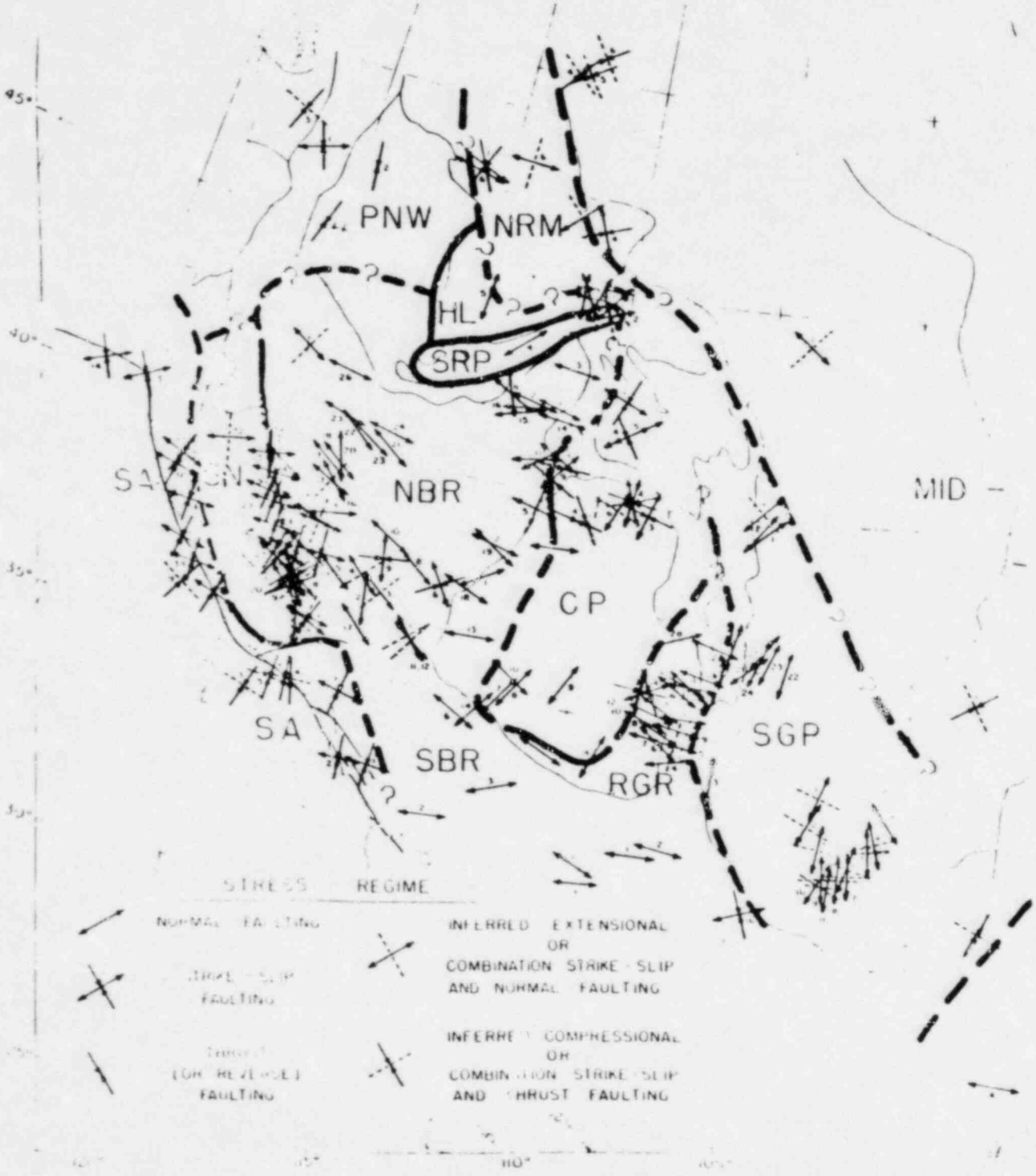


Plate 2. State of stress in the conterminous United States. Heavy shaded lines define boundaries of stress provinces: San Andreas (SA); Pacific Northwest (PNW); Northern Rocky Mountains (NRM); Hebgen Lake; Centennial Valley (SGP). The Basin and Range Rio Grande rift stress province includes the northern (NBR) and southern (SBR

MOSAIC July-August 1976

Intraplate earthquakes. Earthquake activity

1972. Shaded areas delineate