

QC
801
.U6
N3
no.2

NOAA Technical Memorandum EDS NGSDC-2



FINAL REPORT

AN ANALYSIS OF EARTHQUAKE INTENSITIES
WITH RESPECT TO ATTENUATION, MAGNITUDE,
AND RATE OF RECURRENCE - Revised Edition

Prepared for Division of Reactor Safety Research,
Nuclear Regulatory Commission

Rutlage J. Brazee

National Geophysical and Solar-Terrestrial Data Center
Boulder, Colorado
August 1976

noaa

NATIONAL OCEANIC AND
ATMOSPHERIC ADMINISTRATION

/ Environmental Data
Service

NOAA TECHNICAL MEMORANDA

Environmental Data Service National Geophysical and Solar-Terrestrial Data Center

The National Geophysical and Solar-Terrestrial Data Center (NGSDC) of the Environmental Data Service (EDS) combines in a single center the data activities in seismology, marine geology and geophysics, geomagnetism, solar activity, interplanetary phenomena, the ionosphere, cosmic rays, aurorae, and airglow. Data collected from worldwide sources are processed, archived, and provided in many usable formats to the scientific community.

NOAA Technical Memoranda in the EDS/NGSDC series facilitate prompt distribution of scientific and technical material by staff members, cooperators, and contractors. Information presented in this series may be preliminary in nature and may be published formally elsewhere at a later date.

NOAA Technical Memorandum EDS NGSDC-2

QC
801
.u6
N3
no.2
-14-

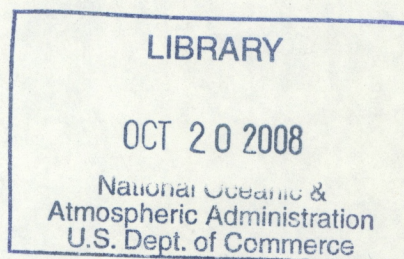
FINAL REPORT

AN ANALYSIS OF EARTHQUAKE INTENSITIES
WITH RESPECT TO ATTENUATION, MAGNITUDE,
AND RATE OF RECURRENCE - Revised Edition

Prepared for Division of Reactor Safety Research,
Nuclear Regulatory Commission, under Modification
2 to Interagency Agreement No. AT(49-25)1004

Rutlage J. Brazee
Principal Investigator

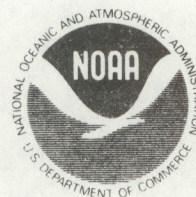
National Geophysical and Solar-Terrestrial Data Center
Boulder, Colorado
August 1976



UNITED STATES
DEPARTMENT OF COMMERCE
Elliot L. Richardson, Secretary

NATIONAL OCEANIC AND
ATMOSPHERIC ADMINISTRATION
Robert M. White, Administrator

Environmental Data
Service
Thomas S. Austin, Director



U.S. Technical Information Service

Final Report

ANALYSIS OF CARBON DIOXIDE
IN THE RESERVOIR TO AID IN THE
ESTIMATION OF AVERAGE RESERVOIR

OF CARBON DIOXIDE IN THE RESERVOIR
AND THE RESERVOIR TO AID IN THE
ESTIMATION OF AVERAGE RESERVOIR

Volume 1, Part 1
Technical Information

Technical Information
Volume 1, Part 1
Technical Information

LIBRARY
OCT 28 2008
U.S. Dept. of Commerce
National Administration
National Administration



TABLE OF CONTENTS

	<i>Page</i>
ABSTRACT	
1.0 INTRODUCTION	1
2.0 DATA PREPARATION	2
3.0 ANALYSES	3
4.0 DISCUSSION	10
5.0 NOTATION	13
6.0 ACKNOWLEDGMENTS	14
7.0 REFERENCES	14

LIST OF FIGURES

Figure

1. Regional divisions by which earthquakes in the file are grouped for independent study	16
2. Schematic outline of convention for determining isoseismal distances	17
3. Number of earthquakes experienced from 1928 through 1973.	18
4. Number of earthquake intensities IV or greater experienced from 1928 through 1973.	19
5. Number of earthquake intensities V or greater experienced from 1928 through 1973	20
6. Number of earthquake intensities VI or greater experienced from 1928 through 1973.	21
7. Number of earthquake intensities VII or greater experienced from 1928 through 1973.	22
8. Maximum intensities experienced throughout the conterminous United States from 1928 through 1973.	23
9. Earthquake recurrence curve for the years 1928 to 1973 at 36.00° N, 90.00° W.	24
10. Earthquake recurrence curve for the years 1928 to 1973 at 34.90° N, 88.30° W.	25
11. Earthquake recurrence curve for the years 1928 to 1973 at 37.00° N, 119.00° W	26
12. Earthquake recurrence curve for the years 1928 to 1973 at 47.00° N, 123.00° W	27
13. Earthquake recurrence curve for the years 1928 to 1973 at 41.33° N, 82.47° W.	28
14. Earthquake recurrence curve for the years 1928 to 1973 at 38.43° N, 85.43° W.	29
15. Earthquake recurrence curve for the years 1928 to 1973 at 45.00° N, 113.00° W	30
16. Earthquake recurrence curve for the years 1928 to 1973 at 36.47° N, 82.80° W.	31

17.	Western United States, Region 8, 8N, and 7, area vs maximum intensity	32
18.	California and western Nevada, Region 8, area vs maximum intensity	33
19.	Washington and Oregon, Region 8N, area vs maximum intensity	34
20.	Western Mountains, Region 7, area vs maximum intensity.	35
21.	Eastern United States, Regions 5 and 6, area vs maximum intensity	36
22.	Central Region, Region 6, area vs maximum intensity	37
23.	Eastern Region, Region 5, area vs maximum intensity	38
24.	Relative distribution of intensity reports with respect to a typical curve; intensity III, California and western Nevada, Region 8.	39
25.	Western United States, Regions 8, 8N, and 7, distance vs maximum intensity	40
26.	California and western Nevada, Region 8, distance vs maximum intensity	41
27.	Washington and Oregon, Region 8N, distance vs maximum intensity	42
28.	Western Mountains, Region 7, distance vs maximum intensity.	43
29.	Eastern United States, Regions 5 and 6, distance vs maximum intensity	44
30.	Central Region, Region 6, distance vs maximum intensity	45
31.	Eastern Region, Region 5, distance vs maximum intensity	46
32.	Magnitude/area ratio for the Western United States, Regions 8, 8N, and 7	47
33.	Magnitude/area ratio for California and western Nevada, Region 8	48
34.	Magnitude/area ratio for Washington and Oregon, Region 8N	49
35.	Magnitude/area ratio for the Western Mountains, Region 7.	50
36.	Magnitude/area ratio for the Eastern United States, Regions 5 and 6	51
37.	Magnitude/area ratio for the Central U.S., Region, Region 6	52
38.	Magnitude/area ratio for the Eastern Region, Region 5	53

APPENDICES

Appendix

A.	Modified Mercalli Intensity Scale of 1931	A-1
B.	Earthquake Report	B-1
C.	Tables 1 through 34	C-1
D.	Printout of Program for Determining Isoseismal Contours	D-1
E.	Explanation of Format of Accompanying Magnetic Tape Earthquake Intensity File.	E-1

AN ANALYSIS OF EARTHQUAKE INTENSITIES WITH RESPECT TO ATTENUATION, MAGNITUDE, AND RATE OF RECURRENCE

Rutlage J. Brazee

Earthquake intensity reports collected by various agencies of the U.S. Government from many thousand localities for the years 1928 through 1973 have been encoded and filed on magnetic tape. A method for determining systematically the isoseismal areas and distances is developed and used for the analysis of intensity attenuation. Suites of curves, with corresponding formulas, are developed depicting the attenuation regimes for the Eastern and Western United States and for each of several subregions. A method of calculating recurrence curves is presented, which permits the determination of such a curve by electronic computer/plotter for any point in the conterminous United States. Magnitude versus area of perceptibility relationships are developed and magnitude versus maximum intensity is defined for the various regions.

1.0 INTRODUCTION

Earthquake intensities are very subjective evaluations of earthquake effects and indications of earthquake energy release. However, in spite of the excellent scientific advances in earthquake theory and the impressive development of instruments and instrumental techniques during the past 75 years, intensities remain among the most acceptable criteria on which to base earthquake risk factors and the projection of future seismic activity. This is due, in part, to the much more extensive intensity data that are available, extending back much further in time and, in part, to the fact that a fallen chimney or a collapsed building can be related much more directly to earthquake risk than can a seismogram written several hundred or several thousand kilometers from the epicenter.

As early as 1883, DeRossi of Italy and Forel of Switzerland collaborated to produce the first widely accepted intensity scale. This scale was used as a basis for several subsequent scales. In 1902, the Rossi-Forel scale was expanded and improved by Mercalli, and in 1904 Cancani published the scale with the addition of levels of acceleration as criteria. These works were consolidated and revised by Sieberg in 1923, and finally the latter work was revised and modified by H.O. Wood and Frank Neumann in 1931. This became the Modified Mercalli (MM) Intensity Scale, which has been used in the United States since that time as the standard (appendix A).

Beginning with the work of the United States Coast and Geodetic Survey (USC&GS) in 1928, there has been a continuing program of collecting comprehensive reports on all earthquakes affecting areas within the United States and its territories. This has been accomplished through the cooperation of state collaborators, especially in the Western States; through systematic questionnaire canvasses of

postmasters, police departments, weather observers and others; through field surveys; and through extensive analysis of news reports.

The objective of this study funded by the Nuclear Regulatory Commission is to extract from these data as much useful information as possible concerning seismic history and the significance of intensity as a seismic indicator. Specifically, four goals are attempted:

- a. To develop a method for calculating and plotting isoseismal maps by electronic computer/plotter;
- b. To derive empirical formulas expressing the attenuation of intensity with distance and area for the conterminous United States and various subregions;
- c. To redefine the relationship between magnitude and maximum intensity;
- d. To explore the relative attenuation between different regions of the United States and to define them quantitatively.

Many investigators have worked on various aspects of the types of intensity analyses covered in this report. In particular, Gutenberg and Richter (1942) and (1956) presented a most definitive study of the relationships among earthquake energy, acceleration, magnitude, and intensity. Many of the results presented in the following pages, though empirical, are based on their theoretical concepts. Formulations similar to theirs are applied to a much more extensive data set in the determination of maximum intensity versus distance and area of perceptibility, and in magnitude-intensity relationships.

These relationships are determined independently for the traditional seismic regions in the conterminous United States, within which, in a very broad sense, seismic conditions are assumed to be similar. These regions, based roughly on the time zones, are designated in this study as: 8-California and Western Nevada; 8N-Washington and Oregon; 7-Western Mountains; Western United States (combining 8, 8N, and 7); 6-Central Region; 5-Eastern Region; and Eastern United States (combining 5 and 6). Figure 1 depicts these divisions.

2.0 DATA PREPARATION

The intensity data collected by the USC&GS and its successors (ESSA-1966, NOAA-1969, and U.S. Geological Survey-1973) have been published in the annual *United States Earthquakes* for the years 1928 through 1973. In addition, more detailed information on earthquakes in the Western States has been published quarterly from 1934 onward in the *Abstracts of Earthquake Reports*. In order to make uniform analyses of these data with the view of producing useful, verifiable results for ready reference, they have been encoded on magnetic tape. Each data record on tape contains the date and time of the earthquake, the time zone in which it occurred, epicenter, magnitude, maximum intensity, town affected, its location, the intensity reported from there, and its distance from the epicenter. The intensities are expressed on the Modified Mercalli (MM) scale (see appendix A).

It is very difficult to apply the MM intensity scale objectively. It must be regarded, particularly in the lower grades, as a measure of the reactions of

the populace. Intensity can be quantified only to the degree that these reactions, with their multiplicity of possible variations, are similar in response to similar stimuli, i.e., magnitude and frequency of vibration. The questionnaire (appendix B) is designed to reflect this wide variation of reaction and to present to the respondent a series of descriptive phrases from which he may select those most nearly approximating his experience during the earthquake.

Because many persons over the years have had responsibility for evaluating these reports, there are notable inconsistencies among the published intensity assignments. As stated by Richter (1958), the intensity at a reporting community can be regarded as the mode of the effects reported. However, a careful examination of the data file indicates the intensity assignments in most instances are based either on a single report or on the maximum effect reported. Some investigators departed from this practice and tried to select modal values with the result that, for several extended periods, the intensity assignments are systematically lower than the norm. To reduce these variations somewhat, the author has reevaluated the input material, applying the MM scale as literally as possible. Since, inevitably, there remains a personal bias, both the originally assigned and the revised intensities are carried in the tape file.

Evernden, et al (1973) have noted that the method of questionnaire canvass and the population distribution emphasize the effects in the valleys and sometimes obscure the intervening ridges completely. This is demonstrated very well, in this study and earlier, in the evaluation of the effects of the earthquake in southern Illinois, November 9, 1968. The isoseismals for that earthquake run orthogonal to the northeast-southwest trending structure of the Appalachian Mountains and give no evidence of what one would suppose to be lines of lower intensity along the ridges. Thus, given the method of assigning intensity based on the highest effect reported and the method of collecting the data, it can be stated that the intensity data file represents the average alluvial conditions, and the areas and distances derived here are the maximum probable values to be expected.

The tape file presently contains over 80,000 reports and, when completed, will include a notation for every report cataloged from 1928 through 1973, about 100,000 in all. The file will be updated annually and plans call for the addition of information on earthquakes prior to 1928 plus any information not included in the present source material which can be gleaned from other sources: town records, local collections, local investigators such as Bollinger (1973), etc.

3.0 ANALYSES

1. Development of a method of calculating and plotting isoseismal maps by electronic computer/plotter. The available maps, published in the *United States Earthquakes* series, vary a great deal in the methods and philosophy used in their construction. At best, these isoseismals serve only to guide the eye and to give a general impression of the affected areas. For this reason the individual intensities reported have been plotted on the published maps. The difficulties

apparent in assigning representative areas for the intensities experienced in an earthquake are several: First, one must assume a gradient based on what are in reality discrete points. There is a gradient, of course, but it is severely masked by a number of first-order effects. The heterogeneity of the sensing devices, i.e., buildings, bridges, dams, etc., and the lack of knowledge of their prior condition limit the usefulness of specific data. The effects of geology or urbanization can easily account for a variation of one level of intensity. Second, presuming a gradient exists, one must decide how detailed the contour must be to represent legitimately the energy distribution. It is possible to contour the data exactly, leaving no excluded points, but it is generally accepted that to be meaningful the contours must be smoothed. Third, one must then develop a philosophy for excluding really spurious data. This philosophy must include an accurate explanation of the resulting contours.

With these difficulties taken into account, a method is developed for the systematic derivation of isoseismals so that the distribution of intensities with respect to area and epicentral distance for earthquakes of given maximum intensities or magnitudes can be made. The method involves the assumption of uniform radial attenuation between reporting points and establishes an arbitrary model. The data for an earthquake are first used to determine a macrocenter. This is accomplished by determining the mean geographic coordinates for each intensity and taking a weighted average of these means, the weighting factors being the intensities themselves. Each macrocenter is compared to the corresponding epicenter and if the latter is offshore or in Canada or Mexico, the isoseismals are centered on it; otherwise, they are centered on the macrocenter. For each 15° sector around the center, the distance to the farthest maximum intensity point is determined and entered in the tableau or matrix from which the subsequent interpolations are made. The next point beyond this maximum for the next lower intensity is entered as a minimum and the farthest point of that intensity is entered as maximum, etc. This continues to the lowest intensity reported in each sector. The resultant tableau comprises 24 columns (15° sectors) of increasing real points expressed as distances. The only limitation on the raw data is that no point is used that exceeds twice the modal distance of all the reported values of that intensity. Interpolation of isoseismal points is then made radially outward according to the diagram, figure 2, with an extrapolation of one value beyond the last real data point. The various conditions that are encountered are treated as follows:

a. When two successive maxima are reported, the isoseismal point for the higher intensity is placed beyond the reported maximum for that intensity .25 times the distance between the reported maxima.

b. When a maximum and succeeding minimum for the next lower intensity are reported, the isoseismal point for the higher intensity is placed halfway between the reported points.

c. When the highest intensity is not reported in a sector, interpolation is made by dividing the distances of the first reported maximum or minimum into quarters, counting two quarters for the highest intensity, four-quarters for

each intervening intensity, and one-quarter if the reported point is a minimum and three-quarters if it is a maximum. Isoseismals are then determined outward by the formula $\Delta \cdot (4N-2)$ where Δ is the $\frac{1}{4}$ distance and N is the isoseismal number, counted outward from the center.

d. Radial extrapolation sets the isoseismal distance beyond the lowest maximum reported at one-quarter the distance between that maximum and the maximum for the next higher intensity, or if a minimum is reported for the lowest intensity the extrapolated point is placed beyond the maximum one-half the distance between the reported points.

Finally, circumferential interpolation is made to fill the columns of the tableau. These values are then smoothed circumferentially, with the constraint that no real data point fall outside the corresponding isoseismal, and contours are drawn through the smoothed points. The isoseismals thus produced are not necessarily more correct than those previously published, but because they are systematically derived, the areas and distances relate more uniformly to other seismic parameters.

Seismic History. This frequently used indicator has been based in the past on actual reports from a point or an area. As a result of the above development, it is now possible to determine the number of times since 1928 a locale was subjected to seismic disturbances, though not necessarily reported, by noting the number of times it was included in the isoseismal area of earthquakes, some of which may have occurred at considerable distances from the area of interest.

Figures 3 through 7 are contour maps for each intensity based on the history of the past 46 years, while figure 8 is a contour map of the maxima for each degree of latitude and longitude. Data used include those determined through the evaluation of isoseismals plus a count of shocks too small or not well enough recorded to permit the construction of isoseismals. This count of smaller events is only applied to the area east of 106° west longitude. Data are much more numerous for the Western U.S. so that the history based on shocks large enough to be in our isoseismal file can be considered representative. Smaller Western events are being added to the file at present. The input data for each degree of latitude and longitude that formed the bases for the contour maps are given in tables 1 through 10 (appendix C).

Recurrence Rates. A further benefit accruing to the systematic derivation of isoseismals is a method of determining recurrence rates. These have been studied extensively by Blume (1965), Newmark (1967), Cornell (1968), Stepp (1972), and many others. Cornell (1968) points out the importance of recurrence rates or return periods but applies his analysis to well-defined fault systems and to areas of well known local geology. Stepp (1972) applies the Type I extreme-value distribution of Gumbel (1958) to 744 shocks occurring in the Puget Sound area from 1820 to 1969. He emphasizes the importance of completeness of the data sample and cites the standard deviation of the mean rate of recurrence versus the total time T as a measure of this completeness. He states that the length of the time sample should be at least five times the return period in order for the sample to be considered complete.

The analysis in the present study does not take into account local geology or tectonic structure (Cornell, 1968), nor does it require that each event be independent, nor is the return period/sample length ratio considered (Stepp, 1972). It is based on two assumptions which are designed to enhance the effectiveness of the data sample: First, for every maximum intensity incurred in an area each lower intensity is assumed to have been experienced, and second, in this analysis the rate of recurrence is assumed to be constant for an area of arbitrary radius (400 km) around the point in question. The first of these assumptions is easily verified by reference to the intensity reports. The second has been tested at approximately 20 randomly selected points and in no case was a systematic variation evident in the b values (slopes) as the radius of the area around the point increased to the 400-km limit.

The data are summed for areas of increasing radius in 50-km increments. Curves of the form $\ln N = a + bI$, where N is the number of intensities occurring per year, are then calculated for each radius and the mean slope (b) is determined. The mean intercept (a) is determined by solving the series of equations $a = \ln N_i + bI$ for each intensity at $r = 50$ km and taking the mean. The curves derived for several points are shown in figures 9 through 16. The actual data for $r = 50$ km are plotted on the curves. Where data are numerous they fit the curves very well and where they are not it is believed that the curve is more representative of the recurrence rate than of the local data sample. Since the data are interdependent, these curves should not be used to project the probability of occurrence to intensities beyond the highest recorded. However, they are in good agreement with the historical information and should be good indices for the prediction of future activity within the range of the recorded intensities.

2. Attenuation of intensity with respect to distance and to isoseismal area.
The data are examined here with a view to providing an estimate of the effects of earthquakes of known maximum intensity occurring at a distance from a point of interest.

In conjunction with the derivation of the isoseismal maps, the area enclosed by each isoseismal is calculated and the mean effective isoseismal distance is determined based on the 24 sector distances of the isoseismal tableaux. Owing to the irregularities of isoseismals, these distances can in some instances vary considerably from the radii that would result if the isoseismal areas were assumed to be circles. Since the mean distances are derived directly from the data, they are considered more representative of intensity attenuation and afford a relatively independent check on the area formulas.

For each of the five seismic regions in the U.S., the data are grouped according to maximum intensities (I_0). For this phase of the analysis, shocks such as those offshore or in Mexico or Canada are eliminated unless the true maximum intensity has been determined. The mean value (area) for each intensity step (I) less than or equal to each maximum intensity (I_0) is calculated. A least-squares curve for each intensity (I) of the form $\ln A = a_I + b_I I_0$ is derived. Tables 11 through 17 (appendix C) list the coefficients and the standard errors

for curves of area versus maximum intensity (I_o) for intensities (I) from III to XII for each region. Because reported intensities I, II, and III are usually grouped as intensity I-III in the source material, this group is designated as III in this report and as 3 in the derived formulas. The data for the higher intensities are sparse and subject to considerable scatter, so that the intercepts and slopes for the higher intensity curves (area versus I_o) are based on extrapolations of curves fitted to the a_i and b_i values for the well-defined curves of the lower intensities. The standard linear regression errors for each set of regional curves are derived as follows:

The standard error of estimate of area (y) on maximum intensity (x),

$$S_{xy} = \sqrt{\frac{\Sigma (y - y_c)^2}{n}} \quad (1)$$

the standard error of the intercept,

$$S_a = S_{xy} \cdot \sqrt{\frac{\Sigma x_i^2}{n \left[\Sigma x_i^2 - \frac{(\Sigma x)^2}{n} \right]}} \quad (2)$$

and the standard error of the slope,

$$S_b = \frac{S_{xy}}{\sqrt{\Sigma x_i^2 - \frac{(\Sigma x)^2}{n}}} \quad (3)$$

Figures 17 through 23 depict these curves of area versus maximum intensity for each intensity (I) for the Western U.S. (west of 106° W), the Eastern U.S. (east of 106° W), and for Regions 8, 8N, 7, 6, and 5. The data plotted are the mean values normalized to the isoseismal for intensity IV.

Figure 24 is a three-dimensional diagram depicting the distribution of intensities reported with respect to the mean curve. In this instance, the curve shown is the area versus maximum intensity for intensity III, Region 8. As is evident, the curve represents an envelope enclosing a large portion of the data. The vertical ticks in the foreground on each line represent the largest values reported.

Figures 25 through 31 give the curves and equations for distance versus maximum intensity. The distances were treated in the same manner as the areas. The sets of coefficients and the corresponding standard errors for these curves are given in tables 18 through 24 (appendix C).

Curves for the Western U.S., Region 8, and Region 7, are based on 963, 751, and 118 earthquakes, respectively. The unadjusted means were used to determine the curves by least-squares fit. The normalized data, as plotted, were not used in these determinations. The attenuation models are well established statistically for these regions. However, curves for the Eastern U.S. and Regions 8N, 6, and 5 were subject to scatter and crossovers so that individual adjustments were necessary. The curves for intensities III, IV, and V in each instance are generally statistically representative but some constraints have been placed on the data, based on the Western and Region 8 models. In each instance the curve for intensity IV is accepted and values for intensity $I_0 = XII$ based on the curves developed for the Western U.S. are introduced for each of the other curves, III and V through XII. These constraints are not absolute but are used in the above fitting process as one data point per curve. Minor adjustments are then made to bring the curves into line with the normalized points and to maintain an internal consistency for each set.

3. Magnitude versus maximum intensity. As pointed out by Karnik (1969) the uniform classification of earthquakes for statistical studies depends on the correlation of the instrumentally derived quantities of magnitude (M) and depth of focus (h) and the maximum intensity (I_0).

Karnik (1969) lists 16 formulas derived by various investigators in Europe and Asia and by Gutenberg and Richter for California. They generally take the form $M = a_1 I_0 + b_1 \log h - c_1$, or if the depth is held constant $M = a_2 I_0 + b_2$. Gutenberg and Richter (1956) state the relationships for California as:

$$M = .6I_0 + 1.8 \log h - 1.0 \quad (4)$$

$$M = 2/3 I_0 + 1.0; h = 18 \text{ km} \quad (5)$$

Magnitude Versus Area of Perceptibility. As a preparatory step in determining the relationships between M_L and I_0 , the magnitude (M_L) versus the area of perceptibility has been determined. This concept is important in evaluating the energy released by earthquakes which occurred prior to the development of magnitude scales and by earthquakes too small or too poorly recorded instrumentally to have provided data necessary for the direct determination of magnitudes. Magnitudes contained in the EDS epicenter data file are derived from several sources--USGS, USC&GS, Pasadena Seismological Laboratory, Berkeley Seismological Laboratory, Lamont-Doherty Geophysical Laboratories, Uppsala, Strasbourg, and others. They occur as M_L , m_b , and M_S , which are not strictly commensurate. The preponderance

of the magnitudes given in the file are M_L , so all other magnitudes used here are converted to it. Many investigators have established m_b/M_L and m_b/M_S relationships. Richter (1958) gives $m_b = 2.5 + .63 M_S$, and $m_b = 1.7 + 8 M_L - .01 M_L^2$. Bath (1973) gives $m_b = 2.9 + .56 M_S$. Karnik (1969) introduces a range of complex relationships for magnitudes derived from a variety of waves--P, PP, S, and LH. Willis, et al (1974) comparing data from 339 earthquakes find:

$$m_b = 2.43 + .48 M_L \quad (6)$$

$$M_b = 4.40 - .48 M_L + .11 M_L^2 \quad (7)$$

$$M_S = -1.91 + 1.33 m_b \quad (8)$$

$$M_S = 8.33 - 2.59 m_b + .37 m_b^2 \quad (9)$$

In view of the variations of these results and the difficulty in choosing a standard, the 95 shocks in our file, for which both m_b and M_L were available, were used to derive a relationship

$$M_L = 1.34 m_b - 1.71 \quad (10)$$

The M_S values on file comprise a small but very important portion of the total. To convert these to M_L equation (10) was combined with the Willis formula (9) to produce

$$M_L = 2.20 \sqrt{M_S - 3.80} + 2.97 \quad (11)$$

Figures 32 through 38 give the magnitude (M_L) versus area of perceptibility for the seven regions based on these magnitude conversions and the derived iso-seismal areas, while table 25 (appendix C) gives the coefficients and standard errors for these regional curves.

Once the relationships of magnitude to area and I_o to area are defined it is possible to relate M_L to I_o by comparing their relationship to the same areas, thus:

$$\ln A = a_m + b_m M_L = a_I + b_I I_o \quad (12)$$

$$\text{or} \quad M_L = k_1 + k_2 I_o \quad (13)$$

$$\text{where} \quad k_1 = \frac{a_I - a_m}{b_m} \quad \text{and} \quad k_2 = \frac{b_I}{b_m} \quad (14)$$

assumptions that would have to be made in assigning depths in areas other than California would be so broad as to rob the depth factor of any significance. In the formulas where the depth is held constant, the term "b log h" is included in the constant term.

The equation for Region 8 becomes:

$$M_L = .49 I_0 + 1.8 \log h - .11 \quad (15)$$

using the Gutenberg and Richter depth term $1.8 \log h$ and $h = 18$ km. This is not appreciably different from equation 4.

4. Comparisons of areas of perceptibility for various regions for earthquakes of the same maximum intensity. It has been recognized for many years that earthquakes of like magnitudes or like maximum intensities occurring in different regions produce a wide variation in areas of perceptibility, with the Eastern and Central Regions being as much as 100 times greater than those resulting from comparable earthquakes in California (Nuttli and Zollweg, 1974). By equating the empirical formulas derived here for area versus I_0 (tables 10-15, appendix C), it is possible to derive relationships for the various isoseismal areas in different regions. As an example, the ratio of areas of perceptibility (III) for Regions 8 and 5 are respectively:

$$\ln A_5 = 5.828 + .883 I_0 \quad (16)$$

$$\ln A_8 = 6.134 + .706 I_0 \quad (17)$$

$$\ln A_5/A_8 = -.306 + .177 I_0 \quad (18)$$

Thus, the ratio is shown to vary with I_0 for $I_0 = III$, $A_5/A_8 = 1.25$ and for $I_0 = X$, $A_5/A_8 = 4.32$. Table 33 gives the ratios between the regions of largest expected variations. Shocks such as the Charleston, S.C., earthquake of 1886, the Timiskaming, Canada, earthquake of 1936, and the southern Illinois earthquake of 1968 far exceed the ratios for the mean values determined here. It is these relatively anomalous shocks that have given rise to the high values cited so often in the literature.

4.0 DISCUSSION

The data file used for this study is unique in its completeness, scope, and accessibility. Every effort has been directed toward uniformity and accuracy.

It stands on its own merit as a contribution to seismological history. The analysis performed here is largely the application of standard techniques with minor modifications with the aim of deriving relationships among magnitude, intensity, and attenuation that will have wide practical application. Because much of the work is strictly empirical, the processes have been described in some detail. Care has been taken to include as much of the data as possible in order not to prejudice the results. Considering the wide variations among and the subjective nature of intensity evaluations, they exhibit a surprising coherence. This is evident in the historic recurrence curves, attenuation models for distance and area for the Western U.S. and Regions 8 and 7, and in the magnitude/ I_0 relationships. The tabular data are the results of the careful analyses of this extensive file and should give reasonable assurance that future activity will conform, in general, to the relationships set forth.

It is obvious that many of the approaches used in this study are based on arbitrary decisions. Other approaches incorporating some refinement could be used and would produce meaningful results. However, the subjective nature of intensity data limits the degree of exact analysis that is warranted. Some of the limitations on the results presented should be noted:

1. The technique for determining isoseismals is only one of many that could be used. The supposed radial distribution of points could be based on the mean value plus one standard deviation or some fixed factor such as 1.6 or 2. A single report could be regarded as a mean distance rather than a maximum. Very detailed interpolation could be used, etc. However, these changes would present only small variations in the general average results and they would be much reduced by any reasonable smoothing technique. They would become insignificant in results derived from the treatment of the total data set. The areas and distances derived here for each earthquake are considered representative of the general attenuation while also accounting for characteristic variations for each earthquake.
2. Figure 8 can be considered a true contour map representing the intensity gradient for the 46-year period (1928-1973). However, the contours in figures 3 through 7, representing the distribution of intensity occurrences over the entire range, do not represent gradients but are based on discrete numbers. They are merely a graphic representation of the intensity file.
3. As has been stated previously, the usefulness of the method of determining recurrence rates is limited to interpolation because of the interdependence of the data and the lack of an adequate test for the effectiveness of the sample length.
4. Figure 17, in addition to the data normalized to the isoseismal for intensity IV, includes the raw data (at the tail of the arrows) to illustrate that the normalizing process brings out the uniformity of attenuation within the intensity grades. Areas and distances that are too large in the lower grades are characteristic and, since they present a physical contradiction, it must be assumed that some determinant factors in the MM scale should be grouped in

the next higher intensity. There is also a tendency in the higher ranges, not evident in figure 17, for values to fall above the curves. This may be regarded also as a failure of the MM scale to differentiate intensity effects properly, although some of this variation may be due to nonrepresentative data and conservatism on the part of those evaluating the reports.

Gutenberg and Richter (1942) developed the equation of Blake (1941) in the form $aD = k \cos i \sqrt{E}$ by considering AD^2/T^2 constant so that:

$$\frac{AD^2}{T^2} = \frac{A_0 h^2}{T_0^2} \quad (19)$$

and applying the inverse square radiation law which assumes hA_0/T_0 is proportional to the square root of the radiated energy. Also assuming T_0 will be constant of a wide range of depth and noting that,

$$A = \frac{aT^2}{4\pi^2} \quad (20)$$

equation 19 reduces to

$$\frac{aD^2}{h} = k \sqrt{E} \quad (21)$$

For straight rays $h = D \cos i$ and equation 21 becomes

$$aD = k \cos i \sqrt{E} \quad (22)$$

They found an empirical relationship

$$\log a = I/3 - 1/2 \quad (23)$$

and combining equations 21 and 23 obtained

$$I/3 + 2 \log D = k \quad (24)$$

and

$$I_1 - I_2 = 6 \log (D_2/D_1) \quad (25)$$

which for a difference of one intensity gives their relationship

$$D_I = 1.47 D_{I+1} \quad (26)$$

They state that any variations from this ratio represent changes in depth. While this development is accepted in the present study as an excellent argument for regular attenuation, based on our data the ratio as expressed in equation 26 is not constant. Table 34 (appendix C) lists the factors corresponding to the 1.47 of equation 26 as indicated by the curves derived for the Western U.S. Similar tables could be developed for the other regions. Both Blake (1941) and Gutenberg and Richter (1942) point out the arbitrariness of some of the assumptions that went into the derivations of equation 26 such as uniform absorption regardless of depth and straight line propagation (homogeneous, non-layered media). Since the variations found here could not be a systematic variation in depth, they are probably due to the complexity of the crust which will not permit approximation by a simple model.

Some of the smoothing and extrapolation that is used in obtaining attenuation curves for the higher intensities may be open to question because they are necessarily subjective and nonstatistical. However, the envelopes for each region, that is, curves for intensities III, IV, and V, are well established and tend to constrain the curves for the higher intensities to logical values. A further corroboration of the reasonableness of the attenuation models is that each region was analyzed independently to the degree possible, using several approaches, and a cross-check of the results shows a fair consistency. When better data are available and more rigorous methods are applied it is difficult to envision results that will be substantially different, for practical applications, from those derived herein.

5.0 NOTATION

R.F.	- Rossi-Forel Intensity Scale
M.M.	- Modified Mercalli Intensity Scale
I_0	- maximum intensity
I	- specific intensities less than or equal to I_0
A	- area (km^2); amplitude (cm)
Δ	- epicentral distance (km)
h	- depth (km)
D	- hypocentral distance (km)
a_I	- intercept of area or distance curve for any intensity, $I \leq I_0$
b_I	- slope of area or distance curve for any intensity, $I \leq I_0$
y	- mean distance or area used in standard error formulas
y_c	- calculated distance or area used in standard error formula
M_L	- local magnitude - generally confined to southern California
m_b	- body-wave magnitude
M_s	- surface-wave magnitude
a_m	- intercept of the M_L versus area curves
b_m	- slope of the M_L versus area curves
A_0	- amplitude at the epicenter (cm)
T_0	- initial period (sec)
T	- period (sec)
E	- energy (ergs)
i	- angle of incidence
a	- acceleration (cm/sec^2)

6.0 ACKNOWLEDGMENTS

Acknowledgment is given to the Nuclear Regulatory Commission, which funded this study under Interagency Agreement No. AT(49-25)1004. Special appreciation also is due to Mr. Robert Glacken whose competence in computer science and mathematics was indispensable and to Miss Nancy Robertson for her dedication and diligence in checking and rechecking our calculations, tables, and illustrations.

7.0 REFERENCES

Bath, Markus, *Introduction to Seismology*, John Wiley and Sons, New York-Toronto, 395 pp, 1973.

Blake, A. "On the Estimation of Focal Depth from Macroseismic Data," *Bull. Seis. Soc. Am.*, Vol. 31, pp 225-231, 1941.

Blume, J.A., "Earthquake Ground Motions and Engineering Procedures for Important Installations Near Active Faults," *Proc. Third World Conf. on Earthquake Engr.* (New Zealand), IV-53, 1965.

Bollinger, G.A., "Seismicity of the Southeastern United States," *Bull. Seis. Soc. Am.*, Vol. 63, No. 5, October 1973.

Cornell, C. Allin, "Engineering Seismic Risk Analysis," *Bull. Seis. Soc. Am.*, Vol. 58, No. 5, October 1968.

Evernden, Jack F., Richard Hilbard, and Joseph F. Schneider, "Interpretation of Seismicity Data," *Bull. Seis. Soc. Am.*, Vol. 63, No. 2, April 1973.

Gumbel, E.J., *Extreme Value Statistics*, Columbia University Press, New York, 1958.

Gutenberg, B. and C.F. Richter, "Earthquake Magnitude, Intensity, Energy, and Acceleration," *Bull. Seis. Soc. Am.*, Vol. 32, No. 3, July 1942.

Gutenberg, B. and C.F. Richter, "Earthquake Magnitude, Intensity, Energy, and Acceleration (Second Paper)," *Bull. Seis. Soc. Am.*, Vol. 46, No. 2, April 1956.

Karnik, V., *Seismicity of the European Area*, Vol. 1 and 2, D. Reidal Publishing Co., Dordrecht, Holland, 581 pp, 1969, 1971.

Newmark, N.M., *Design Criteria for Nuclear Reactors Subjected to Earthquake Hazards*, Urbana, Ill., 1967.

Nuttli, Otto W. and James E. Zollweg, "The Relation Between Felt Area and Magnitude for Central United States Earthquakes," *Bull. Seis. Soc. Am.*, Vol. 64, No. 1, February 1974.

Richter, C.F., *Elementary Seismology*, W.H. Freeman and Co., San Francisco, 768 pp, 1958.

Stepp, J.C., "Analysis of the Completeness of the Earthquake Sample in the Puget Sound Area and Its Effect on Statistical Estimates of Earthquake Hazards", *Proc. Intl. Conf. on Microzonation of Safer Construction Research and Application*, Seattle, Wash., 1972.

Willis, D.E. et al, *Explosion Induced Ground Motion, Tidal and Tectonic Forces and Their Relationship to Natural Seismicity*, Dept. of Geol. Sci., Univ. of Wisconsin, December 1974.

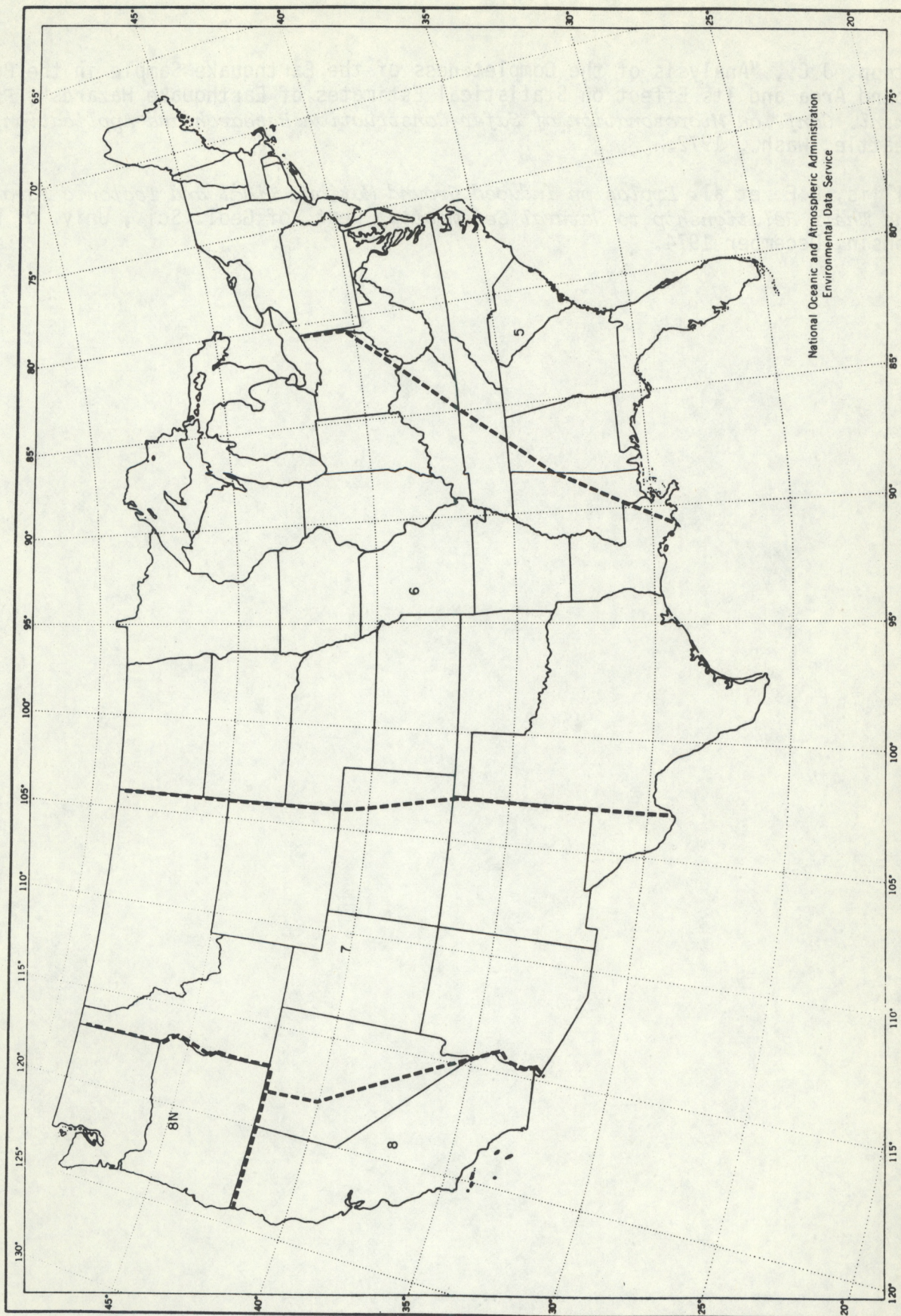


Figure 1. Regional divisions by which earthquakes in the file are grouped for independent study

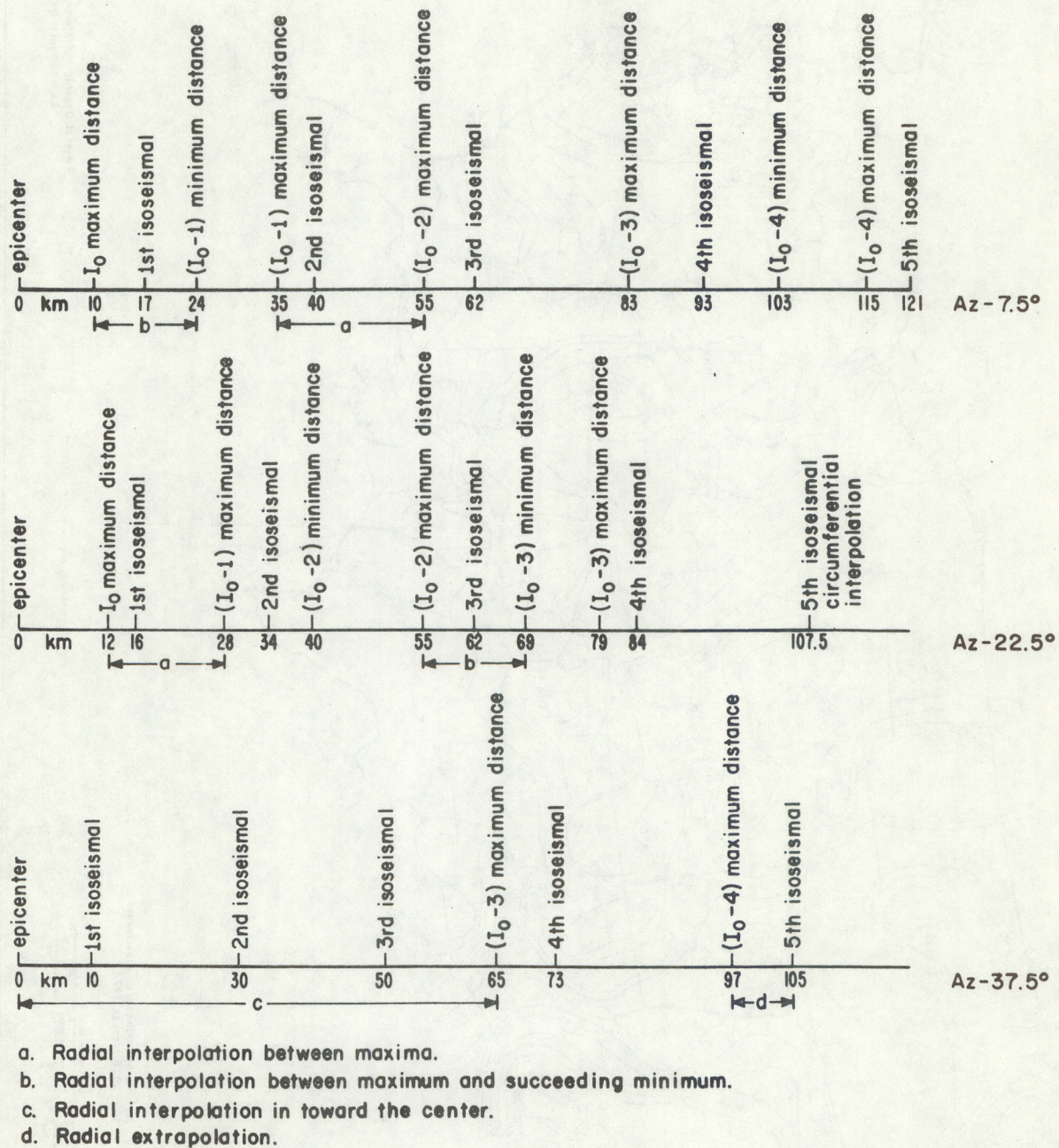


Figure 2. Schematic outline of convention for determining isoseismal distances





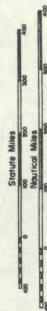
Figure 4. Number of earthquake intensities IV or greater experienced from 1928 through 1973.

Statute Miles
0 50 100 150 200

National Oceanic and Atmospheric Administration
Environmental Data Service



Figure 5. Number of earthquake intensities V or greater experienced from 1928 through 1973.



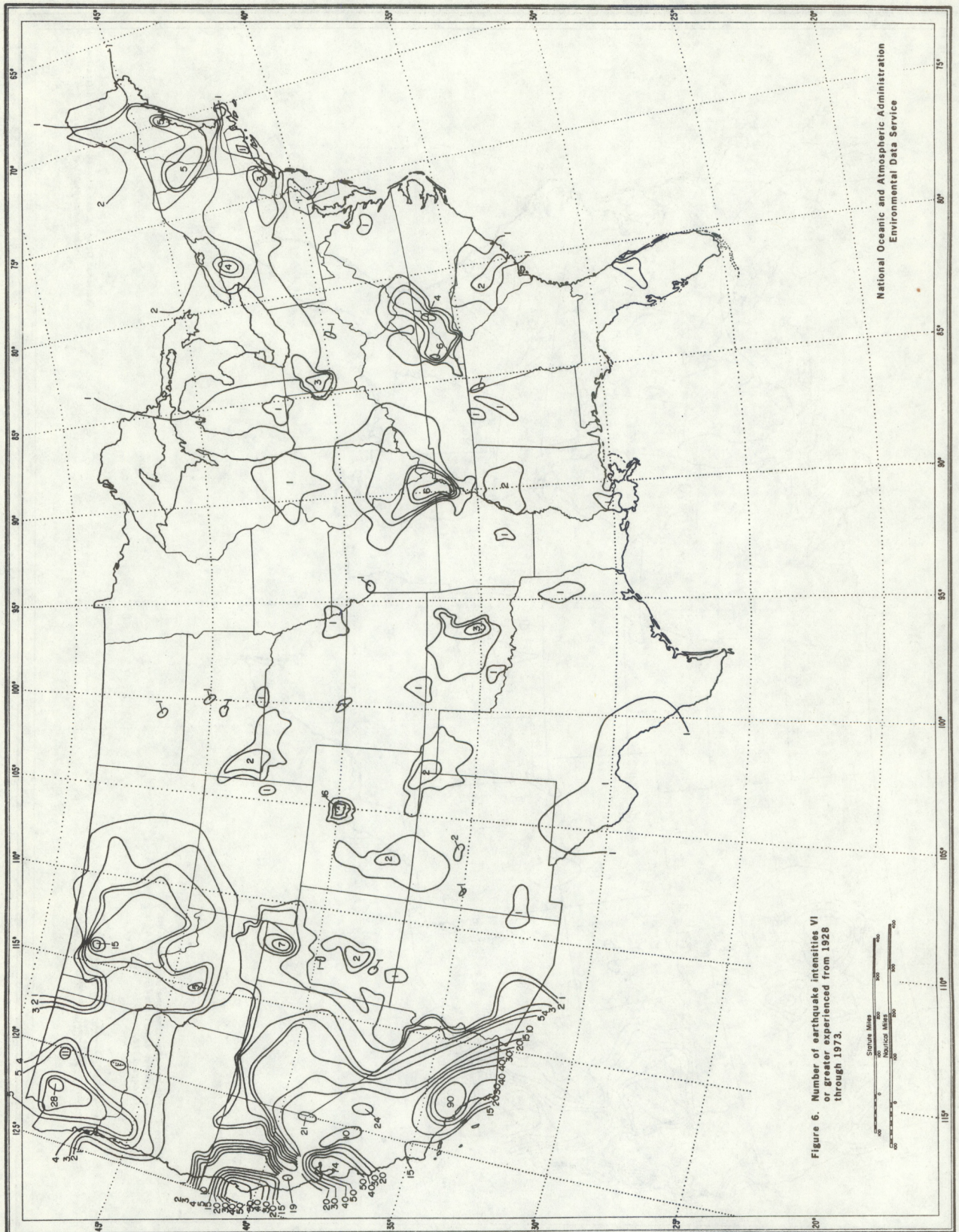
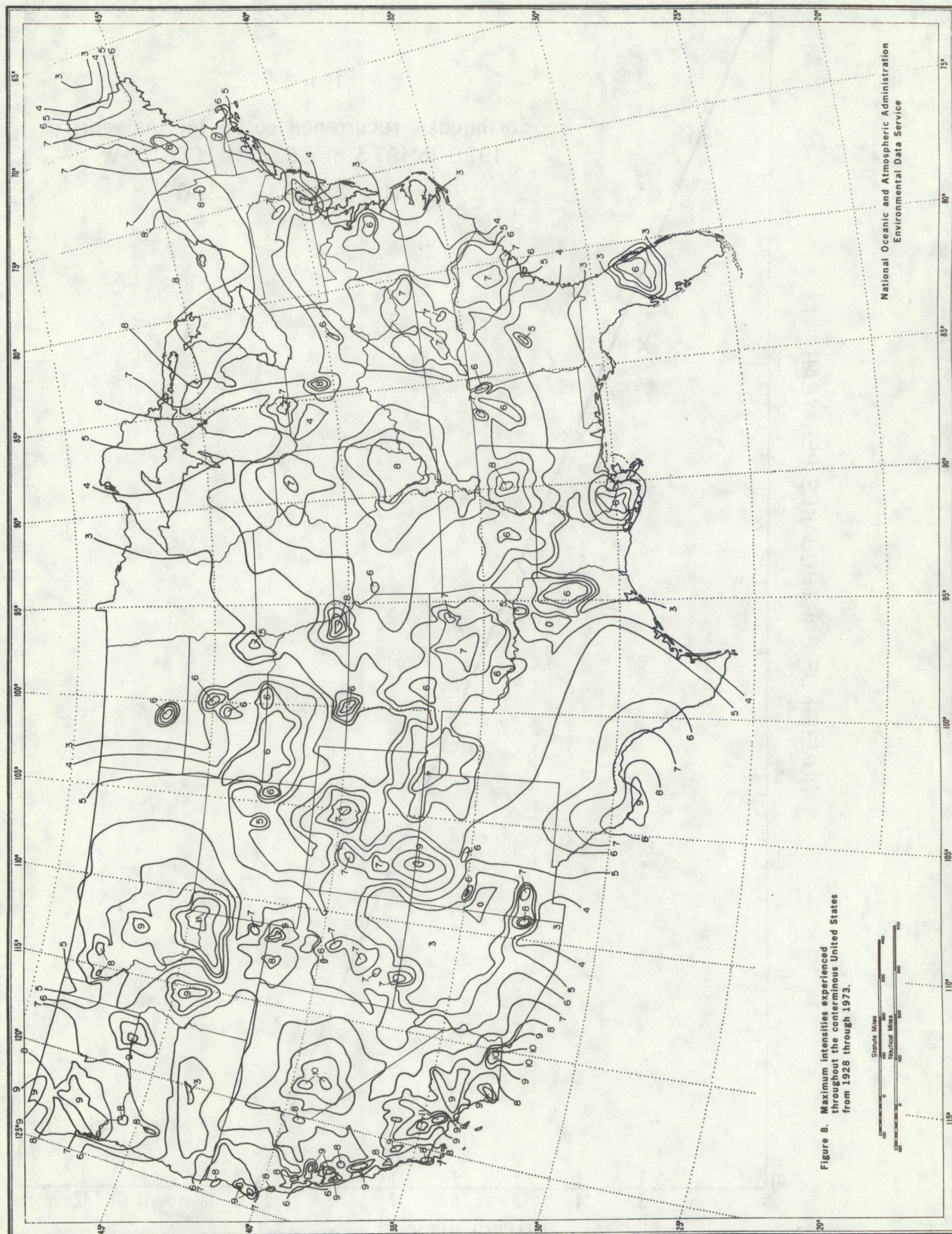
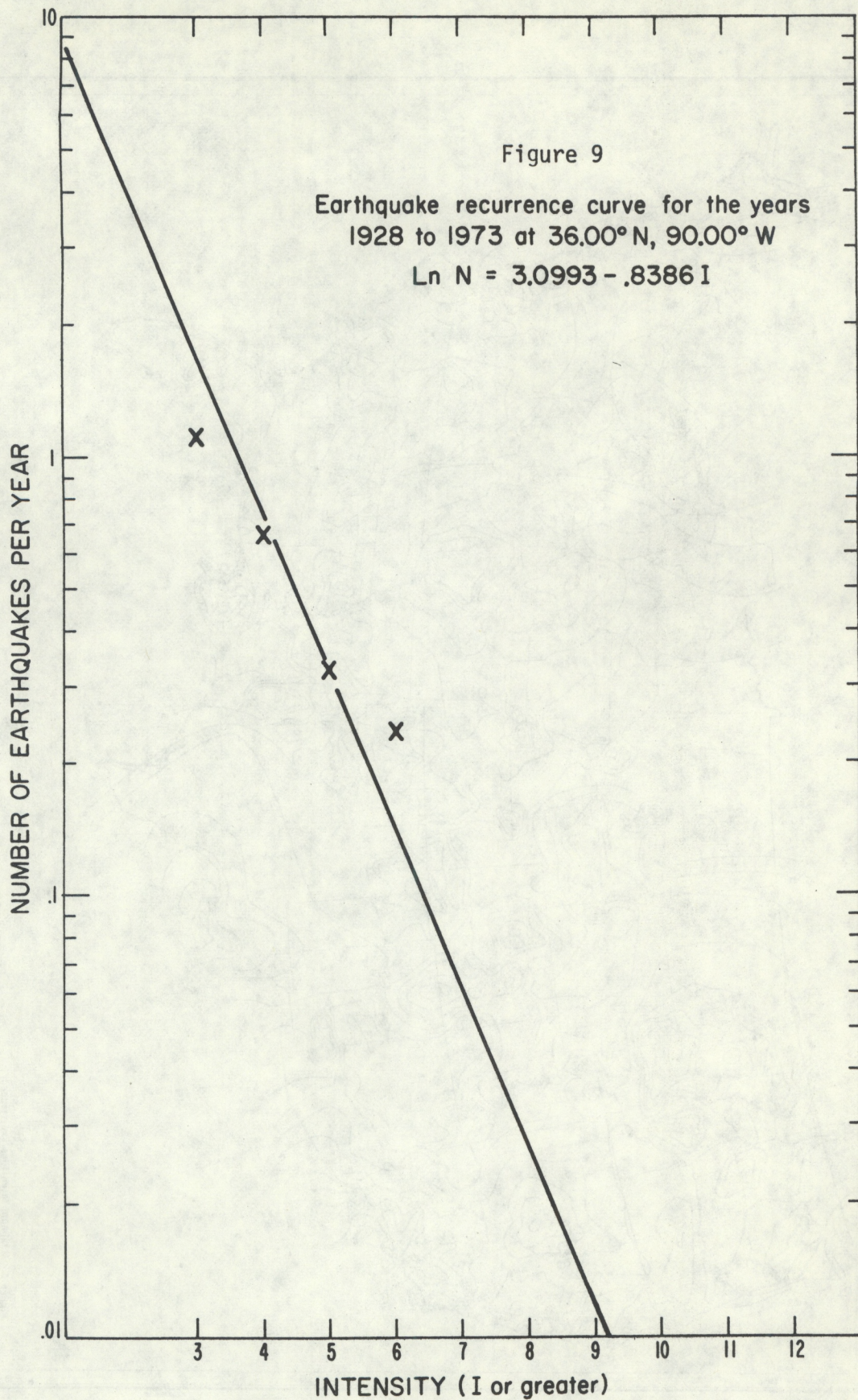


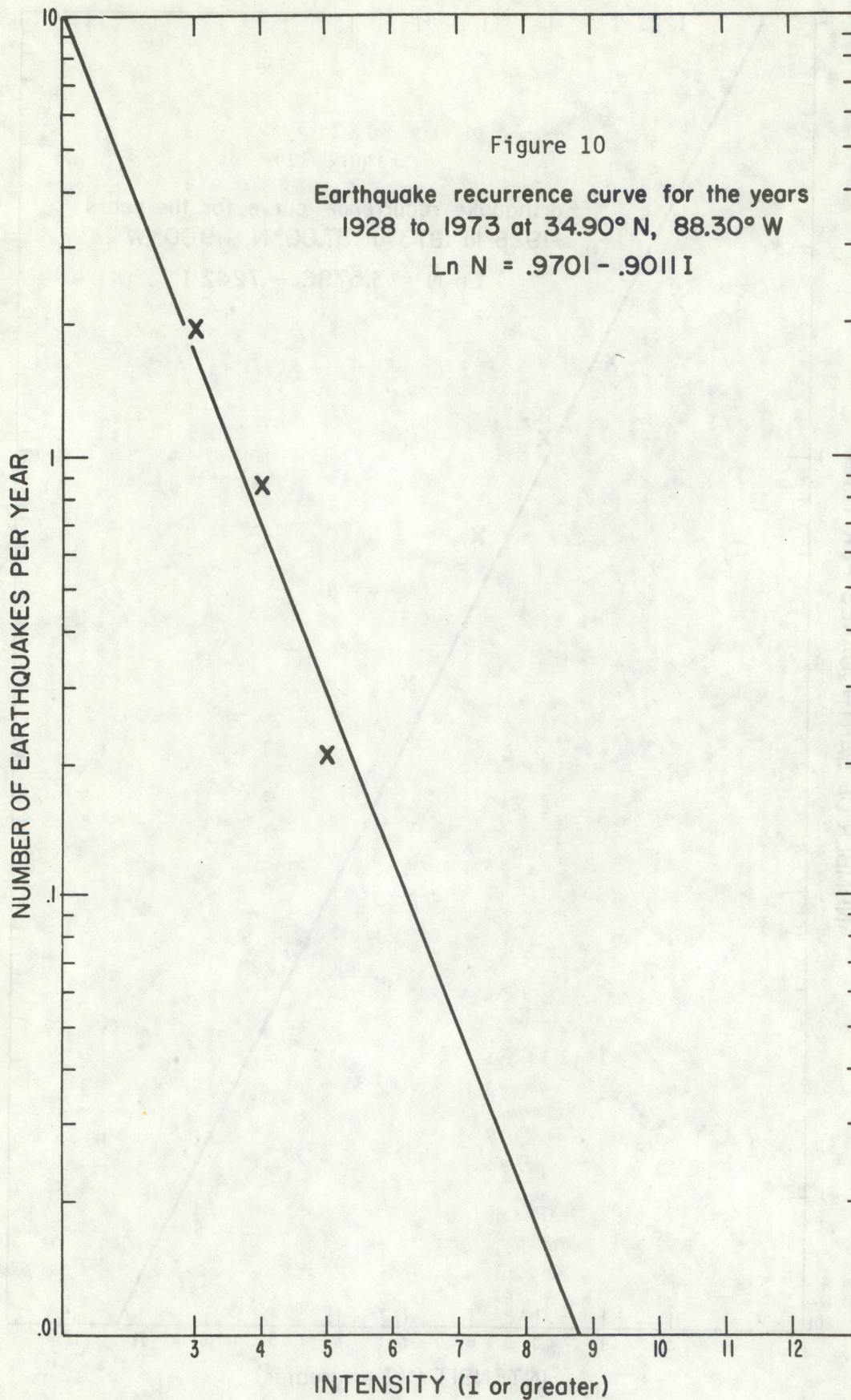
Figure 6. Number of earthquake intensities VI or greater experienced from 1928 through 1973.

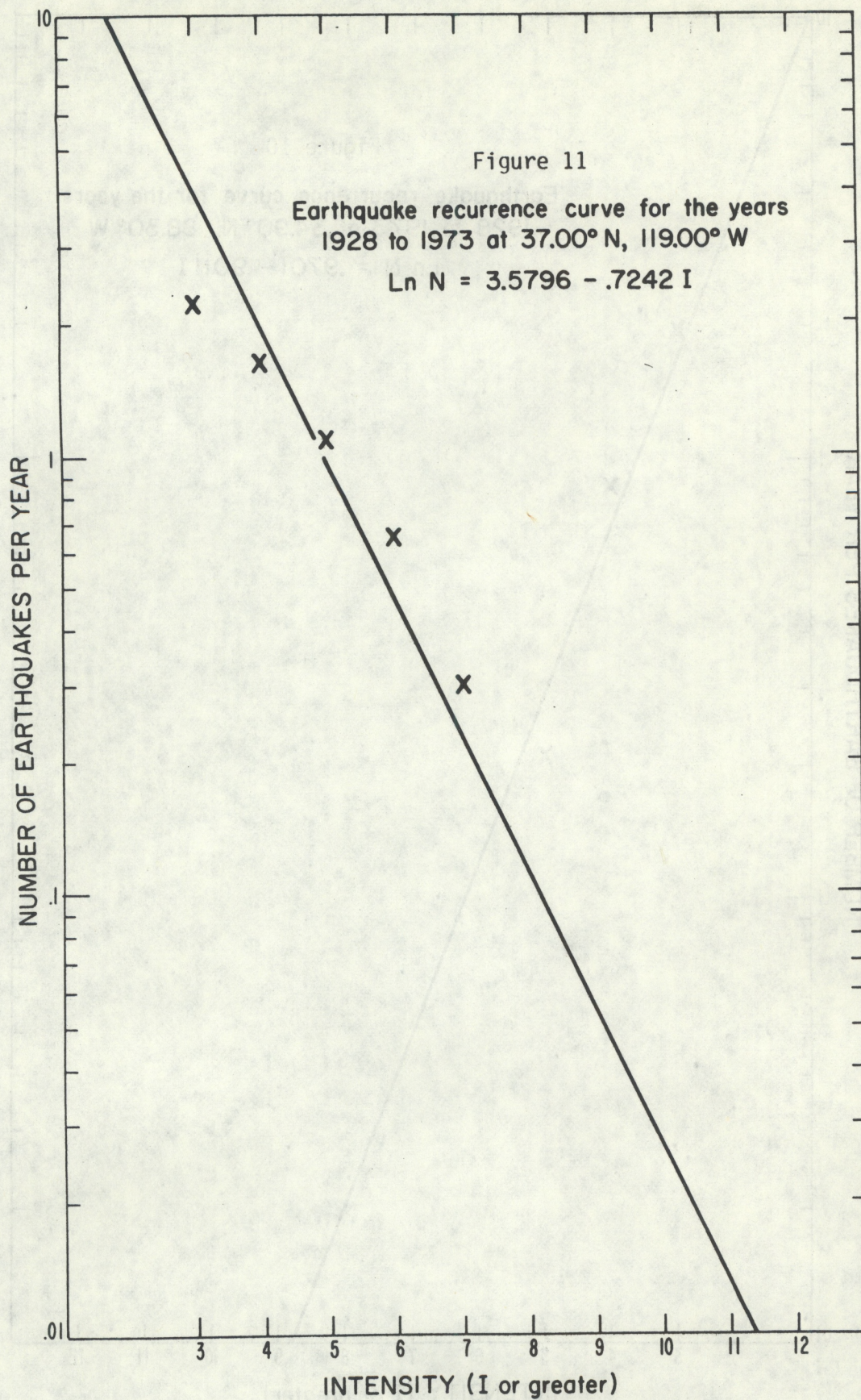


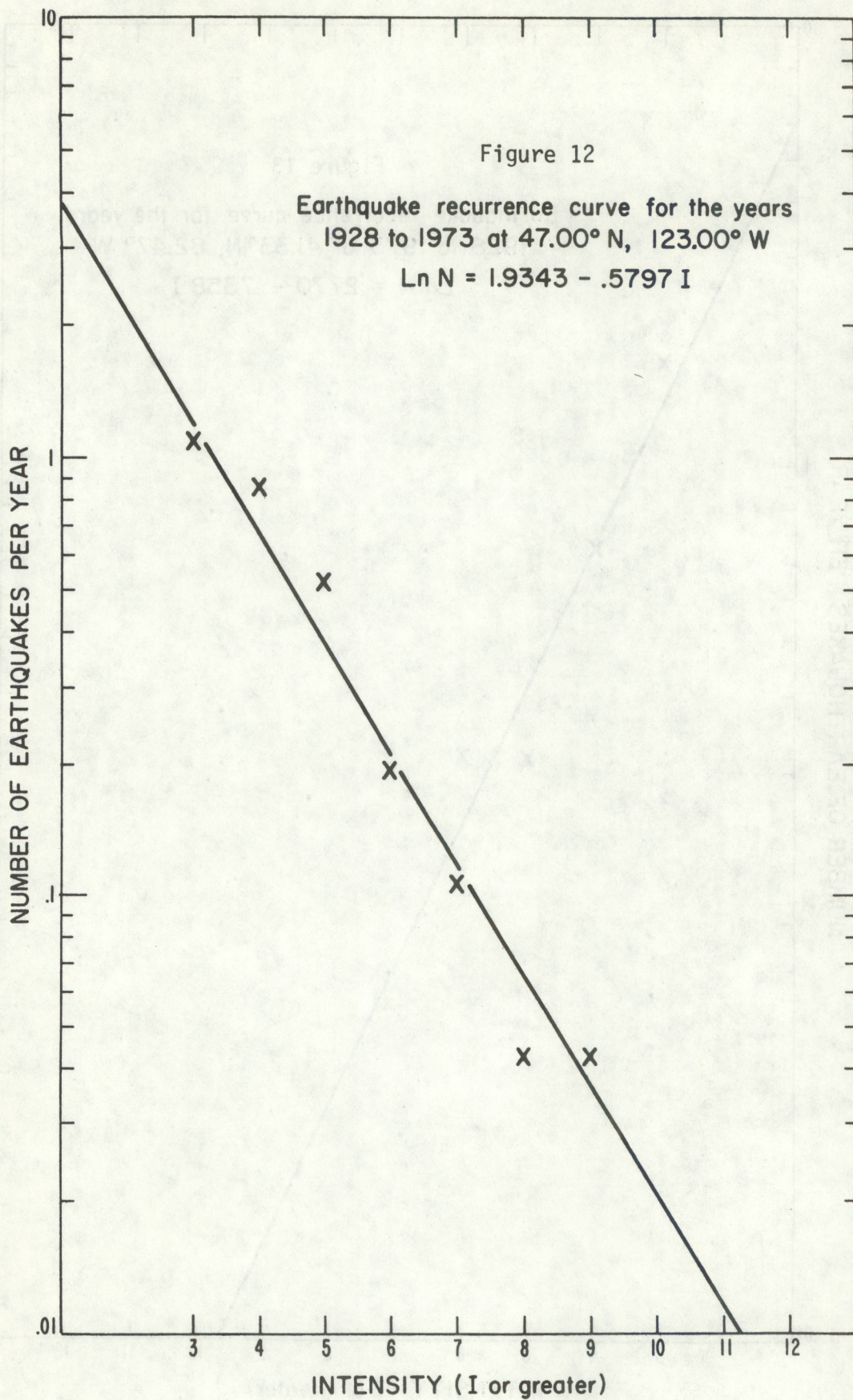
Figure 7. Number of earthquake intensities VII or greater experienced from 1928 through 1973.

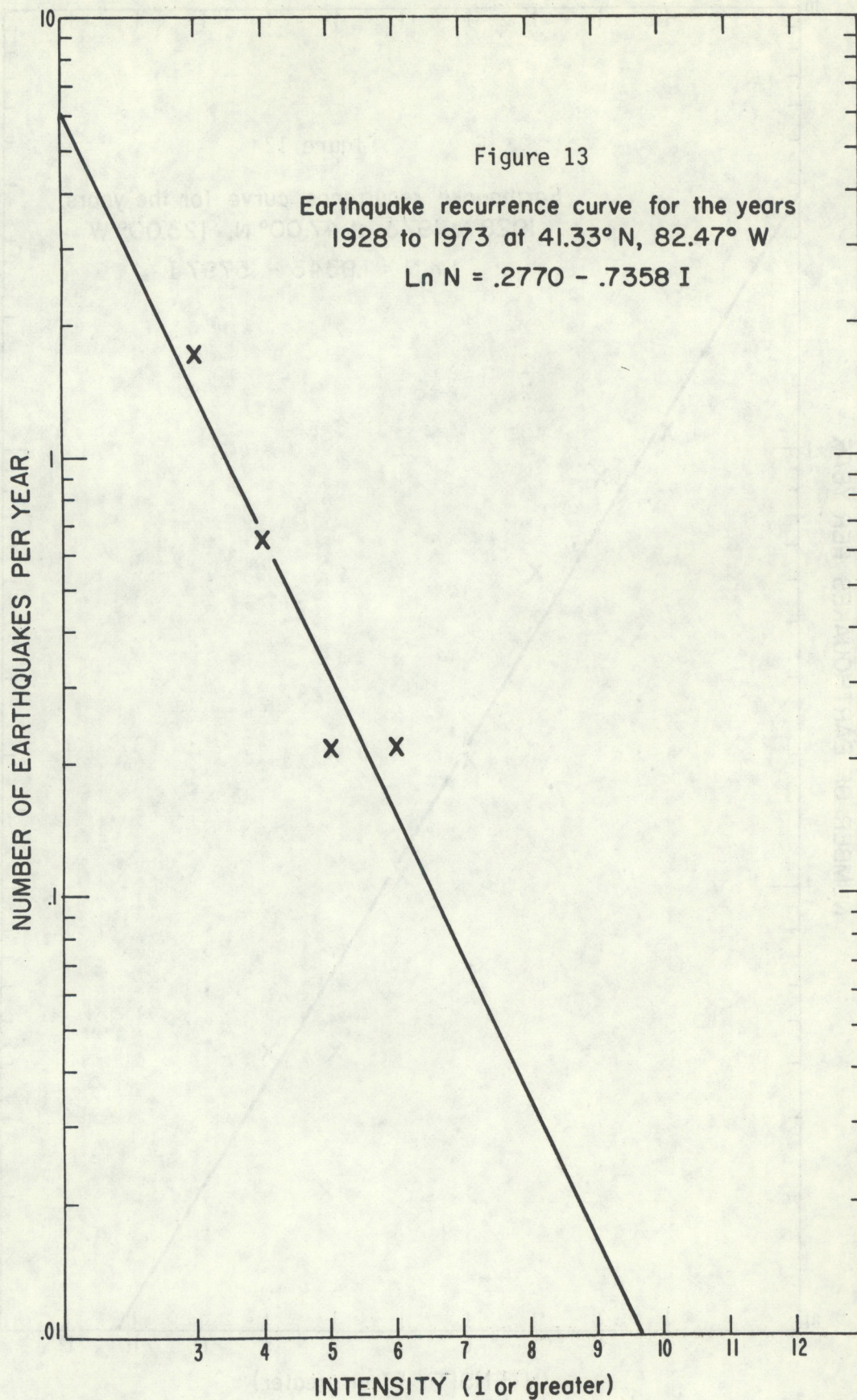


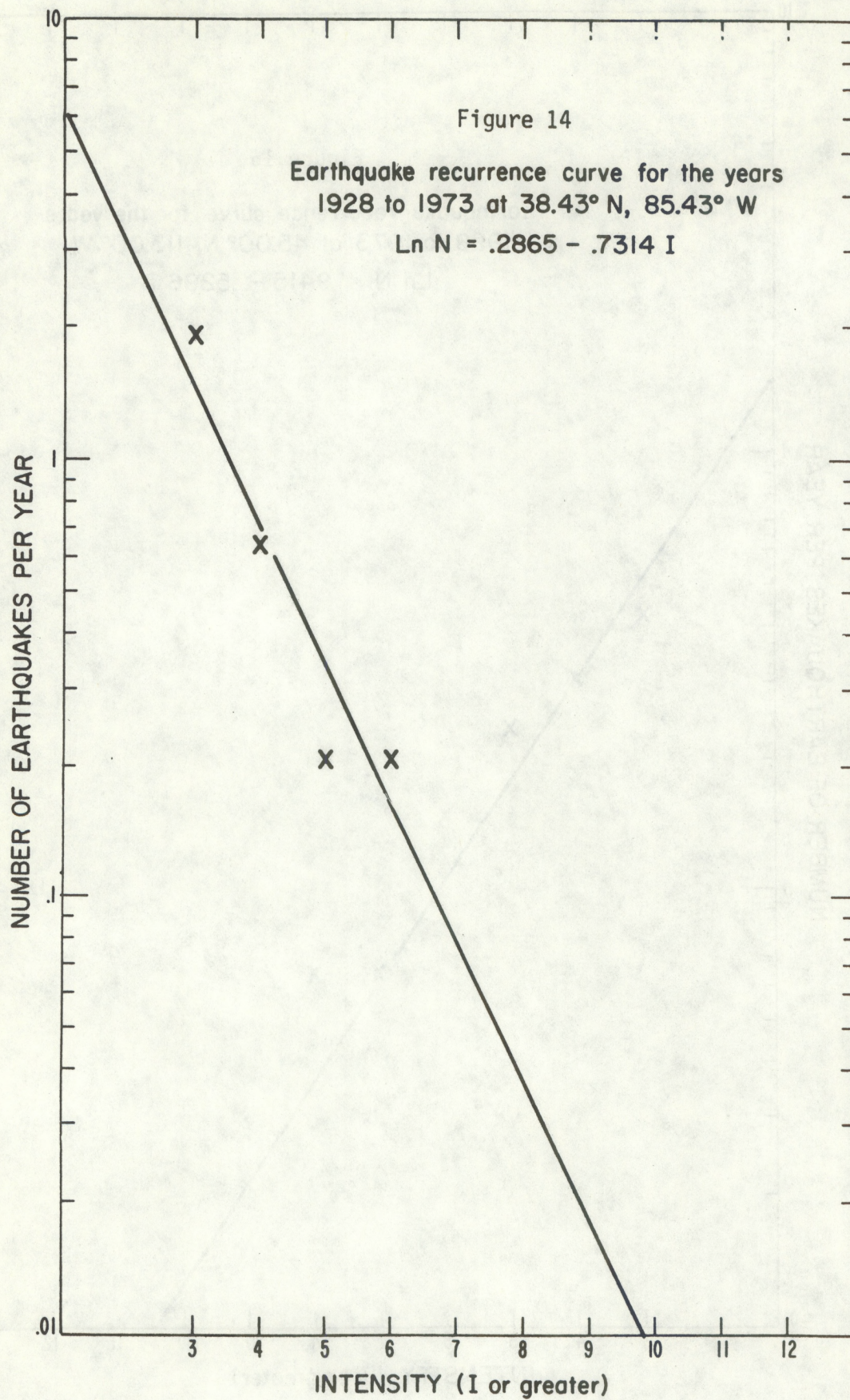


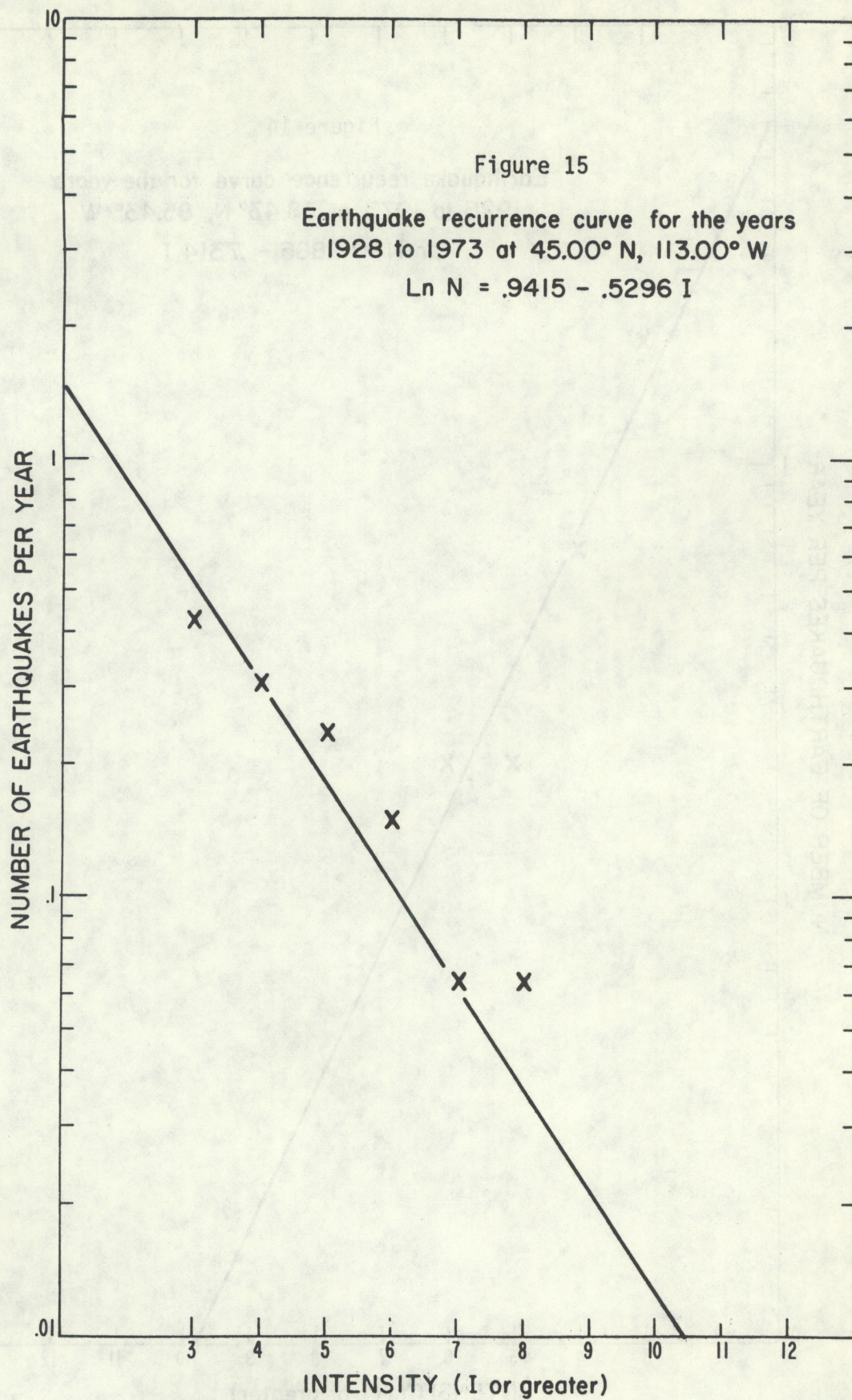


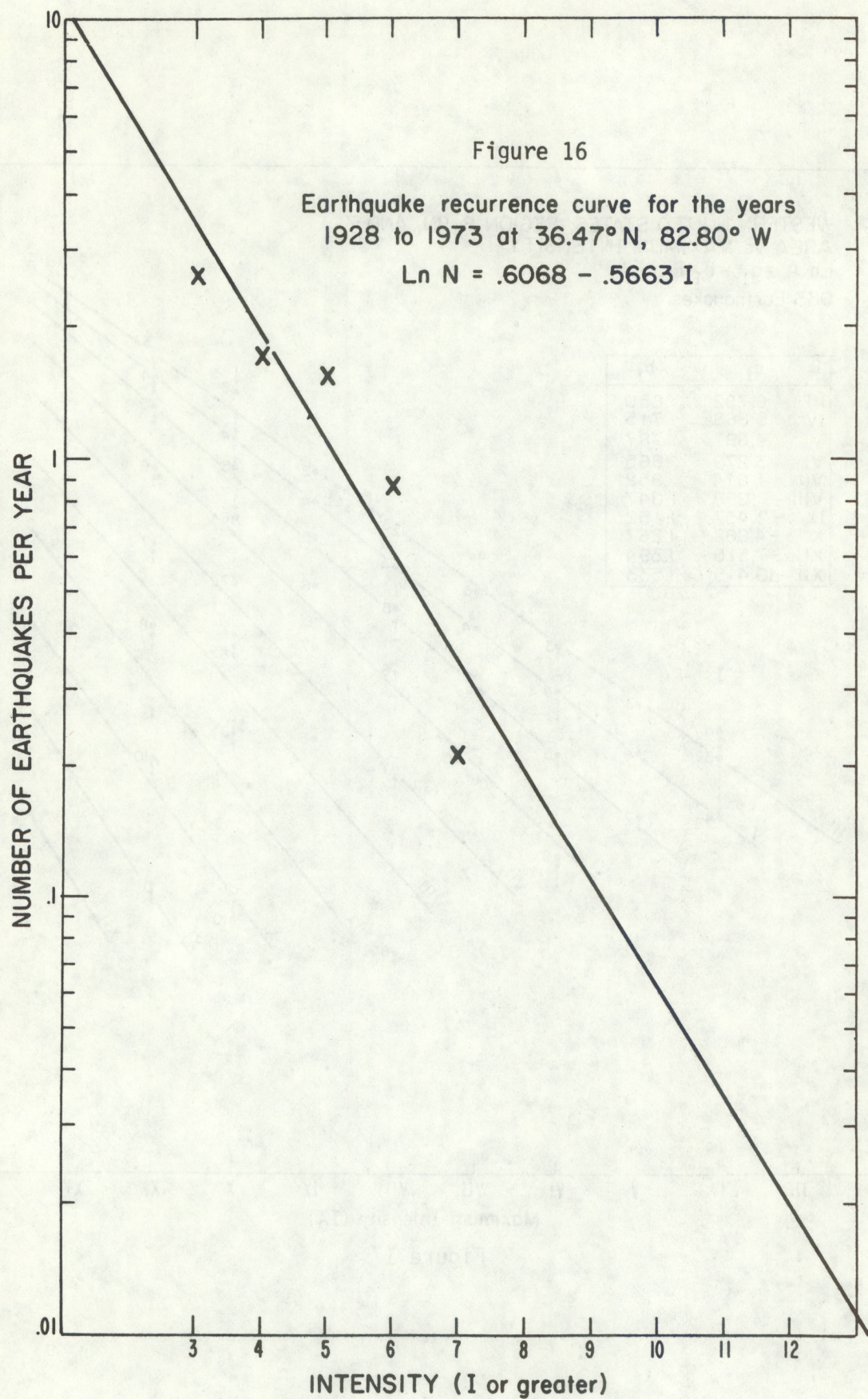












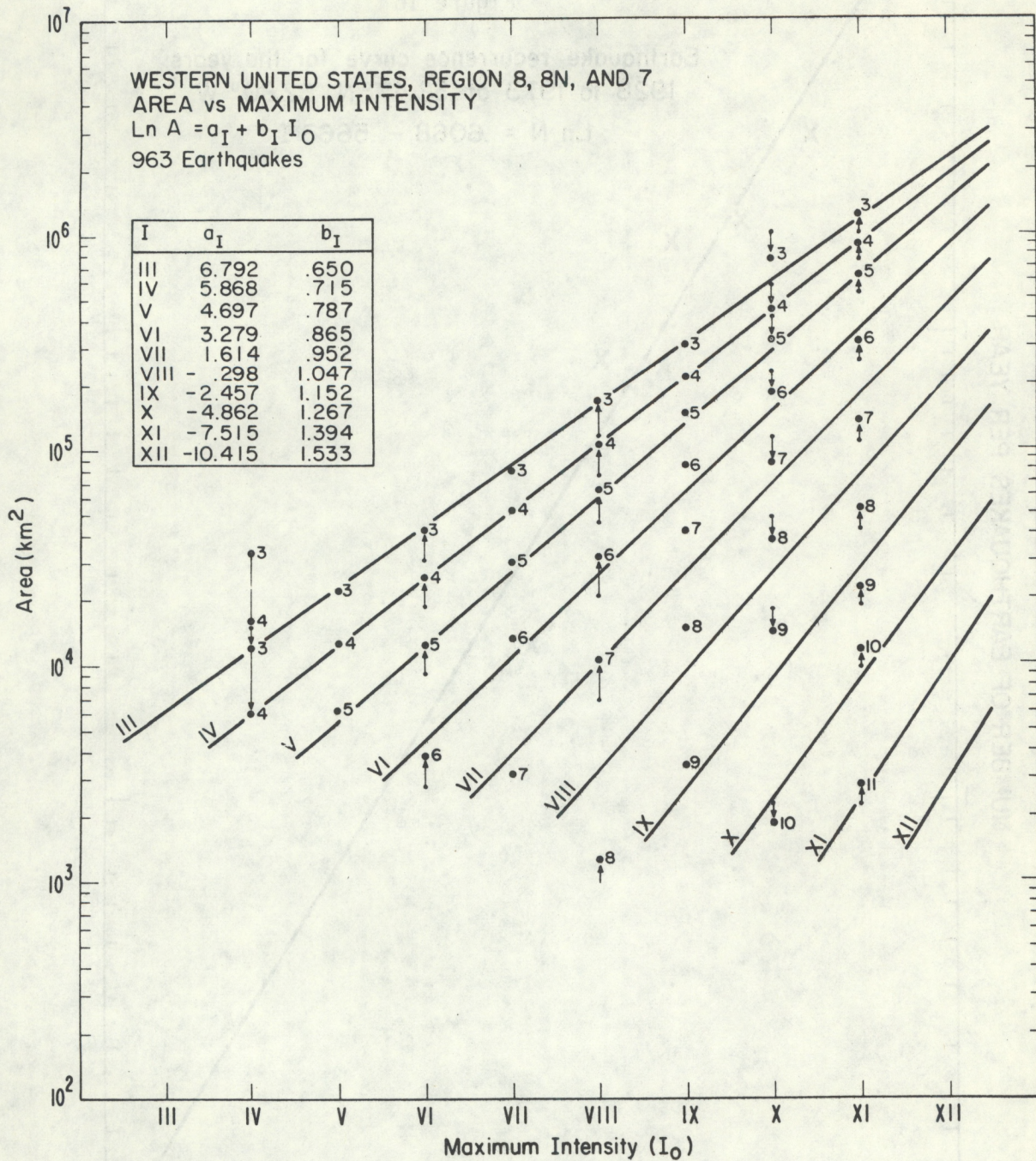


Figure 17

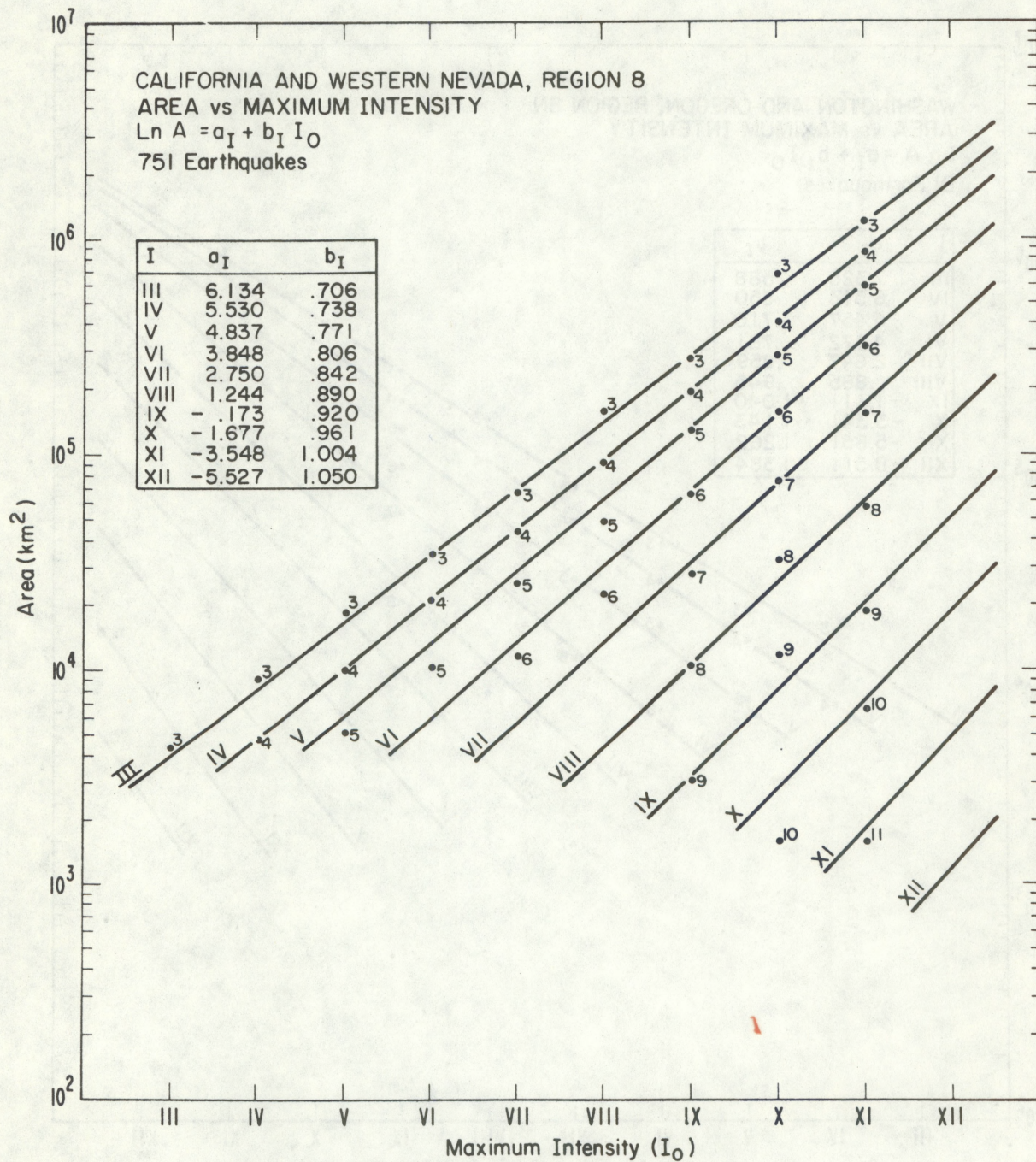


Figure 18

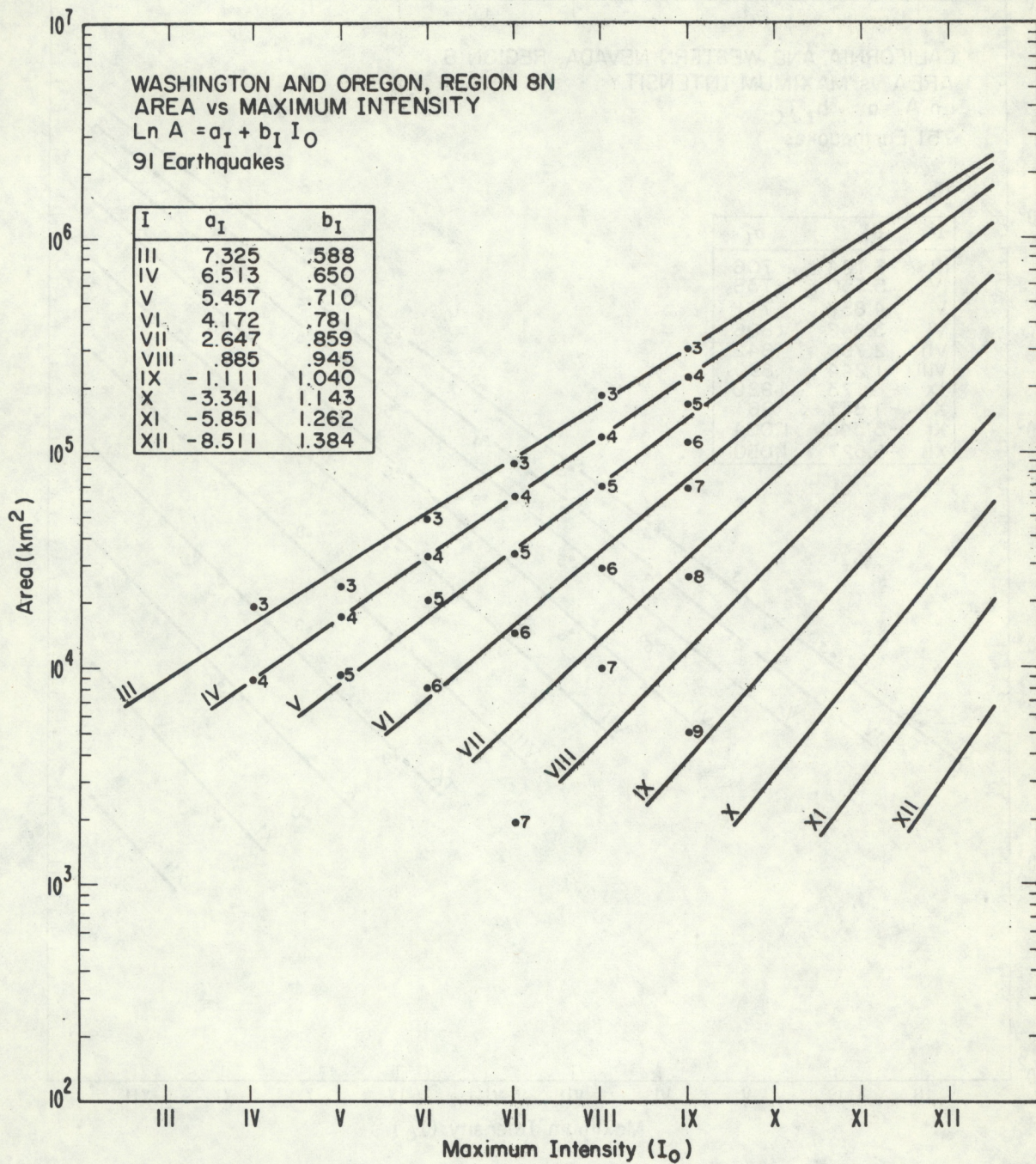


Figure 19

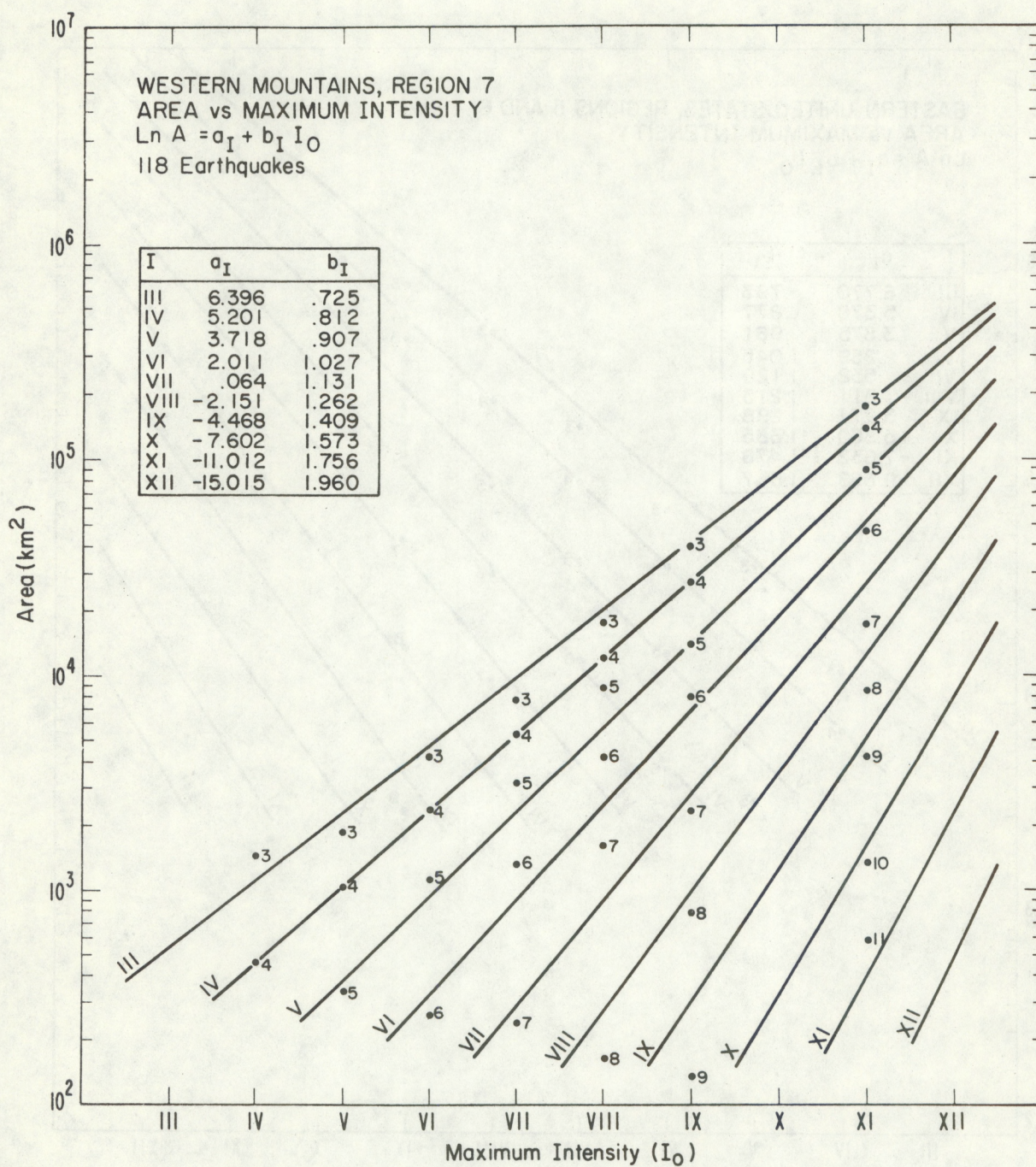


Figure 20

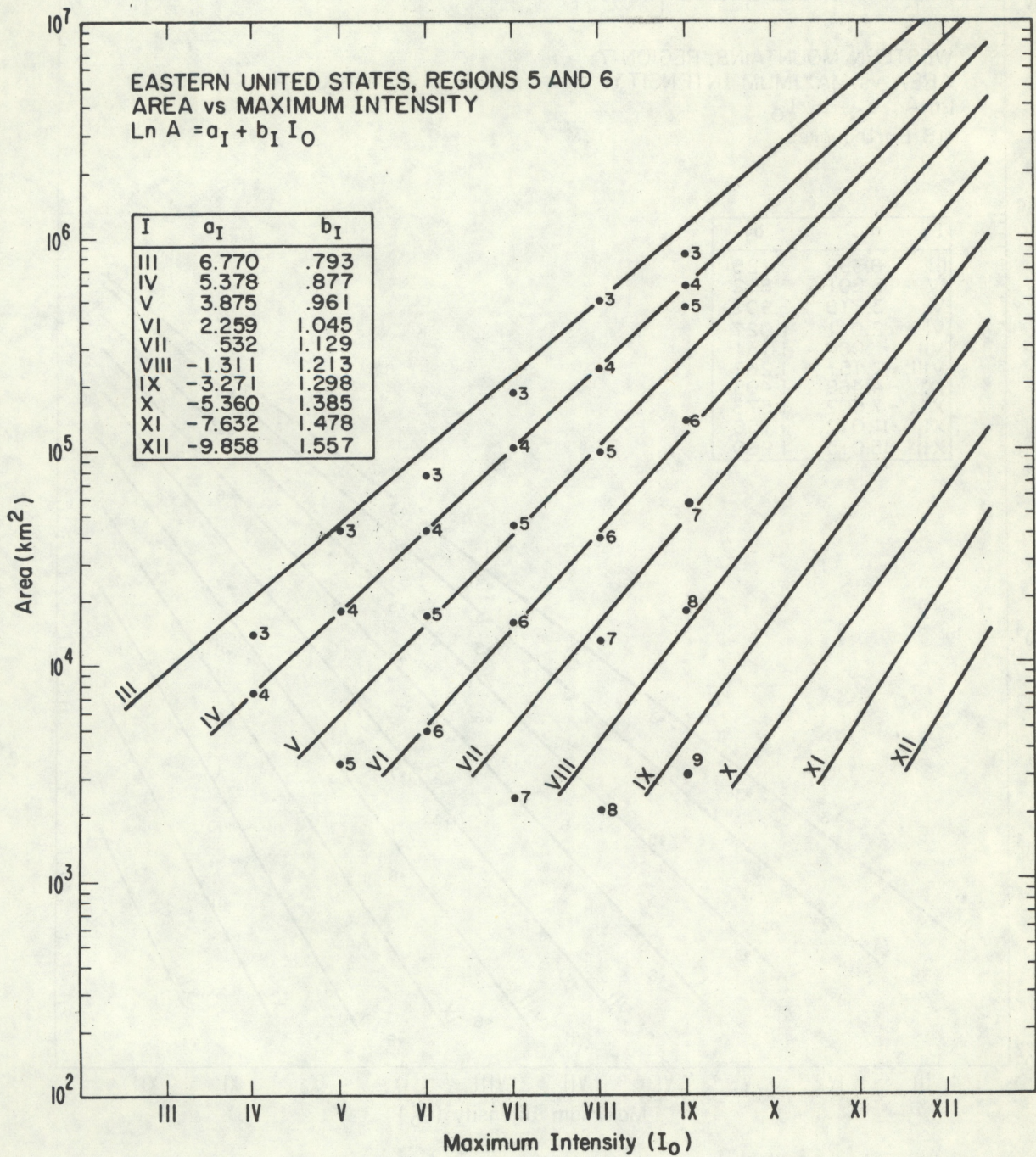


Figure 21

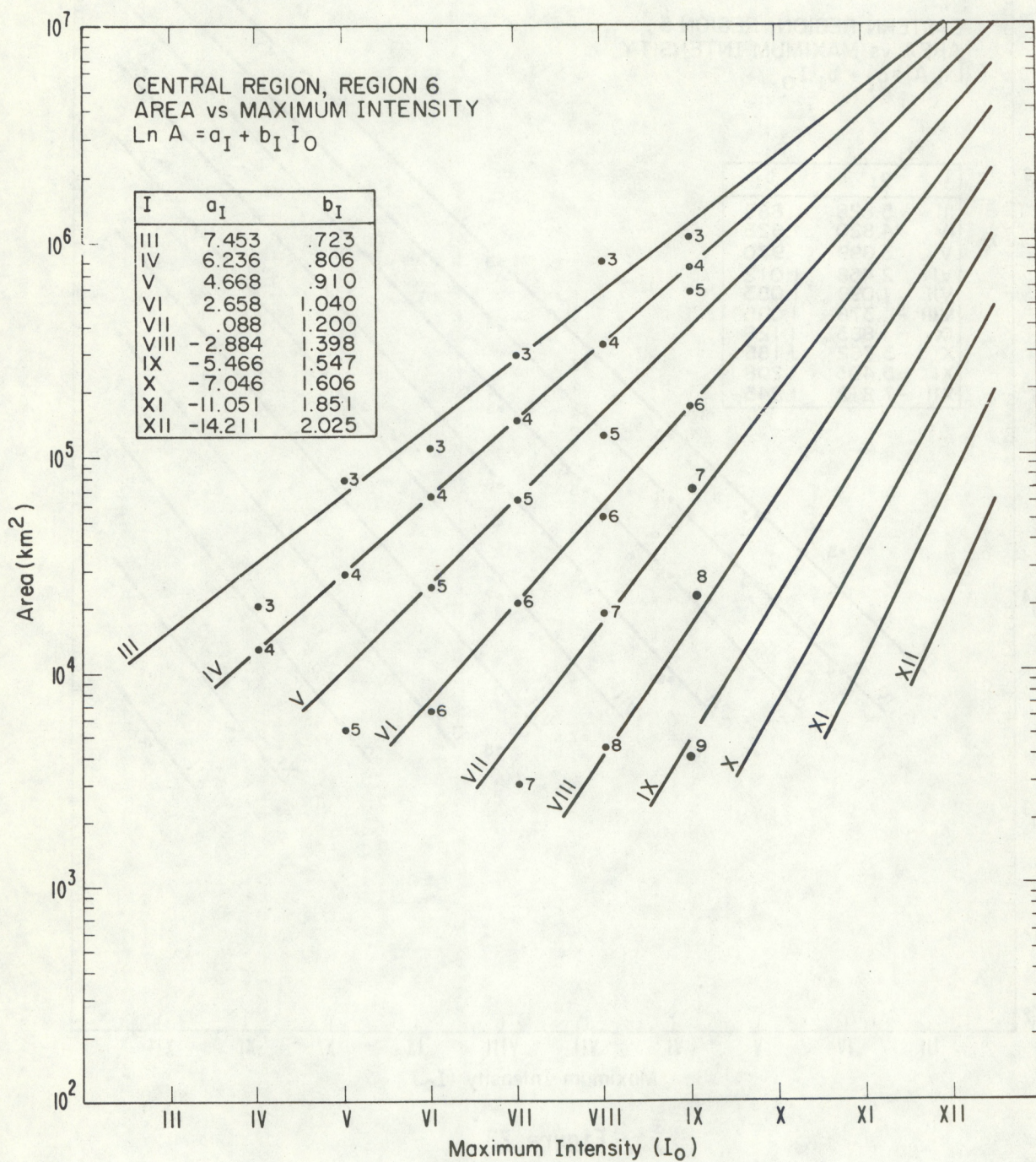


Figure 22

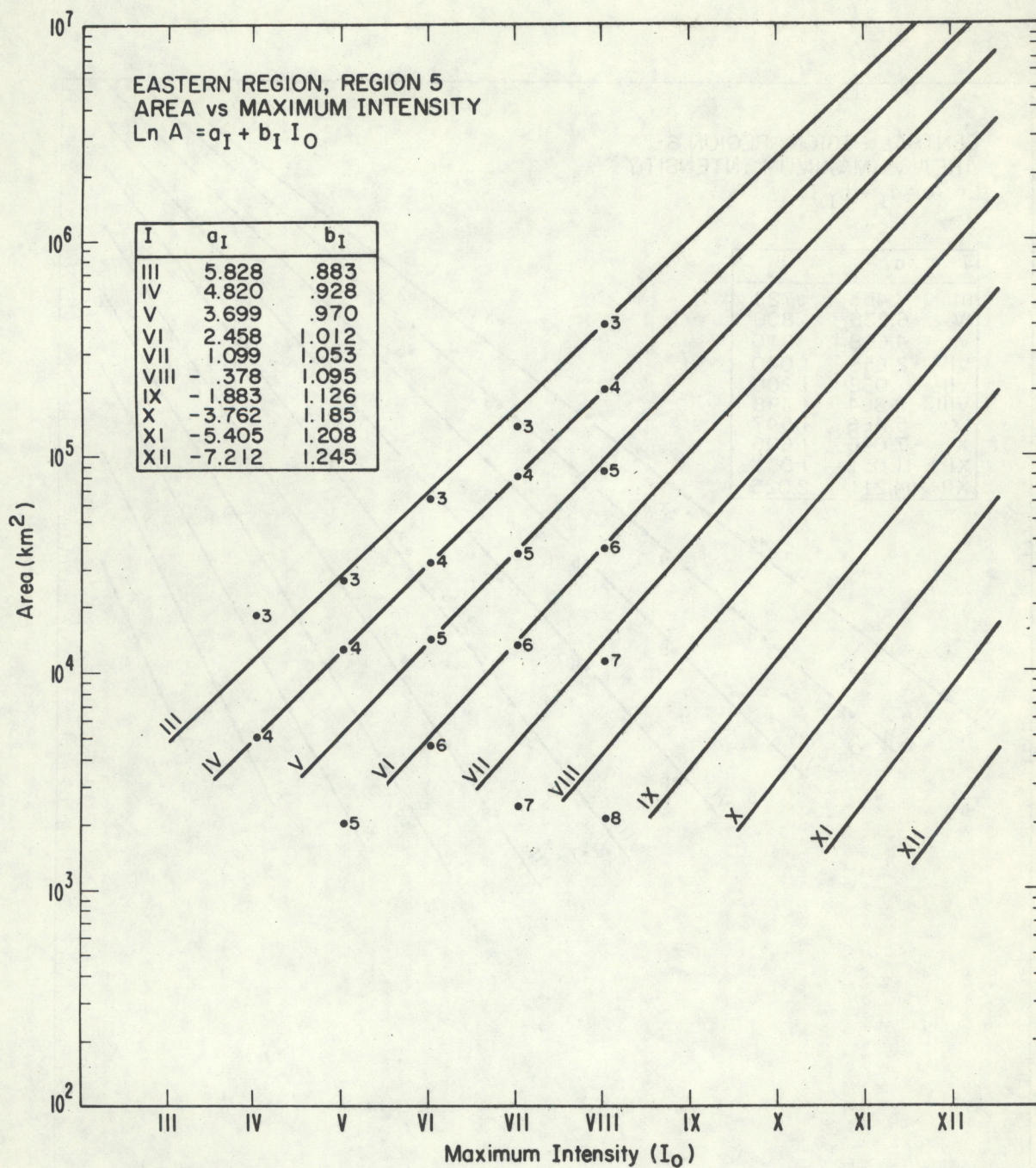


Figure 23

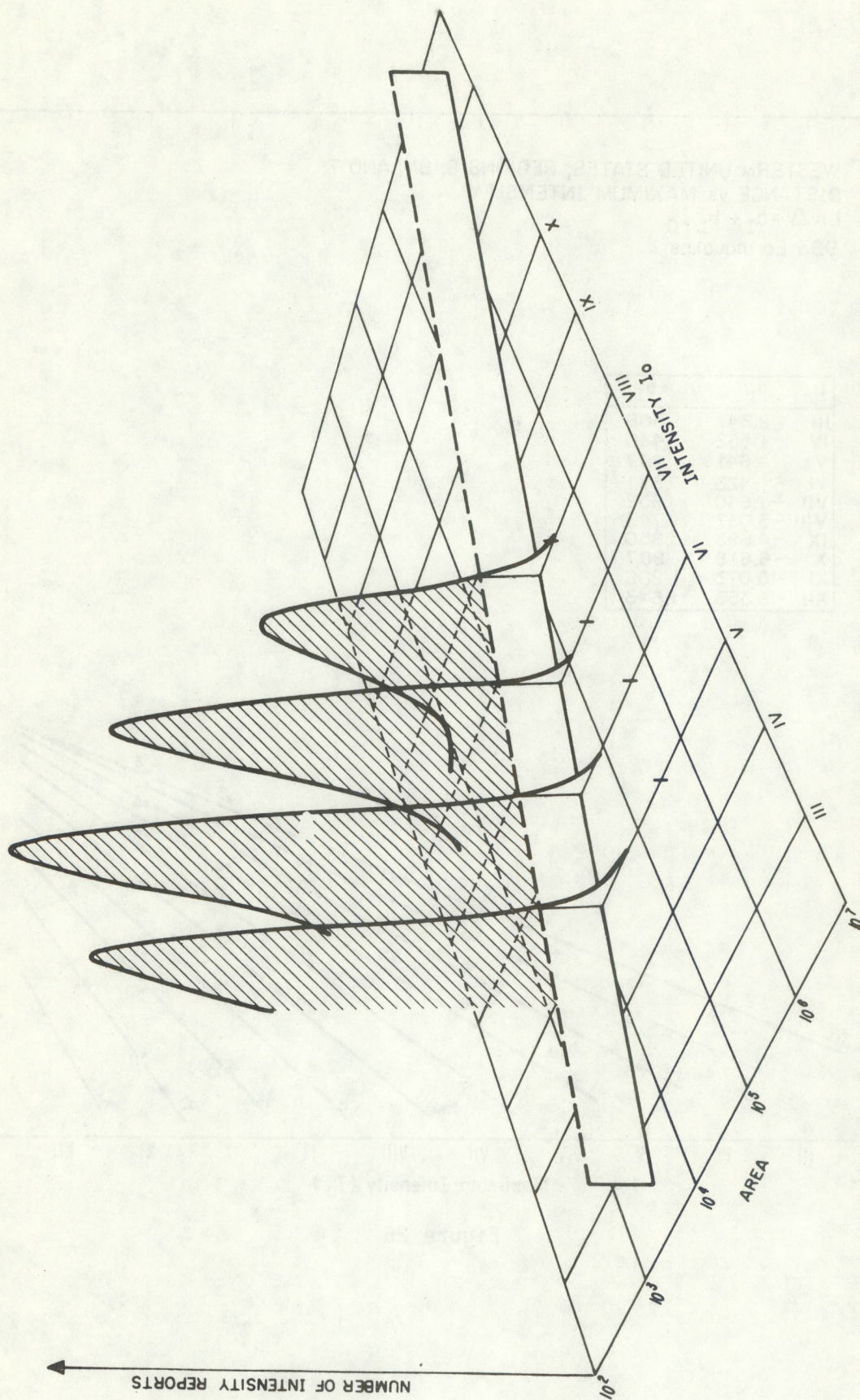


Figure 24. Relative distribution of intensity reports with respect to a typical curve; intensity III, California and western Nevada, Region 8

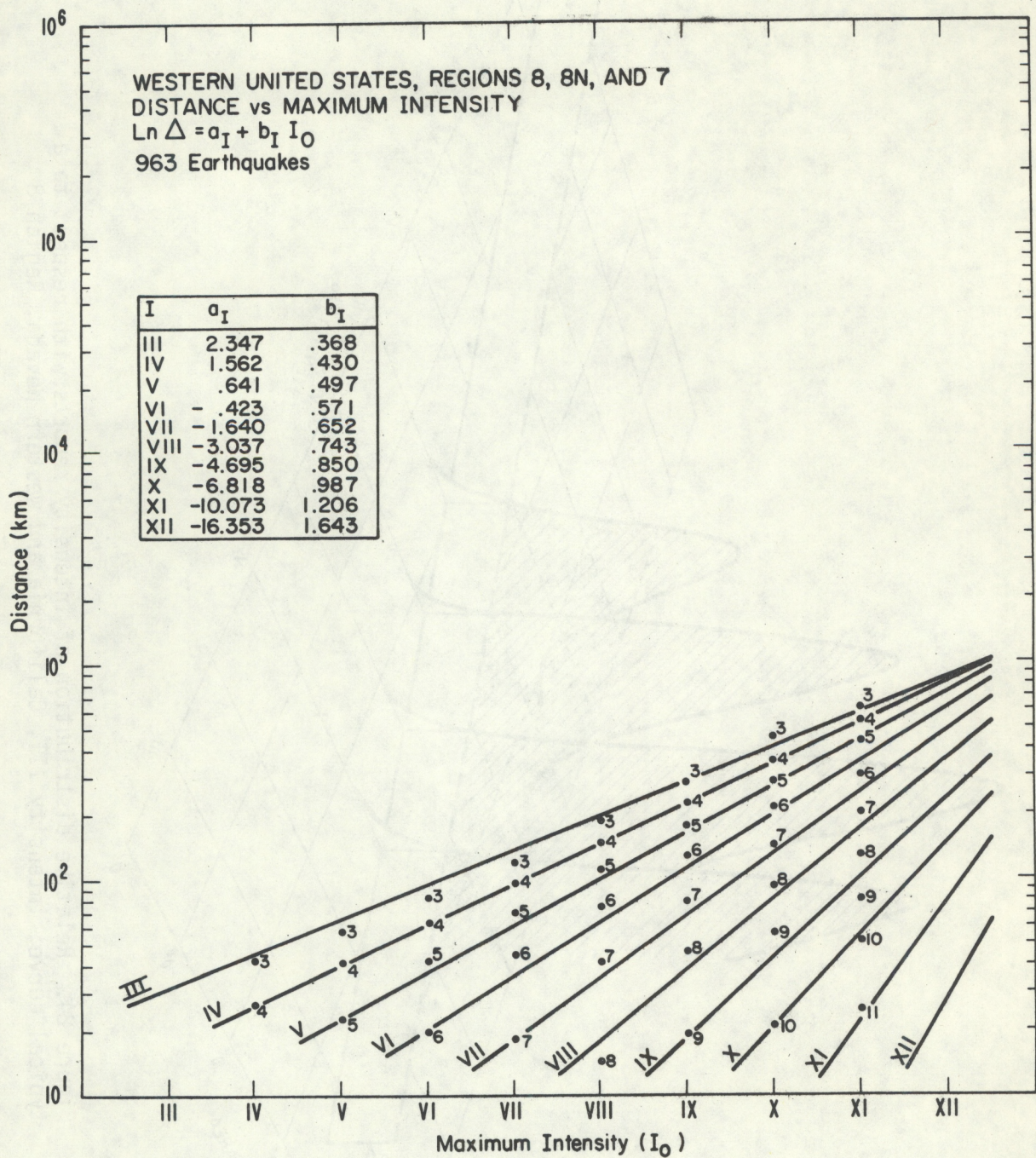


Figure 25

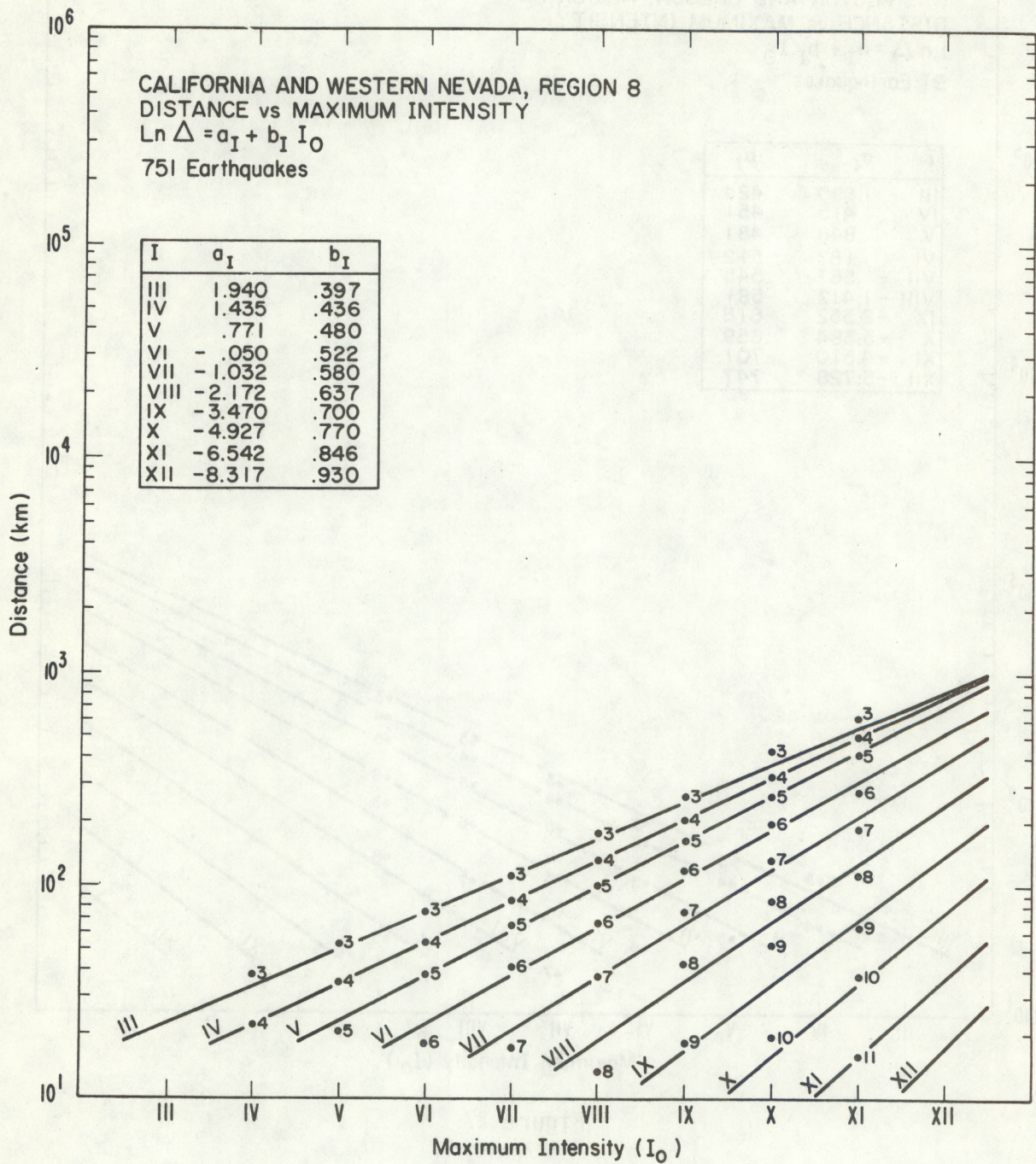


Figure 26

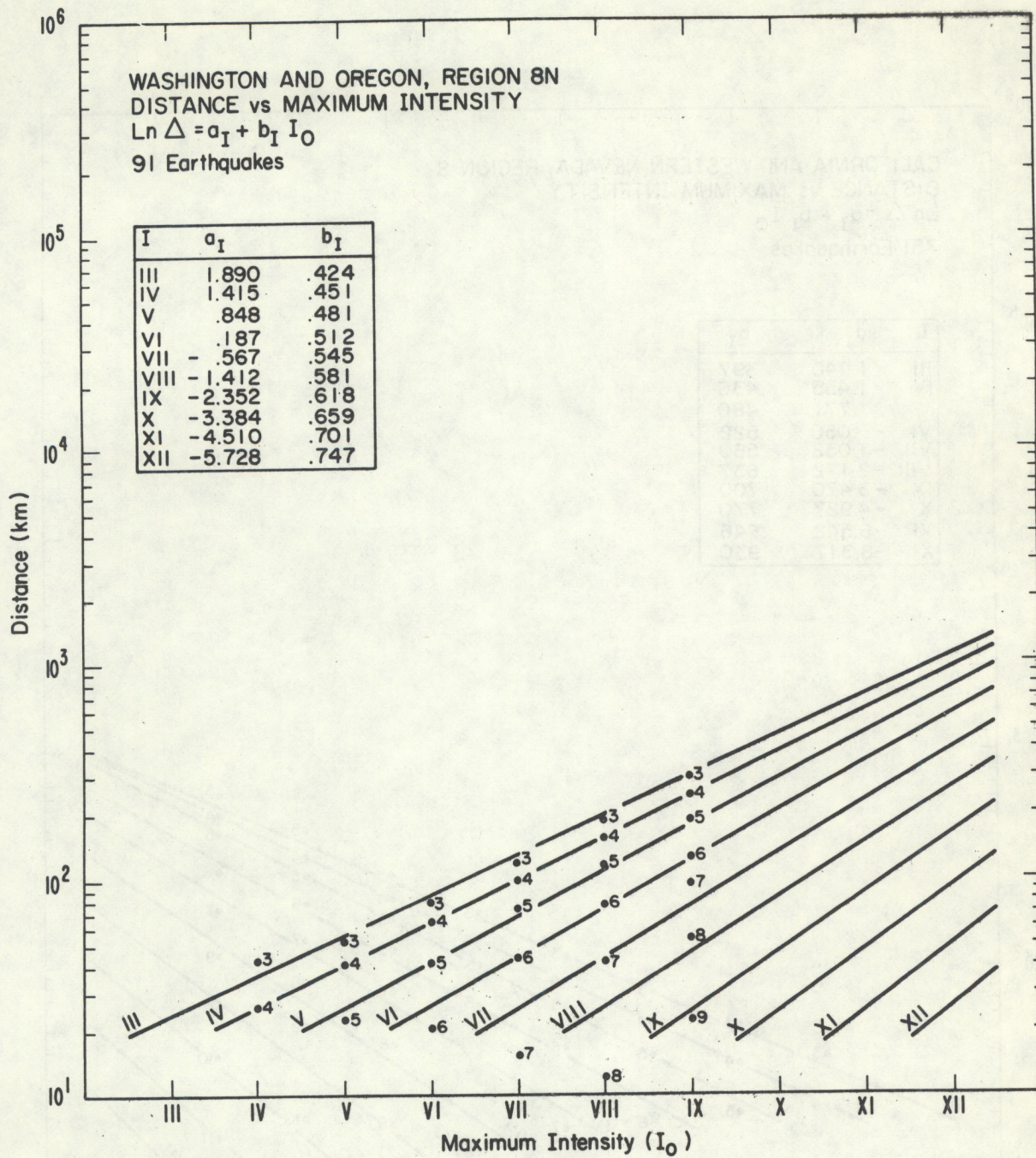


Figure 27

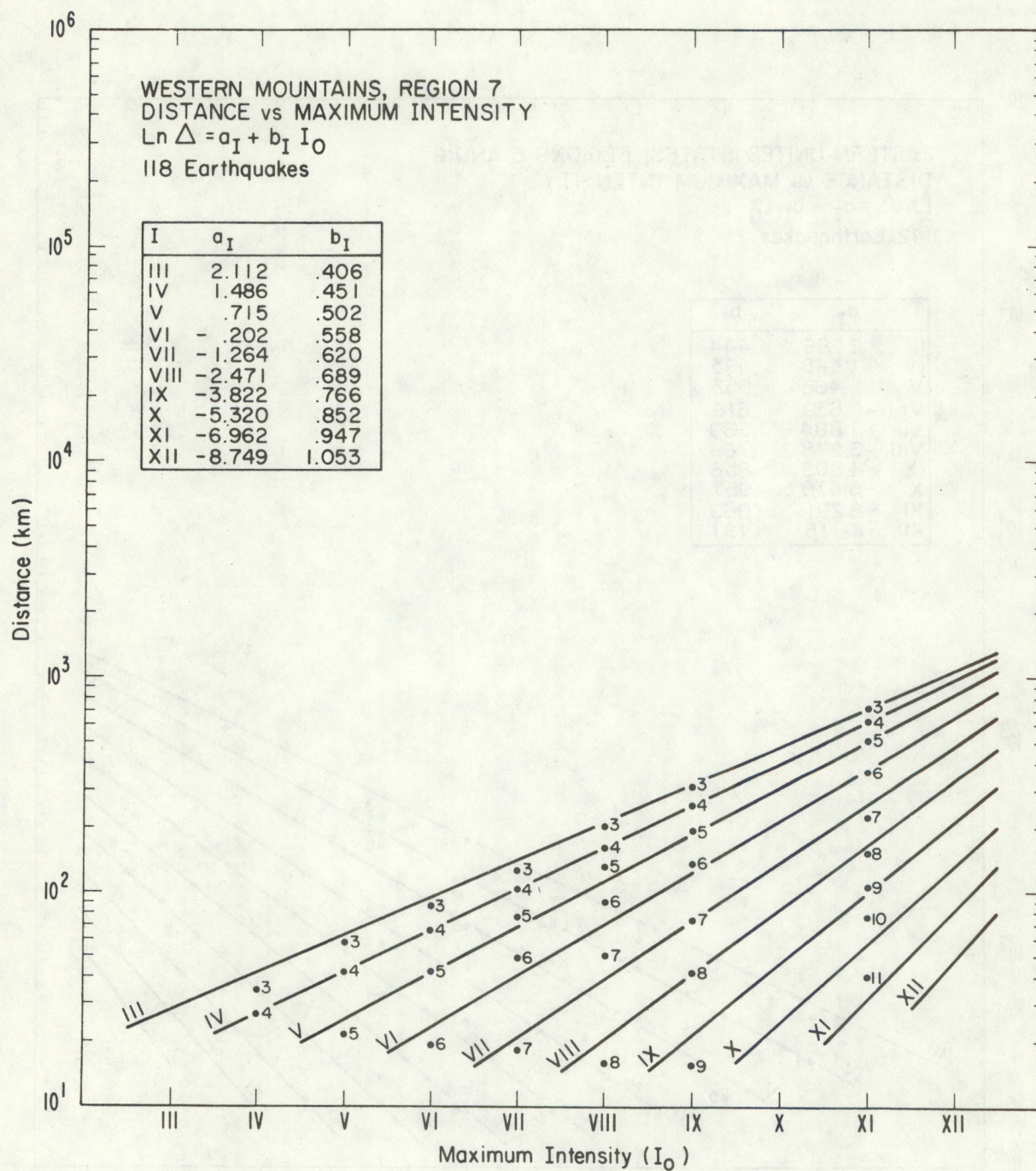


Figure 28

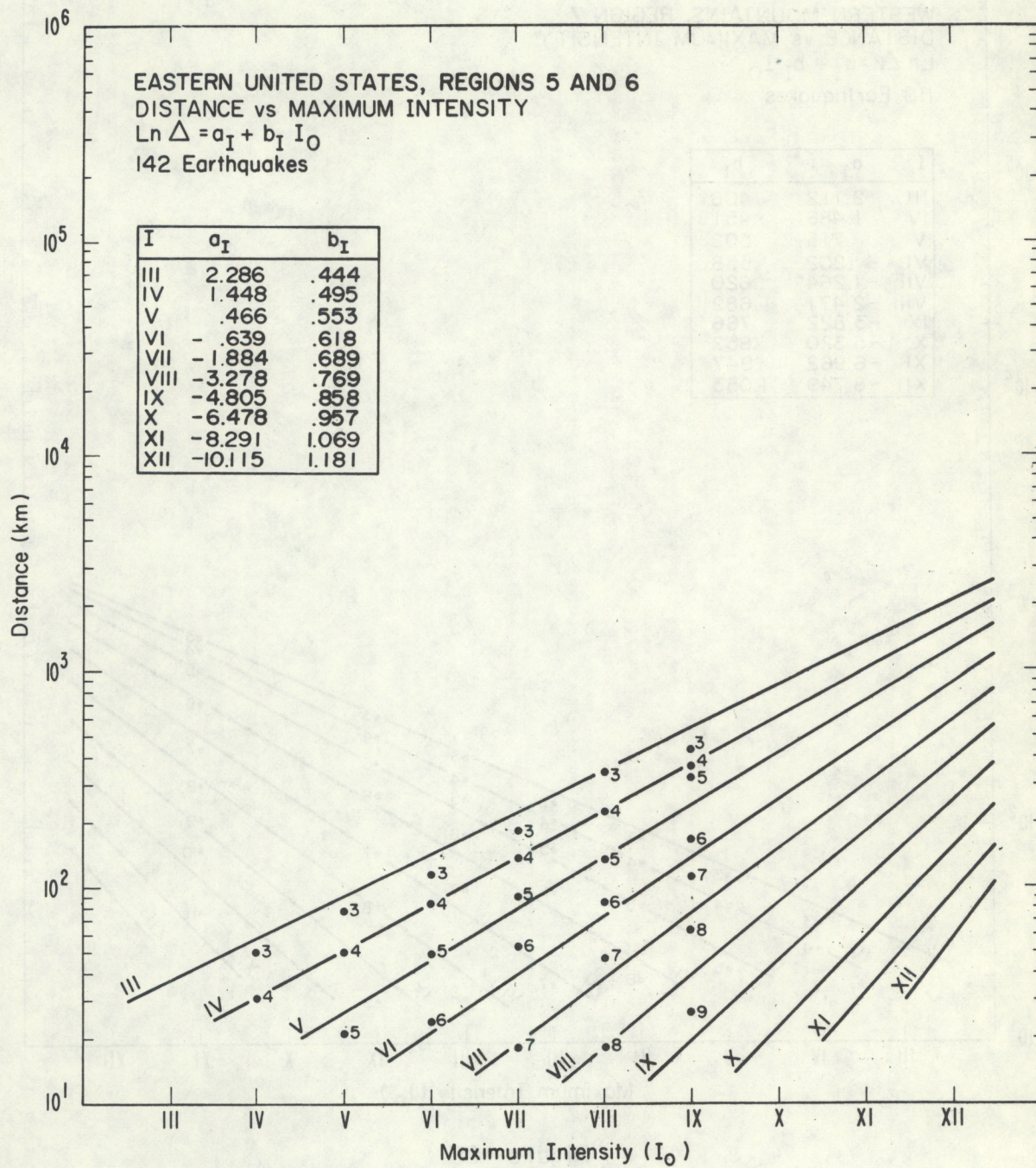


Figure 29

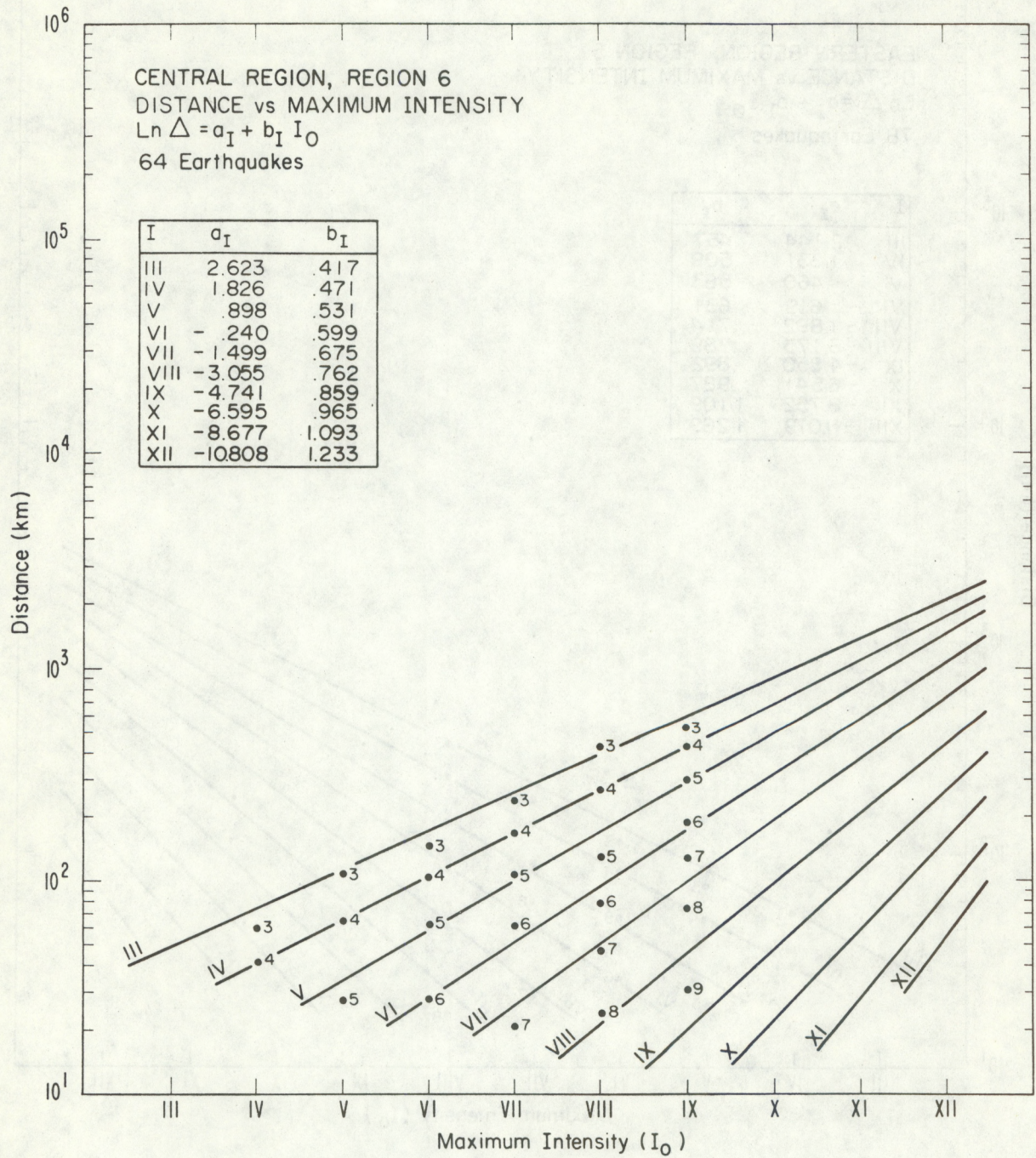


Figure 30

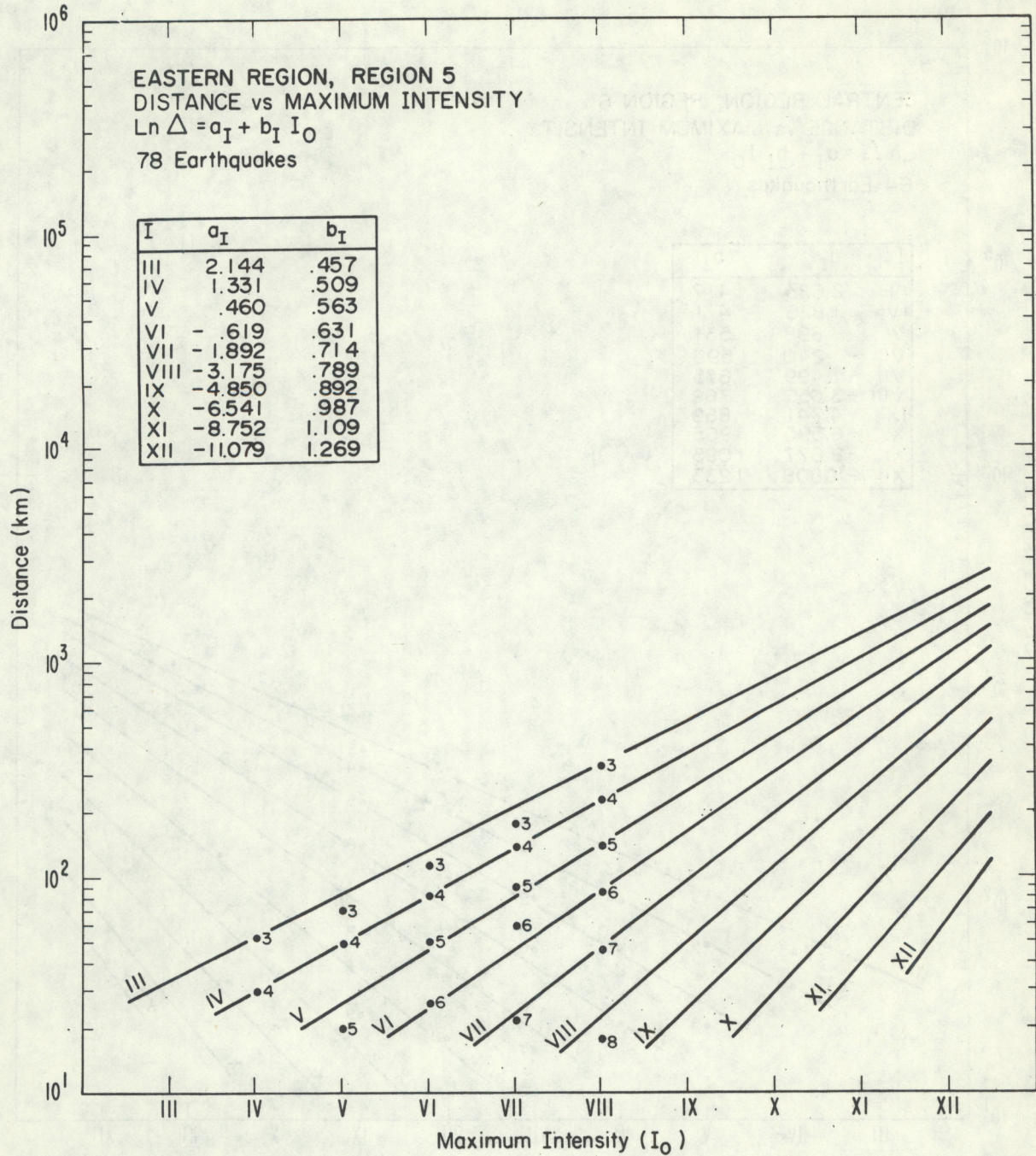
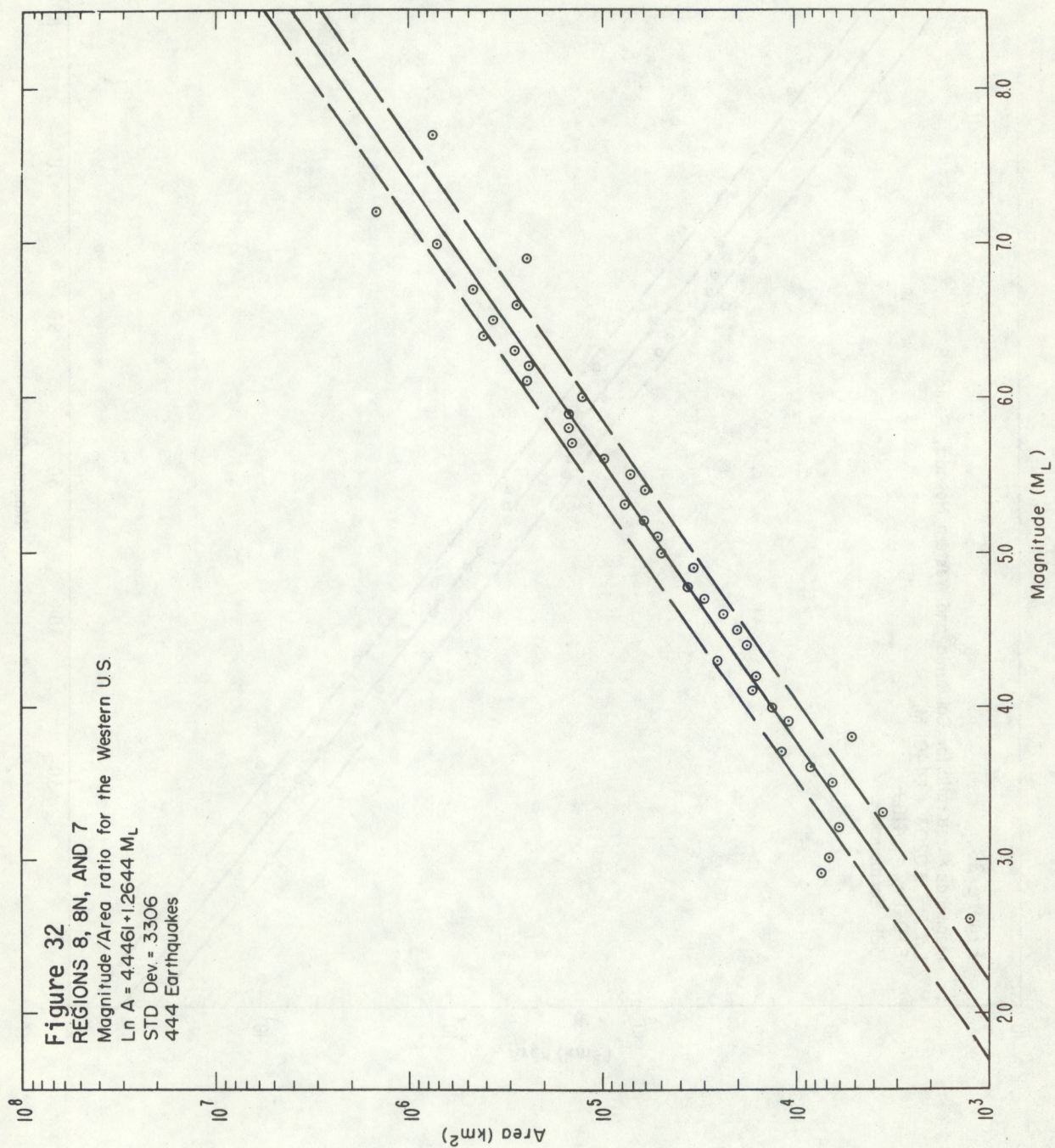
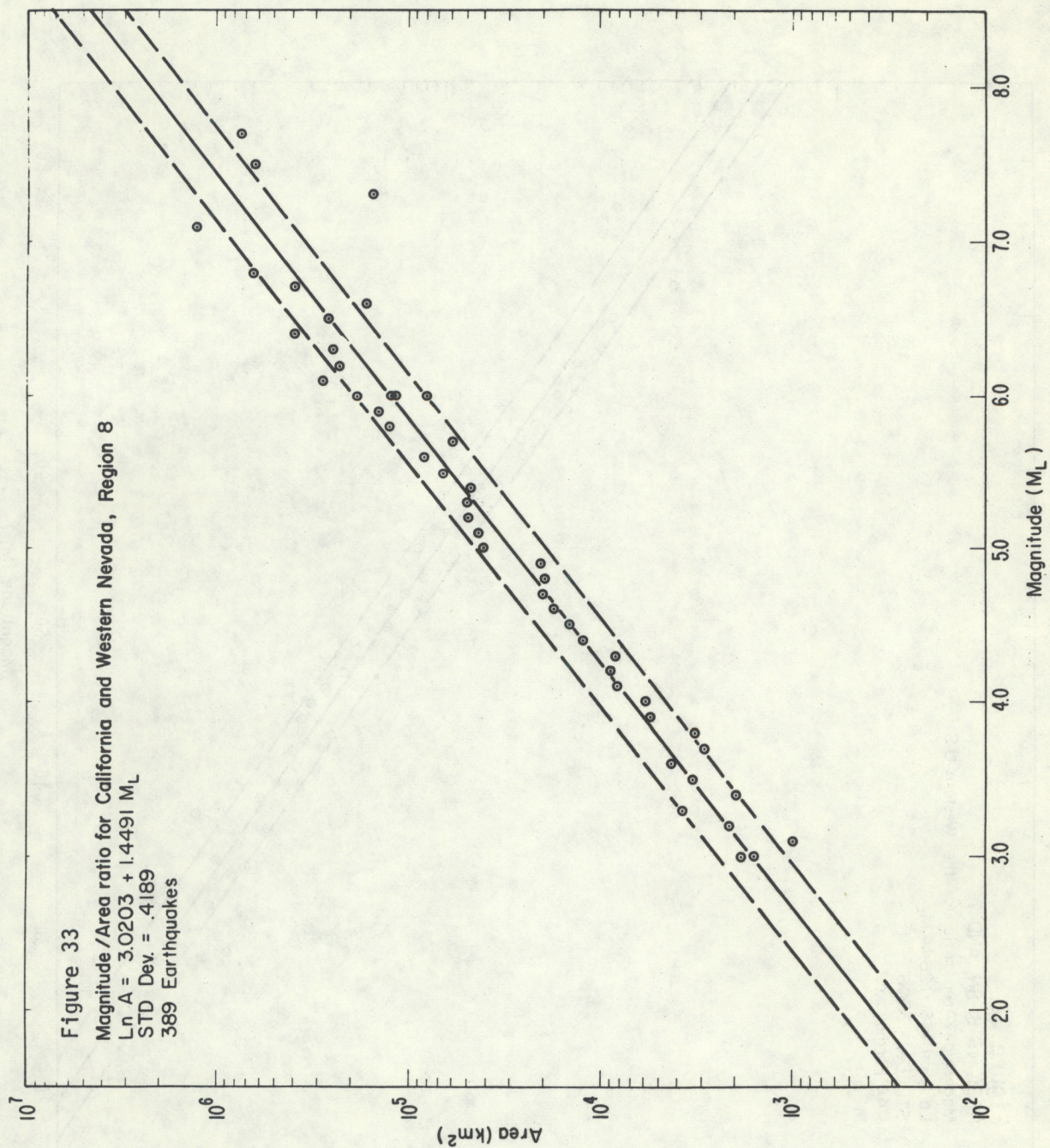
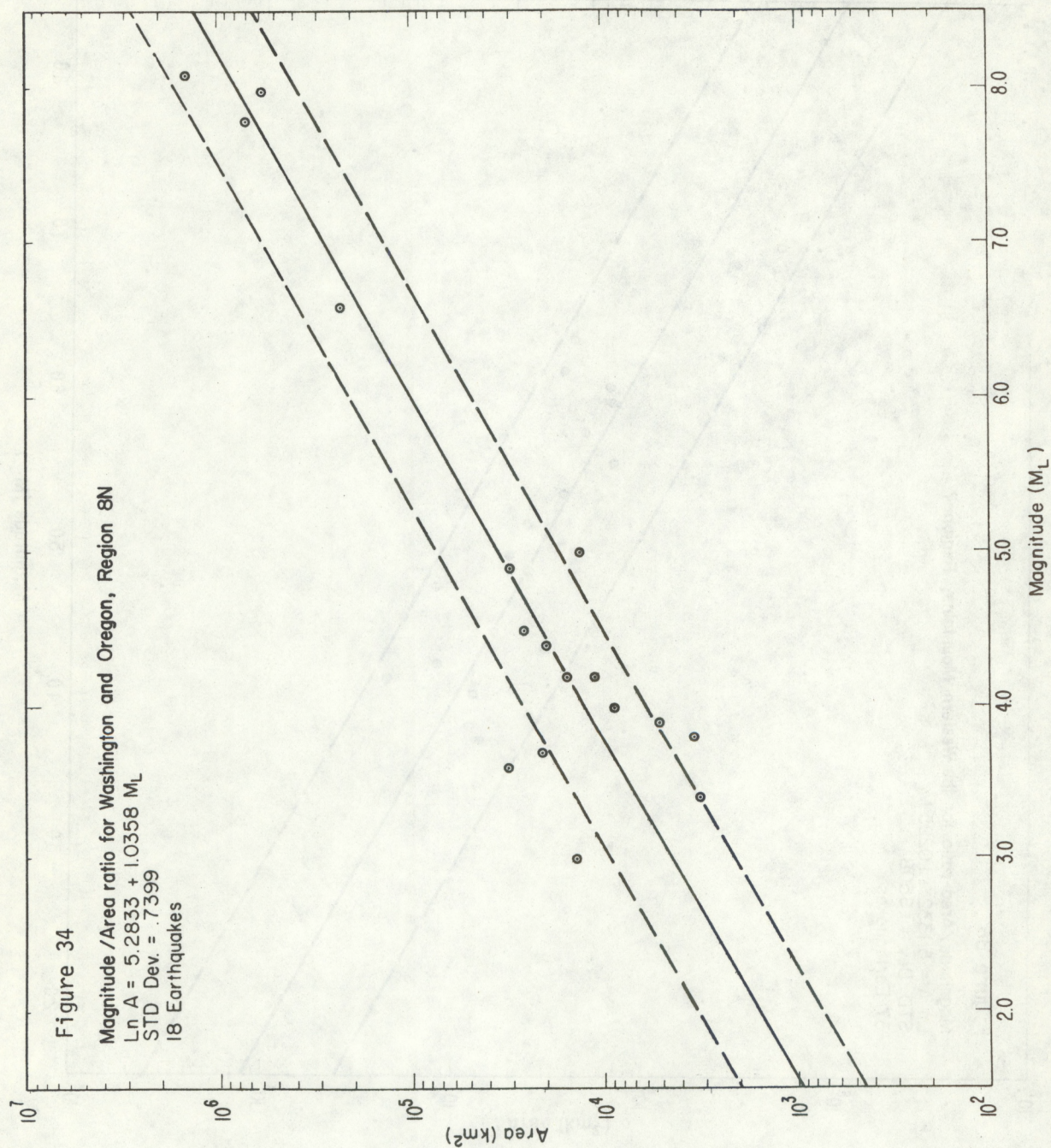
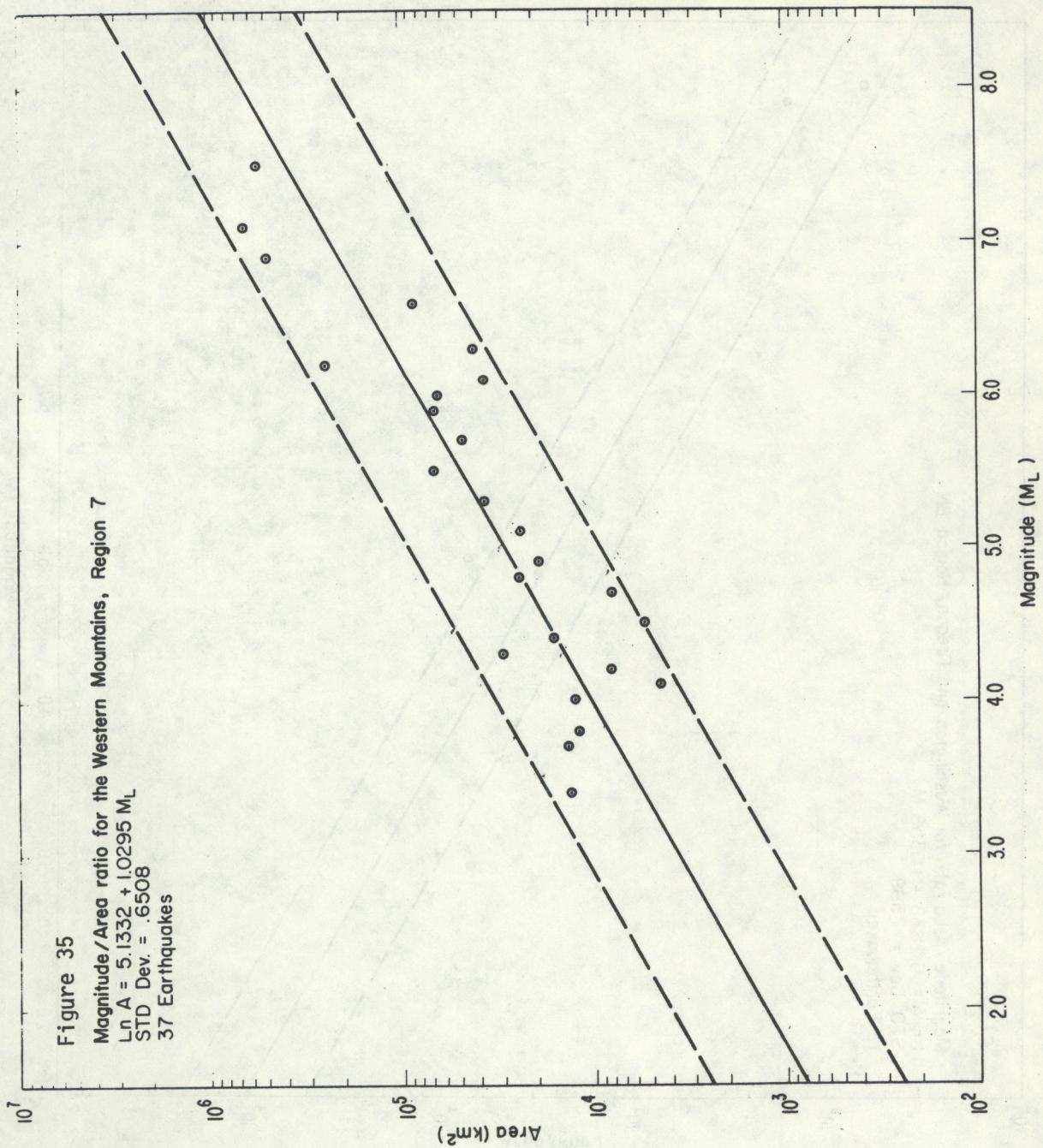


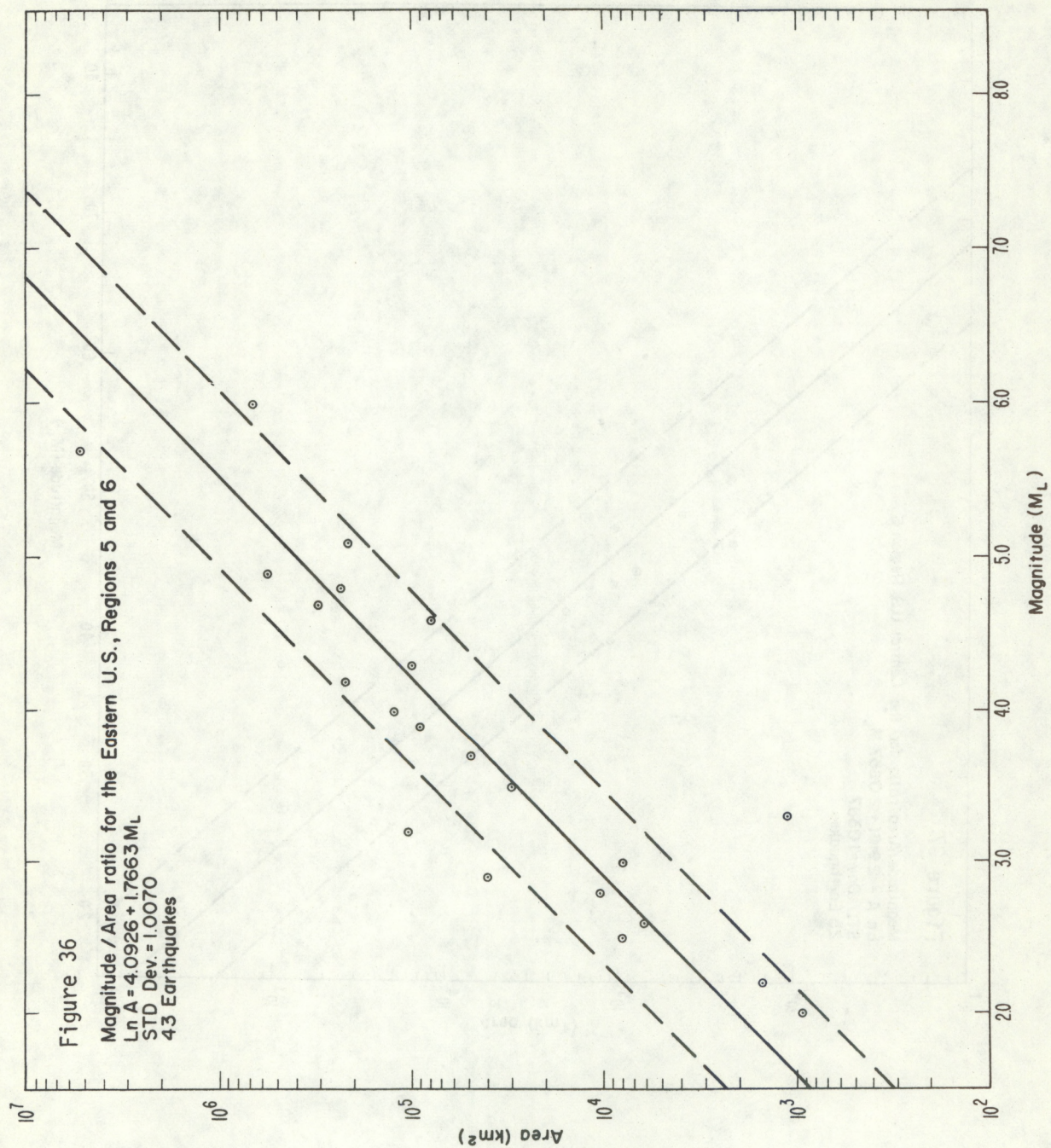
Figure 31

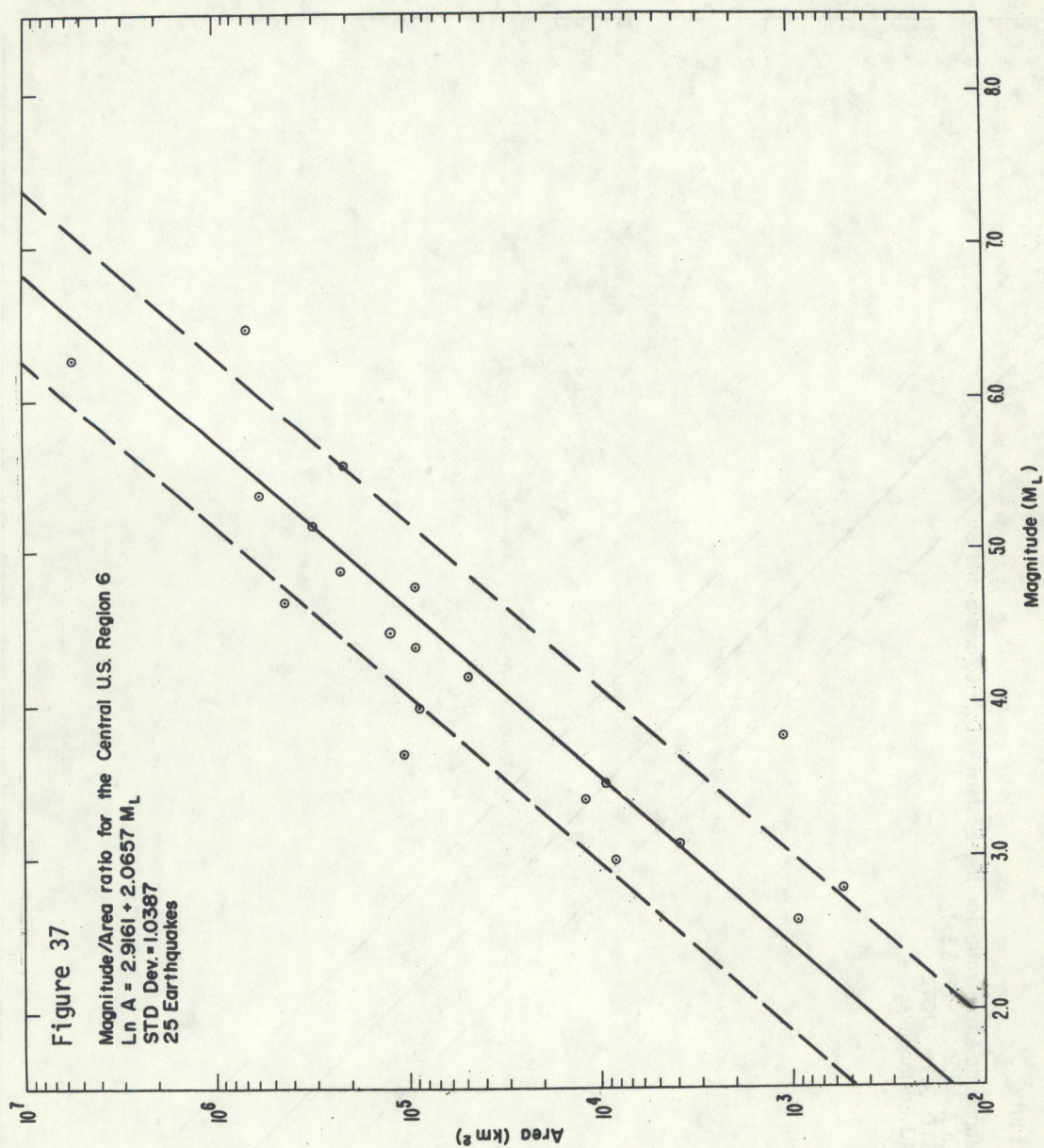


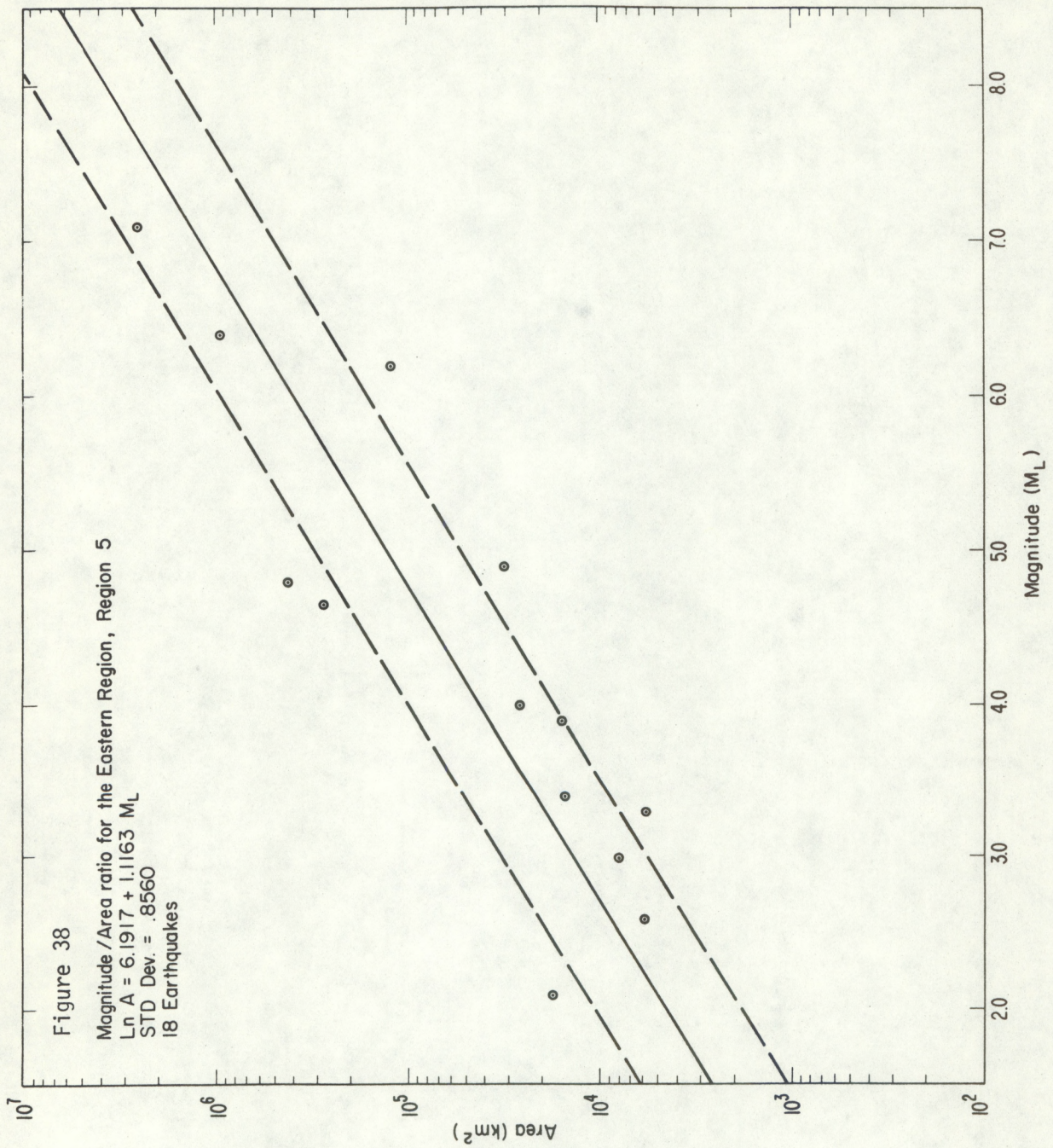












APPENDIX A

MODIFIED MERCALLI INTENSITY SCALE OF 1931

(ABRIDGED)

- I. Not felt except by a very few under specially favorable circumstances. (I Rossi-Forel scale.)
- II. Felt only by a few persons at rest, especially on upper floors of buildings. Delicately suspended objects may swing. (I to II Rossi-Forel scale.)
- III. Felt quite noticeably indoors, especially on upper floors of buildings, but many people do not recognize it as an earthquake. Standing motorcars may rock slightly. Vibration like passing of truck. Duration estimated. (III Rossi-Forel scale.)
- IV. During the day felt indoors by many, outdoors by few. At night some awakened. Dishes, windows, doors disturbed; walls make creaking sound. Sensation like heavy truck striking building. Standing motorcars rocked noticeably. (IV to V Rossi-Forel scale.)
- 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. (V to VI Rossi-Forel scale.)
- VI. Felt by all, many frightened and run outdoors. Some heavy furniture moved; a few instances of fallen plaster or damaged chimneys. Damage slight. (VI to VII Rossi-Forel scale.)
- 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 motorcars. (VIII Rossi-Forel scale.)
- 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. Persons driving motorcars disturbed. (VIII+ to IX- Rossi-Forel scale.)
- 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. (IX+ Rossi-Forel scale.)
- X. Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations; ground badly cracked. Rails bent. Landslides considerable from riverbanks and steep slopes. Shifted sand and mud. Water splashed (slopped) over banks. (X Rossi-Forel scale.)
- 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. Rails bent greatly.
- XII. Damage total. Waves seen on ground surfaces. Lines of sight and level distorted. Objects thrown upward into air.

APPENDIX B

EARTHQUAKE REPORT

FORM C&GS-680
(3-66)

U.S. DEPARTMENT OF COMMERCE
ENVIRONMENTAL SCIENCE SERVICES ADMINISTRATION
COAST AND GEODETIC SURVEY

Budget Bureau No. 41-RO 13.5;
Approval Expires June 30, 1970

EARTHQUAKE REPORT

	1. An earthquake was felt ☐ ; not felt ☐		Time _____ A.M. _____ P.M.	
	Date of shock _____			
If felt, please supply information below (<u>Underline appropriate words or fill spaces.</u>) If not felt, please sign and return card, which requires no postage.				
2. YOUR LOCATION DURING EARTHQUAKE	a. City, County, State (Exact location in city or rural area at time of shock is important.) _____			
	b. Ground: Rocky, gravelly, loose, compact, marshy, filled in, or _____ Level, sloping, steep, or _____			
	c. If inside, type of construction Wood, brick, stone, or _____		d. Quality of construction New, old, well built, poorly built, or _____	
	e. No. of floors in building _____	f. Observer's floor _____	g. Activity when earthquake occurred: Walking, sitting, lying down, sleeping	h. If outside, you, others were: Quiet, active
3. EFFECTS ON POPULATION	a. Felt by: Very few, several, many, all (in your home) (in community)			
	b. Awakened: No one, few, many, all (in your home) (in community)			
	c. Frightened: No one, few, many, all (in your home) (in community); general panic			
4. RELATED SOUNDS	a. Rattling of windows, doors, dishes, etc. _____			
	b. Creaking of building (Describe) _____			
	c. Earth noises: Faint, moderate, loud _____			
5. PHYSICAL EFFECTS AND DAMAGE	a. Outside:			
	(1) Trees and bushes shaken, vehicles rocked, etc. _____			
	(2) Ground cracked; landslides; water disturbed, etc. _____			
	(3) Chimneys, tombstones, elevated water tanks, etc., cracked, twisted, overturned _____			
	(4) Other effects _____			
	b. Buildings:			
	(1) Hanging objects swung moderately, violently; Direction _____			
(2) Small objects shifted, overturned, fell _____				
(3) Furniture shifted, overturned, broken _____				
(4) Plaster cracked, broken, fell _____				
(5) Windows cracked _____				
(6) Structural elements of brick, wood, or _____				
Damage slight, moderate, great _____				

Signature and address of observer _____

Additional information will be appreciated. Use space on reverse side.

USCOMM-DC 36414-P66

APPENDIX C (Tables 1-34)

Table 1. Number of occurrences of intensity III or greater in 1X1 degree area, 1928-1973

LON LAT	125	124	123	122	121	120	119	118	117	116	115	114	113	112	111	110	109	108	107	106	105	104	103	102	101	100	99	98	97	96	95
50	3	3	4	5	4	4	3	3	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
49	3	6	24	29	19	16	14	22	9	12	11	6	6	8	7	6	6	3	3	3	3	2	1	0	0	0	0	0	0	0	0
48	8	12	53	61	29	24	19	20	14	17	19	31	11	11	11	6	6	3	3	3	3	4	1	0	0	0	0	0	0	0	0
47	5	20	52	55	23	17	12	16	19	16	18	22	20	26	18	9	6	3	3	3	3	3	2	0	1	0	0	0	0	0	0
46	5	17	32	24	13	10	12	15	13	13	9	15	26	33	25	11	7	4	3	2	3	3	1	0	0	0	0	0	0	0	0
45	6	12	19	15	8	8	6	8	11	13	11	12	16	21	17	6	5	5	3	3	4	2	1	1	1	1	0	0	0	0	0
44	4	10	12	5	5	8	7	7	10	15	13	11	11	10	8	6	6	3	1	1	1	2	4	1	2	3	2	0	1	1	2
43	4	8	12	6	6	5	4	5	5	9	11	15	7	6	6	5	7	3	2	2	2	3	3	3	2	2	1	0	2	2	2
42	6	22	14	9	9	11	9	12	10	8	8	10	9	9	7	4	3	3	2	0	0	4	3	2	2	2	1	0	2	2	3
41	13	102	71	31	19	15	21	23	15	15	10	10	8	16	8	4	3	3	0	2	3	0	1	0	1	1	1	2	2	4	4
40	12	110	45	49	51	51	30	28	14	18	10	8	7	11	6	5	4	3	5	5	16	2	0	0	0	2	2	3	3	4	4
39	7	39	78	52	73	61	48	36	16	12	12	8	9	9	4	4	4	4	2	2	2	1	0	0	0	0	3	3	2	4	4
38	0	6	104	183	83	73	66	41	19	13	12	10	9	3	3	1	2	1	1	3	1	2	2	1	1	2	2	4	4	4	5
37	0	0	26	209	159	86	95	75	19	14	13	14	7	3	1	1	2	1	1	1	2	2	3	3	3	3	1	1	2	2	4
36	0	0	0	65	120	99	86	80	31	21	17	9	3	3	1	1	2	1	1	1	3	3	3	4	3	2	3	3	5	4	3
35	0	0	0	0	0	71	104	97	74	44	30	18	7	2	1	2	2	2	2	2	2	2	2	6	3	3	3	5	5	4	3
34	0	0	0	0	0	67	106	243	187	88	45	26	11	11	5	3	4	1	1	1	1	1	2	2	3	2	3	3	1	3	3
33	0	0	0	0	0	6	29	52	180	151	62	21	10	7	5	5	4	3	3	3	1	1	1	1	2	1	2	3	2	0	2
32	0	0	0	0	0	0	0	4	19	18	22	13	7	4	4	1	1	2	3	2	1	2	1	1	1	1	1	1	1	0	2
31	0	0	0	0	0	0	0	3	8	8	10	7	6	3	3	1	1	1	2	2	1	1	1	1	1	1	1	1	1	1	0
30	0	0	0	0	0	0	0	0	0	0	7	4	3	1	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0

Table 1 (Continued)

LON LAT	94	93	92	91	90	89	88	87	86	85	84	83	82	81	80	79	78	77	76	75	74	73	72	71	70	69	68	67	66	65
49	0	0	0	1	1	1	1	1	1	1	1	2	2	2	2	2	3	3	3	2	3	3	3	3	3	3	2	1	1	1
48	0	0	1	1	1	1	1	1	1	1	1	2	2	2	2	2	3	3	3	2	3	3	3	3	3	3	3	2	1	1
47	0	0	1	1	1	1	1	2	2	2	3	2	2	2	2	2	3	3	3	3	3	4	5	5	5	6	8	2	1	0
46	0	0	1	1	1	1	2	3	2	2	3	3	2	2	2	2	3	3	3	3	7	5	5	6	7	8	6	4	0	0
45	1	2	2	2	2	3	3	2	3	3	3	3	3	2	2	2	3	3	5	7	10	9	9	10	9	10	7	7	0	0
44	3	3	2	4	3	2	2	3	6	4	3	3	3	3	3	4	4	5	6	6	13	12	12	10	12	9	6	0	0	0
43	3	3	4	4	3	5	4	5	6	6	6	5	5	4	5	7	8	4	10	7	9	12	14	10	7	2	0	0	0	0
42	3	5	4	3	4	4	5	6	5	6	7	6	8	6	6	8	5	4	6	6	6	10	8	11	7	2	0	0	0	0
41	3	4	4	4	3	5	5	4	6	7	8	8	7	8	5	5	3	4	6	6	11	9	7	7	5	0	0	0	0	0
40	4	2	4	4	5	5	3	5	6	6	8	8	6	5	4	3	2	5	6	8	4	2	1	0	0	0	0	0	0	0
39	5	6	6	6	12	7	9	3	4	6	7	6	5	4	4	3	2	5	3	2	2	1	0	0	0	0	0	0	0	0
38	5	6	6	14	16	14	10	4	5	7	7	5	4	4	3	3	8	7	2	1	1	0	0	0	0	0	0	0	0	0
37	3	6	5	13	16	17	8	3	3	6	7	6	6	7	3	2	4	3	1	1	0	0	0	0	0	0	0	0	0	0
36	3	5	6	11	12	13	7	3	2	7	11	10	9	5	3	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0
35	3	4	5	9	12	7	4	3	5	7	7	7	10	6	4	2	1	2	0	0	0	0	0	0	0	0	0	0	0	0
34	2	3	4	7	6	3	2	3	3	5	4	4	7	12	4	3	2	2	0	0	0	0	0	0	0	0	0	0	0	0
33	1	2	3	4	3	3	2	3	2	3	3	3	5	6	6	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
32	1	0	0	2	1	2	2	1	1	1	1	2	3	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31	0	0	0	1	2	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 2. Number of occurrences of intensity IV or greater in 1X1 degree area, 1928-1973

LON	125	124	123	122	121	120	119	118	117	116	115	114	113	112	111	110	109	108	107	106	105	104	103	102	101	100	99	98	97	96	95	
LAT	50	1	1	1	2	1	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
49	2	4	21	24	10	12	10	11	6	4	6	4	4	5	4	3	4	3	4	2	2	1	0	0	0	0	0	0	0	0	0	
48	6	11	42	56	26	23	15	16	11	10	14	25	11	10	6	5	4	3	3	3	2	3	1	0	0	0	0	0	0	0	0	
47	4	10	40	48	20	15	12	9	14	13	12	15	16	17	13	6	5	3	3	3	2	2	2	1	0	1	0	0	0	0	0	
46	4	11	24	16	10	8	7	7	9	7	6	10	19	23	20	9	5	3	3	2	2	1	0	0	0	0	0	0	0	0	0	
45	4	9	14	11	5	5	4	4	4	8	7	9	11	14	13	6	3	4	3	2	2	2	0	0	0	1	0	0	0	0	0	
44	2	5	7	2	2	2	3	4	6	11	9	9	7	9	6	4	4	1	1	1	1	1	2	1	2	2	0	0	1	0	0	
43	1	7	4	0	4	2	3	3	3	5	9	7	3	5	5	4	2	1	0	1	1	2	2	2	2	1	1	0	0	0	0	
42	4	12	10	6	3	6	5	11	7	6	5	7	6	7	6	4	3	0	0	0	0	2	2	2	1	2	0	0	0	0	0	
41	9	90	44	22	15	11	17	17	11	12	9	8	6	12	4	2	1	0	0	1	1	0	0	0	0	0	0	0	1	1	2	
40	6	93	26	37	43	35	25	22	11	11	6	4	5	8	2	2	1	1	1	1	4	16	1	0	0	0	1	0	1	1	1	3
39	6	27	59	41	52	49	37	22	10	7	5	4	5	7	2	2	2	3	2	0	0	0	0	0	0	0	0	0	0	2	3	3
38	0	2	65	143	55	51	46	31	14	6	7	6	7	3	1	1	0	1	1	3	1	1	2	4	1	0	1	1	2	1	1	3
37	0	0	10	165	117	53	77	49	7	9	10	11	3	1	0	0	1	1	1	1	1	2	2	2	2	2	3	2	1	1	1	3
36	0	0	0	41	82	65	66	53	19	12	10	5	0	0	0	0	1	1	1	1	1	1	2	2	3	1	1	1	1	3	2	2
35	0	0	0	0	41	53	73	67	46	27	20	10	1	0	0	0	0	1	1	2	1	1	1	2	1	1	1	1	1	3	4	2
34	0	0	0	0	0	43	68	178	147	75	28	16	4	4	0	0	0	0	1	0	1	1	1	1	2	1	1	2	3	4	4	2
33	0	0	0	0	0	0	1	17	28	117	98	42	17	6	5	3	4	2	3	1	1	1	1	1	1	1	1	2	1	1	0	1
32	0	0	0	0	0	0	0	3	12	11	14	10	6	4	2	0	0	2	1	1	1	2	1	1	1	1	1	1	1	1	0	1
31	0	0	0	0	0	0	0	2	6	8	9	5	4	2	1	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0
30	0	0	0	0	0	0	0	0	0	0	4	3	2	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	0
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0

Table 2 (Continued)

LOW LAT	94	93	92	91	90	89	88	87	86	85	84	83	82	81	80	79	78	77	76	75	74	73	72	71	70	69	68	67	66	65
49	0	0	0	0	0	0	1	1	1	1	1	1	1	1	2	2	3	3	3	2	3	3	3	2	2	1	1	1	0	0
48	0	0	0	0	0	0	1	1	1	1	1	1	1	2	2	2	3	3	3	2	3	3	3	3	2	1	1	0	0	0
47	0	0	0	0	0	0	1	1	1	2	1	1	2	2	2	2	3	3	3	2	3	3	3	4	3	2	3	0	0	0
46	0	0	0	0	0	0	1	1	1	1	1	1	2	2	2	2	3	3	3	2	3	4	4	5	7	5	2	0	0	0
45	0	0	0	0	0	0	1	1	1	1	1	1	2	2	2	2	3	3	3	5	10	8	9	7	8	7	4	4	0	0
44	0	0	0	1	1	1	1	2	2	2	1	1	2	2	2	3	2	3	5	5	9	11	9	10	10	4	2	0	0	0
43	0	1	2	2	2	2	2	1	3	3	3	1	2	2	3	4	5	4	5	6	8	8	11	9	4	1	0	0	0	0
42	1	3	3	3	3	3	2	3	3	4	3	2	2	4	3	4	4	3	3	4	5	6	7	8	3	1	0	0	0	0
41	2	3	3	3	3	3	2	2	3	7	3	3	2	2	3	3	2	3	4	5	6	4	3	2	1	0	0	0	0	0
40	2	2	3	3	3	2	2	2	2	5	5	4	2	1	1	2	1	3	3	6	4	1	0	0	0	0	0	0	0	0
39	3	3	4	4	6	3	3	2	1	4	5	3	2	1	1	0	2	2	2	1	0	0	0	0	0	0	0	0	0	0
38	2	2	5	9	12	8	5	2	1	1	3	2	3	1	1	1	4	3	0	0	0	0	0	0	0	0	0	0	0	0
37	2	2	3	10	12	11	5	1	1	2	5	6	3	4	2	2	3	1	0	0	0	0	0	0	0	0	0	0	0	0
36	1	1	3	7	9	9	3	1	0	5	9	8	8	2	1	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0
35	1	2	2	5	8	4	1	2	2	6	7	7	6	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
34	0	1	3	5	4	2	2	2	2	4	4	3	3	9	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
33	1	1	2	2	2	3	2	2	2	3	1	1	2	4	5	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
32	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 3. Number of occurrences of intensity V or greater in 1X1 degree area, 1928-1973

LON	125	124	123	122	121	120	119	118	117	116	115	114	113	112	111	110	109	108	107	106	105	104	103	102	101	100	99	98	97	96	95
LAT	50	1	1	1	1	1	1	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
49	1	2	15	16	5	6	6	8	3	1	3	3	4	5	3	2	2	1	1	1	1	0	0	0	0	0	0	0	0	0	0
48	3	9	28	40	17	16	10	11	8	7	11	22	9	7	5	5	3	2	2	2	1	0	0	0	0	0	0	0	0	0	0
47	1	6	23	28	14	12	7	6	11	6	7	9	10	11	7	5	3	3	2	1	1	1	0	0	1	0	0	0	0	0	0
46	2	8	14	13	5	5	5	4	4	6	5	7	10	16	18	5	3	3	2	1	1	1	0	0	0	0	0	0	0	0	0
45	0	6	10	9	2	3	3	3	2	7	6	8	8	10	8	3	3	3	1	1	1	1	0	0	0	1	0	0	0	0	0
44	0	3	4	1	2	0	1	2	4	7	8	7	4	3	4	3	2	1	1	1	0	1	2	0	0	0	0	0	0	0	0
43	1	3	2	0	2	0	2	2	3	5	8	4	3	5	2	2	1	0	0	1	0	0	2	1	1	1	1	0	1	0	0
42	3	7	7	3	2	4	3	5	3	3	3	6	5	5	6	2	1	0	0	0	0	0	1	0	1	0	0	0	0	0	0
41	4	87	16	10	6	5	10	12	8	7	6	4	4	9	3	2	1	0	0	1	0	0	0	0	0	1	0	0	0	1	0
40	6	77	9	26	24	22	17	14	9	7	5	3	2	6	2	1	1	1	0	2	16	0	0	0	0	1	0	0	0	1	0
39	2	11	34	21	30	35	29	17	7	4	4	2	1	5	1	1	1	2	1	0	0	0	0	0	0	0	0	0	0	0	1
38	0	0	41	99	25	30	28	19	6	4	7	3	4	2	0	0	0	1	2	1	0	1	0	0	0	0	1	0	0	1	1
37	0	0	2	126	76	26	46	32	3	4	3	5	1	1	0	0	0	1	1	1	2	2	1	2	0	0	2	1	1	1	0
36	0	0	0	22	45	38	39	33	8	8	6	0	0	0	0	0	0	1	1	1	0	1	2	1	1	1	1	1	2	2	0
35	0	0	0	0	27	26	47	36	18	14	12	2	0	0	0	0	0	1	1	1	1	0	0	1	0	0	1	2	1	3	0
34	0	0	0	0	0	22	42	138	103	46	15	8	2	0	0	0	0	0	1	0	1	0	0	0	0	0	0	1	0	1	1
33	0	0	0	0	0	1	5	13	67	76	29	7	4	3	2	3	1	1	1	0	1	1	1	0	0	0	0	0	0	0	1
32	0	0	0	0	0	0	0	2	8	10	11	6	6	3	1	0	0	0	1	1	1	2	1	1	1	1	1	0	0	0	1
31	0	0	0	0	0	0	0	1	5	5	7	3	3	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	0	0
30	0	0	0	0	0	0	0	0	0	0	3	1	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0

Table 3 (Continued)

LON LAT	94	93	92	91	90	89	88	87	86	85	84	83	82	81	80	79	78	77	76	75	74	73	72	71	70	69	68	67	66	65
49	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	2	2	2	1	1	1	1	1	0	0	0
48	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	2	2	2	3	2	2	2	1	1	1	1	0	0	0
47	0	0	0	0	0	0	0	0	1	1	1	1	1	1	2	2	2	2	2	3	3	3	2	1	1	2	0	0	0	0
46	0	0	0	0	0	0	0	0	1	1	1	1	1	1	2	2	2	2	2	3	3	3	2	2	3	2	0	0	0	0
45	0	0	0	0	0	0	0	0	0	0	1	1	1	1	2	2	2	2	2	2	4	5	5	4	3	5	1	1	0	0
44	0	0	0	0	0	0	0	0	0	0	1	1	1	1	2	2	2	2	2	6	6	7	7	7	3	0	0	0	0	0
43	0	0	0	0	1	1	1	0	0	0	1	1	1	1	1	4	5	3	3	4	4	4	8	6	3	1	0	0	0	0
42	0	0	1	1	1	1	1	1	1	1	2	1	1	1	1	1	3	3	2	2	2	3	3	4	1	0	0	0	0	0
41	0	0	3	2	2	2	2	1	0	2	2	2	2	2	1	1	2	1	2	2	3	2	1	1	0	0	0	0	0	0
40	0	0	2	1	1	1	1	1	1	3	4	2	2	1	0	0	0	0	2	5	1	1	0	0	0	0	0	0	0	0
39	2	1	2	2	3	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
38	1	2	2	4	3	3	2	2	1	1	0	1	1	1	1	0	3	2	0	0	0	0	0	0	0	0	0	0	0	0
37	0	0	1	3	6	5	3	1	1	2	3	3	1	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	3	8	4	1	1	1	2	7	5	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
35	1	0	1	1	2	1	1	2	1	2	3	5	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
34	0	0	1	3	2	1	0	1	1	2	0	0	1	5	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
33	0	0	0	1	1	1	0	0	0	0	0	1	0	1	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 4. Number of occurrences of intensity VI or greater in 1X1 degree area, 1928-1973

LON	125	124	123	122	121	120	119	118	117	116	115	114	113	112	111	110	109	108	107	106	105	104	103	102	101	100	99	98	97	96	95
LAT	50	49	48	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25					
1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	1	1	7	9	1	3	3	3	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	1	4	18	28	9	11	3	3	0	1	4	15	4	3	4	2	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0
4	1	4	11	17	4	2	2	3	3	3	2	6	7	7	5	2	1	1	1	0	0	0	0	0	1	0	0	0	0	0	0
5	0	2	10	4	2	1	2	2	2	3	3	4	6	9	9	4	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0
6	0	3	7	3	2	2	2	1	1	3	4	2	2	8	3	3	2	2	1	0	0	0	0	0	0	1	0	0	0	0	0
7	0	2	1	1	0	0	0	0	0	3	5	4	2	2	3	1	1	0	0	0	0	1	2	0	0	1	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	1	1	1	3	0	1	0	0	0	0	0	0	2	1	1	1	0	0	0	0	0
9	0	1	4	3	0	1	2	0	3	0	0	2	2	3	3	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0
10	1	4	53	6	5	2	3	7	7	0	3	2	2	1	7	2	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0
11	4	5	49	4	7	12	14	6	8	6	6	2	2	0	1	1	0	0	0	2	16	0	0	0	0	1	0	0	0	1	0
12	0	3	19	9	15	21	17	12	4	4	3	1	0	2	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0
13	0	0	13	54	10	15	15	9	5	2	1	1	0	2	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0
14	0	0	1	74	36	10	24	15	2	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1	1	0	0	0	0
15	0	0	0	6	16	18	19	12	6	3	3	0	0	0	0	0	0	0	1	0	1	0	2	1	0	0	0	1	1	2	0
16	0	0	0	0	0	16	11	29	20	7	9	3	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1	3
17	0	0	0	0	0	7	22	90	62	20	5	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
18	0	0	0	0	0	0	0	1	4	34	46	16	6	2	1	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	1	7	7	6	4	4	2	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1
20	0	0	0	0	0	0	0	0	0	3	4	3	2	1	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0
34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0
35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0
37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0
41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0
42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0
43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0
44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0
45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0
46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0
47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0
49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0
50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0

Table 4 (Continued)

LON LAT	94	93	92	91	90	89	88	87	86	85	84	83	82	81	80	79	78	77	76	75	74	73	72	71	70	69	68	67	66	65
49	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	0	0	0	0
47	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	2	2	2	1	1	1	1	1	2	0	0	0	0
46	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	2	2	2	2	2	2	1	1	2	1	0	0	0	0
45	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	2	2	2	2	2	3	2	3	3	2	3	0	1	0	0
44	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	2	2	2	2	5	4	2	5	1	0	0	0	0
43	0	0	0	0	0	1	0	0	0	0	1	1	1	1	1	2	4	2	1	1	1	2	5	4	1	0	0	0	0	0
42	0	0	0	1	1	1	1	0	1	1	1	1	1	1	1	2	1	1	1	1	1	1	0	3	1	0	0	0	0	0
41	0	0	0	0	0	1	0	0	0	0	2	2	1	1	1	0	0	0	2	2	3	1	1	1	0	0	0	0	0	0
40	0	0	0	0	0	1	1	0	0	1	3	0	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0
39	1	0	1	1	2	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
38	0	0	1	3	2	2	2	2	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
37	0	0	0	1	5	4	1	1	1	0	1	1	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	1	6	2	0	0	0	0	6	3	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0	1	0	0	0	3	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
34	0	0	1	2	2	0	0	0	1	1	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

[illegible]

Table 5 (Continued)

LON	94	93	92	91	90	89	88	87	86	85	84	83	82	81	80	79	78	77	76	75	74	73	72	71	70	69	68	67	66	65
LAT	49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	1	0	0	0	0	0
47	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1	1	1	1	1	1	0	0	0	1	1	0	0	0	0	0
46	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	2	2	0	0	0	1	1	0	0	0	0	0
45	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	2	2	3	2	0	1	1	0	0	0	0	0	0
44	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
43	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	4	1	1	1	1	0	0	0	0	0	0	0	0	0
42	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
39	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
38	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
37	0	0	0	0	2	2	1	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	1	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
34	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

[illegible]

Table 6 (Continued)

LON	94	93	92	91	90	89	88	87	86	85	84	83	82	81	80	79	78	77	76	75	74	73	72	71	70	69	68	67	66	65
LAT	49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
46	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0
45	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	1	1	1	2	0	1	0	0	0	0	0	0	0	0
44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1	0	0	0	0	0	0
43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0	1	0	0	0	0	0	0	0	0	0
42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
38	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 7. Number of occurrences of intensity IX or greater in 1X1 degree area, 1928-1973

LON	125	124	123	122	121	120	119	118	117	116	115	114	113	112	111	110	109	108	107	106	105	104	103	102	101	100	99	98	97	96	95
LAT	50	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	49	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	48	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	47	0	0	2	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	46	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	45	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	44	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	42	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	41	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	40	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	39	0	0	0	1	0	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	38	0	0	0	3	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	37	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	36	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	35	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	34	0	0	0	0	0	2	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	33	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	32	0	0	0	0	0	0	0	0	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
	28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 7 (Continued)

LON	94	93	92	91	90	89	88	87	86	85	84	83	82	81	80	79	78	77	76	75	74	73	72	71	70	69	68	67	66	65
LAT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 8. Number of occurrences of intensity X or greater in 1X1 degree area, 1928-1973

LON	125	124	123	122	121	120	119	118	117	116	115	114	113	112	111	110	109	108	107	106	105	104	103	102	101	100	99	98	97	96	95
LAT	50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
45	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
44	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
35	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
32	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 8 (Continued)

LON	94	93	92	91	90	89	88	87	86	85	84	83	82	81	80	79	78	77	76	75	74	73	72	71	70	69	68	67	66	65
LAT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 9. Number of occurrences of intensity XI or greater in 1X1 degree area, 1928-1973

LON LAT	125	124	123	122	121	120	119	118	117	116	115	114	113	112	111	110	109	108	107	106	105	104	103	102	101	100	99	98	97	96	95
50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
35	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
34	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

Table 9 (Continued)

LON	94	93	92	91	90	89	88	87	86	85	84	83	82	81	80	79	78	77	76	75	74	73	72	71	70	69	68	67	66	65
LAT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 10. Maximum intensities felt in 1X1 degree areas, 1928-1973

LON	125	124	123	122	121	120	119	118	117	116	115	114	113	112	111	110	109	108	107	106	105	104	103	102	101	100	99	98	97	96
LAT	49	0	9	9	8	7	7	7	5	4	5	5	5	6	6	5	5	5	5	5	5	4	3	0	0	0	0	0	0	0
48	0	8	7	9	7	7	7	6	5	6	7	8	6	7	6	6	6	6	6	5	5	4	3	0	0	0	0	0	0	0
47	0	7	9	9	8	7	6	6	6	6	7	7	8	9	7	6	7	6	6	5	5	4	4	0	6	0	0	0	0	0
46	0	8	9	7	7	7	6	9	6	6	7	7	8	8	8	7	7	6	6	5	5	5	4	0	0	0	0	0	0	0
45	0	7	7	7	6	6	6	6	6	7	8	6	8	10	11	9	7	6	6	5	5	5	3	3	3	6	0	0	0	0
44	0	6	6	6	5	4	5	5	5	7	8	7	10	10	10	8	6	5	5	4	4	6	6	4	4	6	3	0	4	0
43	0	5	4	4	5	4	5	5	5	5	6	6	6	6	5	5	5	4	3	5	3	6	6	6	6	6	5	0	5	3
42	0	8	6	5	6	5	5	6	5	5	5	6	8	9	7	5	5	3	3	3	0	4	6	4	6	4	3	0	4	3
41	0	9	7	7	6	7	7	6	6	6	6	6	7	7	6	6	5	3	0	4	4	0	3	0	3	3	3	3	5	4
40	0	7	6	7	6	7	8	10	8	7	6	6	5	5	5	5	5	5	4	4	7	4	0	0	0	6	3	4	5	8
39	0	0	8	7	7	8	8	10	9	8	7	6	5	6	5	5	5	5	7	3	4	3	0	0	0	0	3	3	5	4
38	0	0	6	9	6	7	8	8	8	7	6	5	5	7	4	3	3	6	7	5	4	5	4	4	0	4	5	4	5	5
37	0	0	0	8	6	7	7	6	7	6	5	5	5	7	3	3	4	6	9	6	6	6	7	6	5	3	6	5	7	4
36	0	0	0	0	0	9	9	8	7	6	6	4	3	3	3	3	4	6	7	4	4	5	6	6	5	5	5	6	6	7
35	0	0	0	0	0	7	11	8	8	7	6	6	3	3	3	3	3	6	4	6	4	4	4	5	4	4	4	6	6	4
34	0	0	0	0	0	7	9	11	9	8	6	5	5	4	3	3	3	0	4	5	5	4	4	4	4	4	4	6	4	4
33	0	0	0	0	0	0	0	0	9	8	10	6	6	6	5	4	8	7	4	5	5	5	5	4	4	4	4	4	4	0
32	0	0	0	0	0	0	0	0	8	9	10	9	7	6	5	3	3	4	5	5	6	6	5	5	5	5	4	4	4	0
31	0	0	0	0	0	0	0	0	0	0	0	0	7	5	4	3	3	4	5	7	7	7	6	5	5	5	5	5	4	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	8	7	6	6	6	5	5	4	3
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	9	9	7	6	6	5	5	4	3
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	6	6	5	5	4	0
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	5	4	0	0
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	3	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	0	0	0

Table 10 (Continued)

LON LAT	94	93	92	91	90	89	88	87	86	85	84	83	82	81	80	79	78	77	76	75	74	73	72	71	70	69	68	67	66	65
49	0	0	0	3	3	3	4	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0
48	0	0	3	3	3	3	4	4	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	7	7	6	0	0	0	0
47	0	0	3	3	3	3	4	4	5	5	6	6	7	0	0	0	0	0	0	0	0	6	6	7	7	6	4	4	4	0
46	0	0	3	3	3	3	4	4	5	6	7	7	8	8	8	8	0	0	0	0	7	6	7	7	7	6	4	4	3	0
45	3	3	3	3	3	3	3	4	4	5	7	8	8	7	7	8	8	8	8	8	8	7	7	7	6	6	5	6	5	0
44	3	3	3	4	4	4	4	4	4	4	6	6	7	7	7	7	8	7	7	7	7	7	7	8	6	6	0	0	0	0
43	3	4	4	5	5	6	5	4	4	4	6	6	6	7	7	7	8	8	7	7	8	7	7	8	6	6	0	0	0	0
42	4	4	4	5	6	7	6	5	6	7	8	6	6	6	6	6	6	7	7	6	6	6	6	6	6	6	0	0	0	0
41	4	4	5	5	5	6	5	5	4	5	6	6	6	6	5	5	5	6	5	6	6	5	5	7	6	0	0	0	0	0
40	4	4	5	5	5	6	6	5	5	6	6	5	6	5	4	4	4	4	4	7	5	6	0	0	0	0	0	0	0	0
39	6	5	6	6	6	7	7	6	5	5	5	4	5	4	4	4	4	4	3	4	0	0	0	0	0	0	0	0	0	0
38	5	5	6	6	7	8	8	7	6	5	6	6	6	5	5	4	5	6	3	0	0	0	0	0	0	0	0	0	0	0
37	4	4	5	5	7	8	7	6	5	5	6	6	7	7	6	4	4	4	0	0	0	0	0	0	0	0	0	0	0	0
36	4	4	4	5	6	6	5	5	5	5	6	7	7	6	4	4	3	0	0	0	0	0	0	0	0	0	0	0	0	0
35	5	4	5	5	5	5	5	7	5	4	5	6	5	5	5	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0
34	3	4	6	5	8	6	4	5	6	4	4	4	5	7	6	5	3	0	0	0	0	0	0	0	0	0	0	0	0	0
33	4	4	4	5	5	5	4	4	4	4	3	3	4	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
32	4	0	0	3	3	3	3	3	3	3	3	3	3	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31	0	0	0	3	3	3	3	3	3	3	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	3	6	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0	0	0	0	0	6	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 11. Coefficients and Standard Errors for Area vs. Maximum Intensity Curves for the Western United States, Regions 8, 8N, and 7

Intensity (I)	Intercept (a_I)	Slope (b_I)	S_{xy}	S_a	S_b
III	6.792	.650	.4994	.4810	.0645
IV	5.868	.715	.5453	.6598	.0841
V	4.697	.787	.2361	.3679	.0446
VI	3.279	.865	.3563	.7384	.0852
VII	1.614	.952	.4233	1.2196	.1339
VIII	- .298	1.047	.8134	3.4798	.3638
IX	- 2.457	1.152	.4869	3.4545	.3443
X	- 4.862	1.267	.0813	1.2087	.1150
XI	- 7.515	1.394	-	-	-
XII	-10.415	1.533	-	-	-

Table 12. Coefficients and Standard Errors for Area vs. Maximum Intensity Curves for California and Western Nevada, Region 8

Intensity (I)	Intercept (a_I)	Slope (b_I)	S_{xy}	S_a	S_b
III	6.134	.706	.1266	.1220	.0163
IV	5.530	.738	.0300	.0363	.0005
V	4.837	.771	.1307	.2037	.0247
VI	3.848	.806	.3047	.6314	.0728
VII	2.750	.842	.4243	1.2223	.1342
VIII	1.244	.890	.6409	2.7415	.2866
IX	- .173	.920	.3208	2.2763	.2269
X	- 1.677	.961	.4060	6.0362	.5742
XI	- 3.548	1.004	-	-	-
XII	- 5.527	1.050	-	-	-

Table 13. Coefficients and Standard Errors for Area vs. Maximum Intensity Curves for Washington and Oregon, Region 8N

Intensity (I)	Intercept (a_I)	Slope (b_I)	S_{xy}	S_a	S_b
III	7.325	.588	.5721	.9190	.1367
IV	6.513	.650	.4674	.7508	.1117
V	5.457	.710	.4581	1.0344	.1448
VI	4.172	.781	.6219	2.1089	.2781
VII	2.647	.859	1.0242	5.8239	.7242
VIII	.885	.945	1.1304	13.6123	1.5987
IX	- 1.111	1.040	-	-	-
X	- 3.341	1.143	-	-	-
XI	- 5.851	1.262	-	-	-
XII	- 8.511	1.384	-	-	-

Table 14. Coefficients and Standard Errors for Area vs. Maximum Intensity Curves for the Western Mountains, Region 7

Intensity (I)	Intercept (a_I)	Slope (b_I)	S_{xy}	S_a	S_b
III	6.396	.725	.6946	.8805	.1177
IV	5.201	.812	.5927	.7513	.1004
V	3.718	.907	.4122	.6756	.0853
VI	2.011	1.027	.4936	1.0749	.1283
VII	.064	1.131	.6484	1.9451	.2192
VIII	- 2.151	1.262	.2586	1.1272	.1197
IX	- 4.468	1.409	.6570	4.6692	.4646
X	- 7.602	1.573	-	-	-
XI	-11.012	1.756	-	-	-
XII	-15.015	1.960	-	-	-

Table 15. Coefficients and Standard Errors for Area vs. Maximum Intensity Curves for the Eastern United States, Regions 5 and 6

Intensity (I)	Intercept (a_I)	Slope (b_I)	S_{xy}	S_a	S_b
III	6.770	.793	.1893	.3041	.0452
IV	5.378	.877	.1029	.1654	.0246
V	3.875	.961	.3226	.7286	.1020
VI	2.259	1.045	.1205	.4086	.0539
VII	.532	1.129	.4121	2.3433	.2914
VIII	- 1.311	1.213	.5119	6.1644	.7240
IX	- 3.271	1.298	-	-	-
X	- 5.360	1.385	-	-	-
XI	- 7.632	1.478	-	-	-
XII	- 9.858	1.557	-	-	-

Table 16. Coefficients and Standard Errors for Area vs. Maximum Intensity Curves for the Central Region, Region 6

Intensity (I)	Intercept (a_I)	Slope (b_I)	S_{xy}	S_a	S_b
III	7.453	.723	.4816	.7737	.1151
IV	6.236	.806	.5995	.9632	.1433
V	4.668	.910	.8312	1.8772	.2629
VI	2.658	1.040	.7719	2.6177	.3452
VII	.088	1.200	.8389	4.7703	.5932
VIII	- 2.884	1.398	.9422	11.3455	1.3325
IX	- 5.466	1.547	-	-	-
X	- 7.046	1.606	-	-	-
XI	-11.051	1.851	-	-	-
XII	-14.211	2.025	-	-	-

Table 17. Coefficients and Standard Errors for Area vs. Maximum Intensity Curves for the Eastern Region, Region 5

Intensity (I)	Intercept (a _I)	Slope (b _I)	S _{xy}	S _a	S _b
III	5.828	.883	.4769	.9297	.1508
IV	4.820	.928	.3449	.6724	.1091
V	3.699	.970	.7269	2.1442	.3251
VI	2.458	1.012	.3575	1.7814	.2528
VII	1.099	1.053	.6799	7.2270	.9615
VIII	- .378	1.095	-	-	-
IX	- 1.883	1.126	-	-	-
X	- 3.762	1.185	-	-	-
XI	- 5.405	1.208	-	-	-
XII	- 7.212	1.245	-	-	-

Table 18. Coefficients and Standard Errors for Distance vs. Maximum Intensity Curves for Western United States, Regions 8, 8N, and 7

Intensity (I)	Intercept (a _I)	Slope (b _I)	S _{xy}	S _a	S _b
III	2.347	.368	.1965	.2378	.0303
IV	1.562	.430	.1499	.1814	.0231
V	.641	.497	.1260	.1964	.0238
VI	- .423	.571	.3064	.6351	.0733
VII	- 1.640	.652	.2219	.6393	.0702
VIII	- 3.037	.743	.3317	1.4192	.1484
IX	- 4.695	.850	.3538	2.5101	.2502
X	- 6.818	.987	.2361	3.5106	.3340
XI	-10.073	1.206	-	-	-
XII	-16.353	1.643	-	-	-

Table 19. Coefficients and Standard Errors for Distance vs. Maximum Intensity Curves for California and Western Nevada, Region 8

Intensity (I)	Intercept (a _I)	Slope (b _I)	S _{xy}	S _a	S _b
III	1.940	.397	.1904	.2304	.0294
IV	1.435	.436	.1538	.1861	.0237
V	.771	.480	.1673	.2606	.0316
VI	- .050	.522	.2308	.4784	.0552
VII	- 1.032	.580	.2536	.7306	.0802
VIII	- 2.172	.637	.4022	1.7207	.1799
IX	- 3.470	.700	.4306	3.0547	.3045
X	- 4.927	.770	.3434	5.1057	.4857
XI	- 6.542	.846	-	-	-
XII	- 8.317	.930	-	-	-

Table 20. Coefficients and Standard Errors for Distance vs. Maximum Intensity Curves for Washington and Oregon, Region 8N

Intensity (I)	Intercept (a _I)	Slope (b _I)	S _{xy}	S _a	S _b
III	1.890	.424	.5417	.8702	.1295
IV	1.415	.451	.4876	.7833	.1166
V	.848	.481	.1868	.4219	.0591
VI	.187	.512	.2407	.8161	.1076
VII	- .567	.545	.4554	2.5895	.3220
VIII	- 1.412	.581	.5440	6.5507	.7693
IX	- 2.352	.618	-	-	-
X	- 3.384	.659	-	-	-
XI	- 4.510	.701	-	-	-
XII	- 5.728	.747	-	-	-

Table 21. Coefficients and Standard Errors for Distance vs. Maximum Intensity Curves for the Western Mountains, Region 7

Intensity (I)	Intercept (a_I)	Slope (b_I)	S_{xy}	S_a	S_b
III	2.112	.406	.1973	.2500	.0334
IV	1.486	.451	.2041	.2587	.0346
V	.715	.502	.1882	.3085	.0390
VI	- .202	.558	.2760	.6010	.0717
VII	- 1.264	.620	.3441	1.0324	.1163
VIII	- 2.471	.689	.1112	.4847	.0515
IX	- 3.822	.766	.0990	.7034	.0700
X	- 5.320	.852	-	-	-
XI	- 6.962	.947	-	-	-
XII	- 8.749	1.053	-	-	-

Table 22. Coefficients and Standard Errors for Distance vs. Maximum Intensity Curves for the Eastern United States, Regions 5 and 6

Intensity (I)	Intercept (a_I)	Slope (b_I)	S_{xy}	S_a	S_b
III	2.286	.444	.2360	.3792	.0564
IV	1.448	.495	.2695	.4329	.0644
V	.466	.553	.3663	.8272	.1158
VI	- .639	.618	.3700	1.2547	.1655
VII	- 1.884	.689	.5276	3.0003	.3731
VIII	- 3.278	.769	.7223	8.6974	1.0215
IX	- 4.805	.858	-	-	-
X	- 6.478	.957	-	-	-
XI	- 8.291	1.069	-	-	-
XII	-10.115	1.181	-	-	-

Table 23. Coefficients and Standard Errors for Distance vs. Maximum Intensity Curves for the Central Region, Region 6

Intensity (I)	Intercept (a_I)	Slope (b_I)	S_{xy}	S_a	S_b
.III	2.623	.417	.1945	.3125	.0465
IV	1.826	.471	.2207	.3545	.0527
V	.898	.531	.3103	.7008	.0981
VI	- .240	.599	.2689	.9119	.1203
VII	- 1.499	.675	.3740	2.1264	.2644
VIII	- 3.055	.762	.5823	7.0116	.8235
IX	- 4.741	.859	-	-	-
X	- 6.595	.965	-	-	-
XI	- 8.677	1.093	-	-	-
XII	-10.808	1.233	-	-	-

Table 24. Coefficients and Standard Errors for Distance vs. Maximum Intensity Curves for the Eastern Region, Region 5

Intensity (I)	Intercept (a_I)	Slope (b_I)	S_{xy}	S_a	S_b
III	2.144	.457	.2954	.5758	.0934
IV	1.331	.509	.2306	.4496	.0729
V	.460	.563	.1934	.5706	.0865
VI	- .619	.631	.2277	1.1347	.1610
VII	- 1.892	.714	.2624	2.7897	.3711
VIII	- 3.175	.789	-	-	-
IX	- 4.850	.892	-	-	-
X	- 6.541	.987	-	-	-
XI	- 8.752	1.109	-	-	-
XII	-11.079	1.269	-	-	-

Table 25. Coefficients and Standard Errors for Magnitude (M_L) vs. Area Curves for Each Region

Region	Intercept (a_I)	Slope (b_I)	Standard Deviation
Western Mountains. . .	4.446	1.264	.3306
8.	3.020	1.449	.4189
8N	5.283	1.036	.7399
7.	5.133	1.030	.6508
Eastern United States.	4.093	1.766	1.007
6.	2.916	2.066	1.0387
5.	6.192	1.116	.8560

Table 26. Relationships between I_o and M_L , m_b and M_S for the Western United States, Regions 8, 8N, and 7

$$\ln A = 6.792 + .650 I_o = 4.446 + 1.264 M_L$$

$$M_L = 1.856 + .514 I_o$$

$$m_b = 1.276 + .749 M_L$$

$$= 2.666 + .385 I_o$$

$$M_S = -1.939 + 1.189 M_L^*$$

$$= .268 + .611 I_o$$

I_o	M_L	m_b	M_S
III	3.39	3.82	2.10
IV	3.91	4.20	2.71
V	4.42	4.59	3.32
VI	4.94	4.97	3.93
VII	5.45	5.36	4.54
VIII	5.96	5.75	5.15
IX	6.48	6.13	5.76
X	6.99	6.51	6.37
XI	7.51	6.90	6.99
XII	8.02	7.28	7.60

* Based on $m_b = 2.5 + .63 M_S$ (Richter, 1958)

Table 27. Relationships between I_o and M_L , m_b and M_S for California and Western Nevada, Region 8

$$\ln A = 6.134 + .706 I_o = 3.020 + 1.449 M_L$$

$$M_L = 2.149 + .487 I_o$$

$$m_b = 1.276 + .749 M_L$$

$$= 2.886 + .365 I_o$$

$$M_S = -1.939 + 1.189 M_L$$

$$= .616 + .579 I_o$$

I_o	M_L	m_b	M_S
III	3.61	3.98	2.35
IV	4.10	4.35	2.93
V	4.58	4.71	3.51
VI	5.07	5.08	4.09
VII	5.56	5.44	4.67
VIII	6.05	5.81	5.25
IX	6.53	6.17	5.83
X	7.02	6.54	6.41
XI	7.51	6.90	6.99
XII	7.99	7.26	7.56

Table 28. Relationships between I_o and M_L , m_b and M_S for Washington and Oregon, Region 8N

$$\ln A = 7.325 + .588 I_o = 5.283 + 1.036 M_L$$

$$M_L = 1.971 + .568 I_o$$

$$\begin{aligned} m_b &= 1.276 + .749 M_L \\ &= 2.752 + .425 I_o \end{aligned}$$

$$\begin{aligned} M_S &= -1.939 + 1.189 M_L \\ &= .405 + .675 I_o \end{aligned}$$

I_o	M_L	m_b	M_S
III	3.68	4.03	2.43
IV	4.24	4.45	3.11
V	4.81	4.88	3.78
VI	5.38	5.30	4.46
VII	5.95	5.73	5.13
VIII	6.52	6.16	5.81
IX	7.08	6.58	6.48
X	7.65	7.01	7.16
XI	8.22	7.43	7.83
XII	8.79	7.86	8.51

Table 29. Relationships between I_o and M_L , m_b and M_S for Western Mountains, Region 7

$$\ln A = 6.396 + .725 I_o = 5.133 + 1.030 M_L$$

$$M_L = 1.226 + .704 I_o$$

$$m_b = 1.276 + .748 M_L$$

$$= 2.193 + .527 I_o$$

$$M_S = -1.939 + 1.189 M_L$$

$$= - .481 + .837 I_o$$

I_o	M_L	m_b	M_S
III	3.34	3.77	2.04
IV	4.04	4.30	2.87
V	4.74	4.82	3.71
VI	5.45	5.36	4.55
VII	6.15	5.88	5.39
VIII	6.85	6.40	6.23
IX	7.56	6.94	7.06
X	8.27	7.46	7.90
XI	8.97	7.99	8.73
XII	9.67	8.52	9.58

Table 30. Relationships Between I_o and M_L , m_b and M_S for the Eastern United States, Regions 5 and 6

$$\ln A = 6.770 + .793 I_o = 4.093 + 1.766 M_L$$

$$M_L = 1.516 + .449 I_o$$

$$m_b = 1.276 + .748 M_L$$

$$= 2.410 + .336 I_o$$

$$M_S = -1.939 + 1.189 M_L$$

$$= -.136 + .534 I_o$$

I_o	M_L	m_b	M_S
III	2.86	3.42	1.47
IV	3.31	3.75	2.00
V	3.76	4.09	2.53
VI	4.21	4.43	3.07
VII	4.66	4.76	3.60
VIII	5.11	5.10	4.14
IX	5.56	5.43	4.67
X	6.01	5.77	5.20
XI	6.46	6.11	5.74
XII	6.90	6.44	6.27

Table 31. Relationships Between I_o and M_L , m_b and M_S for Central Region, Region 6

$$\ln A = 7.453 + .723 I_o = 2.916 + 2.066 M_L$$

$$M_L = 2.196 + .350 I_o$$

$$m_b = 1.276 + .748 M_L$$

$$= 2.919 + .262 I_o$$

$$M_S = -1.939 + 1.189 M_L$$

$$= .672 + .416 I_o$$

I_o	M_L	m_b	M_S
III	3.25	3.71	1.92
IV	3.60	3.97	2.34
V	3.95	4.23	2.75
VI	4.30	4.49	3.17
VII	4.65	4.75	3.59
VIII	5.00	5.02	4.00
IX	5.35	5.28	4.42
X	5.70	5.54	4.83
XI	6.05	5.80	5.25
XII	6.40	6.06	5.67

Table 32. Relationships Between I_o and M_L , m_b and M_S for Eastern Region, Region 5

$$\ln A = 5.828 + .833 I_o = 6.192 + 1.116 M_L$$

$$M_L = - .326 + .746 I_o$$

$$m_b = 1.276 + .748 M_L$$

$$= 1.032 + .559 I_o$$

$$M_S = -1.939 + 1.189 M_L$$

$$= -2.327 + .887 I_o$$

I_o	M_L	m_b	M_S
III	1.91	2.70	.33
IV	2.65	3.26	1.22
V	3.40	3.82	2.11
VI	4.15	4.38	2.99
VII	4.85	4.94	3.88
VIII	5.64	5.50	4.77
IX	6.38	6.06	5.66
X	7.13	6.62	6.54
XI	7.88	7.18	7.43
XII	8.62	7.74	8.31

Table 33. A Comparison of Areas of Perceptibility (I=III) for Each Intensity I_0 for Three Region Pairs

I_0	Eastern/Western	Region 5/Region 8	Region 6/Region 8
III	1.50	1.25	3.93
IV	1.73	1.49	4.00
V	2.00	1.78	4.07
VI	2.31	2.13	4.14
VII	2.66	2.54	4.21
VIII	3.07	3.03	4.28
IX	3.54	3.62	4.36
X	4.08	4.32	4.43
XI	4.72	5.16	4.51
XII	5.44	6.16	4.58

Table 34. Table of Parameters Relating the Distance of Isoseismal Intensity (I) to Isoseismal Intensity (I+1) for Western U.S. (h = 18 km)

$$k = D_I / D_{I+1} + 1$$

I_0	III-IV	IV-V	V-VI	VI-VII	VII-VIII	VIII-IX	IX-X	X-XI	XI-XII
III									
IV	1.52								
V	1.53	1.54							
VI	1.47	1.57	1.54						
VII	1.41	1.53	1.60	1.54					
VIII	1.33	1.45	1.56	1.64	1.56				
IX	1.25	1.37	1.48	1.60	1.67	1.61			
X	1.17	1.28	1.38	1.49	1.60	1.71	1.74		
XI	1.10	1.20	1.28	1.38	1.48	1.60	1.79	1.96	
XII	1.04	1.12	1.19	1.27	1.35	1.45	1.61	1.84	2.45

PRINTOUT OF PROGRAM FOR DETERMINING ISOSEISMAL CONTOURS*

*Housekeeping subprograms (OPENRW, DECODER, BEARDST, and SORT I) are available from NGSDC.


```

103  FORMAT( 41X, F5.2, F6.2, I2 )
      IF( (ALAT.EQ. 0.0) .OR. (WLON.EQ. 0.0) ) GO TO 1
      I = MAXI - INT
      CALL BEARST( A0, 00, ALAT, WLON, BEAR, DIST )
      IF( DIST.GT. 1000.0 ) GO TO 1
      NDIST = DIST
      LAT = ALAT*100.0
      LON = (WLON - 60.0)*100.0
      IF( LON.LT. 0 ) GO TO 1
      IF( BEAR.LT. 0.0 ) BEAR = BEAR + 360.0
      NBEAR = BEAR + 0.5
      BEAR = NBEAR
      J = (HALFA3 + BEAR)/WHOLEA
      IF( J.GT. MAXJ ) J = 1
      N = N+1

```

C
C
C
C
C

J	I	BEAR	DIST	LAT	LON
8	4	9	13	13	13
52	48	39	26	13	0

```

      NSAVE(N) = SHIFT( J, 52) .OR. SHIFT( I, 48) .OR.
*      SHIFT( NBEAR, 39) .OR. SHIFT( NDIST, 26) .OR.
*      SHIFT( LAT, 13) .OR. LON
      IF( I.EQ. IO ) GO TO 6
4      IF( L.LT. 5 ) GO TO 5
      CALL SORTI( LIMS, L )
      L1 = (L+1)/2
      L2 = (L+2)/2
      LIMIT(IO) = REJL*( LIMS(L1) + LIMS(L2)
5      IF( NEXT.GT. 1 ) GO TO 11
      L = 0
      IO = I
6      L = L+1
      LIMS(L) = NDIST
      GO TO 1
8      PRINT 108, IREC
      GO TO 1
108  FORMAT( 27H0* * * DECODE ERROR * * * , 8A10 )
9      NEXT = 9
10     MAXN = N
      NEXT = NEXT+1
      IF( MAXN ) 80, 80, 4
11     CALL SORTI( NSAVE, MAXN )
      DO 12 I = 1, MAXI
      DO 12 J = 1, MAXJ
      DO 12 K = 1, MAXK
12     ISO(I,J,K) = -K
      IR = MAXI-1
      DO 13 I = 2, MAXI
      IF( LIMIT(IR) .GT. 0.9*LIMIT(IR+1) ) LIMIT(IR) = 0.9*LIMIT(IR+1)

```



```

13  IR = IR-1
    JO = -1
    JIO = -1
    DO 19  N = 1, MAXN
    JI = SHIFT( NSAVE(N), 12 ) .AND. MASKR9
    IF( JI .EQ. JIO ) GO TO 14
    JIO = JI
    I = JI .AND. MASKR4
    J = JI/20B
    M = 0
    IF( J .EQ. JO ) GO TO 14
    JO = J
    LAST = -1
14  NDIST = SHIFT( NSAVE(N), 34 ) .AND. MASKR13
    IF( NDIST .LE. LAST ) GO TO 19
    IF( NDIST .GT. LIMIT(I) ) GO TO 19
    M = M+1
    IF( M .EQ. 2 ) ISO(I,J,1) = ISO(I,J,2)
    ISO(I,J,2) = NDIST
    LAST = NDIST
    ISO(I,J,7) = SHIFT(NSAVE(N), 21) .AND. MASKR9
19  CONTINUE
C   PRINT 199, (KNAMES(KK), ((ISO(II,JJ,KK), JJ = 1, MAXJ), II = PRNT
C   * 1, MAXI), KK = 1, 1 ) PRNT
C   PRINT 199, (KNAMES(KK), ((ISO(II,JJ,KK), JJ = 1, MAXJ), II = PRNT
C   * 1, MAXI), KK = 2, 2 ) PRNT
C   SET ISO VALUES
    DO 29  J = 1, MAXJ
    R = 0.0
    I3 = 1
    IL3 = 2
    IN = 0
    VN = 0.0
    IF( ISO(1,J,2) .LT. 0 ) GO TO 21
    IN = 1
    VN = ISO(1,J,2)
    R = VN
    ISO(1,J,3) = R+R
21  DO 25  I = 2, MAXISO
    K = 1
    IF( ISO(I,J,1) .LT. 0 ) GO TO 24
    IL = IN
    VL = VN
    IN = 4*I - 5
    VN = ISO(I,J,1)
    R = (VN-VL)/(IN-IL)
22  ISO(I3,J,3) = VL + R*(IL3-IL)
    I3 = I3 + 1
    IL3 = IL3 + 4
    IF( IL3 .LT. IN ) GO TO 22
    IF( K .EQ. 2 ) GO TO 25

```



```

24  IF( ISO(I,J,2) .LT. 0 ) GO TO 25
    K = 2
    IL = IN
    VL = VN
    IN = 4*I - 3
    VN = ISO(I,J,2)
    R = (VN-VL)/(IN-IL)
    ISO(I,J,3) = VL + R*(IN+1-IL)
    IF( IL+2 .NE. IN ) GO TO 22
25  CONTINUE
    IF( R .EQ. 0.0 ) GO TO 29
    R = 4*R
    DO 26 I = 1, MAXISO
    IF( ISO(I,J,3) .LT. 0 ) GO TO 26
    IN = I
    ISO(I,J,4) = ISO(I,J,3)
    ISO(I,J,5) = ISO(I,J,3)
26  CONTINUE
    IF( IN .GE. MAXISO ) GO TO 29
    IF( IN .LE. 1 ) GO TO 27
    ITEST = ISO(IN,J,2)*1.1
    IF( ITEST .LT. 10 ) ITEST = ITEST+1
    ISO(IN,J,3) = MIN0( ITEST, ISO(IN,J,3) )
    ISO(IN,J,4) = ISO(IN,J,3)
    ISO(IN,J,5) = ISO(IN,J,3)
27  CONTINUE
    IN = IN+1
    DO 28 I = IN, MAXISO
28  ISO(I,J,4) = ISO(I-1,J,4) + R
29  CONTINUE
C   PRINT 199, (KNAMES(KK), ((ISO(II,JJ,KK), JJ = 1, MAXJ), II = PRNT
C   * 1, MAXISO), KK = 3, 3 ) PRNT
C   PRINT 199, (KNAMES(KK), ((ISO(II,JJ,KK), JJ = 1, MAXJ), II = PRNT
C   * 1, MAXISO), KK = 4, 4 ) PRNT
C   PRINT 199, (KNAMES(KK), ((ISO(II,JJ,KK), JJ = 1, MAXJ), II = PRNT
C   1, MAXISO), KK = 5, 5 ) PRNT
C
C   LATERAL INTERPOLATION
C
    MAXJ1 = MAXJ+1
    K = 5
    DO 38 I = 1, MAXISO
    KEEP = ISO(I,MAXJ1,K)
    ISO(I,MAXJ1,K) = ISO(I,1,K)
    J1 = 0
    DO 37 J = 1, MAXJ1
    IF( ISO(I,J,K) .GE. 0 ) GO TO 36
    IF( J1 .EQ. 0 ) GO TO 37
    J2 = J
    JJ2 = 1
    DO 31 JJ = 2, MAXJ
    J2 = J2+1

```



```

      IF( J2 .GT. MAXJ ) J2 = J2-MAXJ
31  IF( ISO(I,J2,K) ) 31, 32, 32
      JJ2 = JJ
      GO TO 38
32  COUNT = JJ2+1
      V = ISO(I,J1,K)
      R = (ISO(I,J2,K) - V)/COUNT
      J2 = J-1
      DO 34 JJ = 1, JJ2
      J2 = J2+1
      IF( J2 .GT. MAXJ ) J2 = 1
      V = V+R
      IF( I .EQ. 1 ) GO TO 33
      ITEST = ISO(I-1,J2,K)
      IF( IFIX(V) .GT. ITEST ) GO TO 33
      JTEST = 1.1*ITEST + 0.5
      IF( JTEST .EQ. ITEST ) JTEST = JTEST +
      ISO(I,J2,K) = JTEST
      GO TO 34
33  ISO(I,J2,K) = V
34  CONTINUE
36  J1 = J
37  CONTINUE
      ISO(I,MAXJ1,K) = KEEP
38  CONTINUE
C   PRINT 199, (KNAMES(KK), ((ISO(II,JJ,KK), JJ = 1, MAXJ), II = PRNT
C   1, MAXISO), KK = 5, 5 ) PRNT
C
C   FORM ISO FROM RAD AND LAT
C
      DO 49 J = 1, MAXJ
      IDEL = ISO(1,J,5)
      ISO(1,J,6) = IDEL
      DO 48 I = 2, MAXISO
      ISO(I,J,6) = ISO(I,J,5)
      IF( ISO(I,J,6) .GT. 0 ) GO TO 47
      ISO(I,J,6) = ISO(I-1,J,6) + IDEL
47  IDEL = ISO(I,J,6) - ISO(I-1,J,6)
48  CONTINUE
49  CONTINUE
C   PRINT 199, (KNAMES(KK), ((ISO(II,JJ,KK), JJ = 1, MAXJ), II = PRNT
C   * 1, MAXISO), KK = 6, 6 ) PRNT
C
C   SMOOTH ISO
C
      DO 69 NS = 1, 2
      NYPR2 = 0
      DO 59 I = 1, MAXISO
      C = ISO(I,1,6)
      B = ISO(I,MAXJ,6)
      KEEP = ISO(I,MAXJ+1,6)
      ISO(I,MAXJ+1,6) = ISO(I,1,6)
      DO 58 J = 1, MAXJ
      A = B
      B = C
      C = ISO(I,J+1,6)

```



```

71  J1 = J+1
    IF( J1 .GT. MAXJ ) J1 = 1
72  V1 = ISO(I,J1,6)
    IF( V1 .LT. 0.0 ) GO TO 75
    V0 = ISO(I,J,6)
    X = ABS( BEAR-BEARJ )/WHOLEA
    Y = X*V1 + (1.0-X)*V0
    DEL = ISO(I,J,2) - Y
    IF( DEL .LT. 0.0 ) GO TO 75
    DELT = (DEL + 2.0)/(X**2 + (1.0-X)**2)
    ISO(I,J,6) = ISO(I,J,6) + (1.0-X)*DELT
    ISO(I,J1,6) = ISO(I,J1,6) + X*DELT
75  IF( I .EQ. 1 ) GO TO 77
    IF( ISO( I,J,6) .LT. 1.05*ISO(I-1,J,6) )
*    ISO(I,J,6) = 1.05*ISO(I-1,J,6)
77  BEARJ = BEARJ + WHOLEA
78  CONTINUE
C   PRINT 199, (KNAMES(KK), ((ISO(II,JJ,KK), JJ = 1, MAXJ), II = PRNT
C   * 1, MAXISO), KK = 6, 6 ) PRNT
C   PRINT 199, (KNAMES(KK), ((ISO(II,JJ,KK), JJ = 1, MAXJ), II = PRNT
C   * 1, MAXISO), KK = 7, 7 ) PRNT
C
C   SAVE DATA FOR 1 DEG AND FOR PLOT
C
    AMAX = A0 + ISO(MAXISO, 1, 6)/111.0
    DO 73 I = 1, MAXI
    DO 73 J = 1, MAXJ
    IF( ISO(I,J,6) .GE. 0 ) GO TO 74
73  CONTINUE
    PRINT 173, IREC1, IREC2
173  FORMAT( *0NO CONTOURS FOUND FOR *, 2A10 )
    GO TO 80
74  CONTINUE
    AMIN = A0 - ISO(MAXISO,13, 6)/111.0
    OMAX = 00 - ISO(MAXISO, 9, 6)/71.0
    OMIN = 00 + ISO(MAXISO,21, 6)/71.0
    ENCODE( 120, 178, RECORD ) IREC1, IREC2, MAXISO, A0, 00
178  FORMAT( 2A10, I5, 2F6.2, 83X )
    CALL RW( -12, RECORD, 120, LENO )
    DO 79 I = 1, MAXISO
    ENCODE( 120, 179, RECORD ) ( ISO(I,J,6), J = 1, MAXJ )
179  FORMAT( 24I5 )
79  CALL RW( -12, RECORD, 120, LENO ,
    WRITE (13) IREC1, IREC2, MAXISO, MAXN, A0, 00,
*    AMAX, AMIN, OMAX, OMIN, ( NSAVE(I), I = 1, MAXN )
C    INIZE
80  IF( NEXT .GE. 9 ) GO TO 90
    NEXT = 0
    N = 0
    IREC1 = IREC(1)
    IREC2 = IREC(2) .AND. MASKL
    IF( NYCARD .EQ. 0 ) GO TO 84

```



```

82 IF( KOMPARE( CARD, 1, IREC, 1, 15 ) ) 83, 84, 1
83 READ( 60, 181) CARD
   IF( EOF(60) .NE. 0.0 ) GO TO 90
   PRINT 182, CARD
   GO TO 82
84 CONTINUE
C   JAHR = 0
C   CALL CMOVE( IREC1, 1, JAHR, 7, 4 )
C   IF( JAHR .LT. 4R1961 ) GO TO 1
   DECODE( 80, 180, IREC ) A0, 00, IN1
180 FORMAT( 17X, F5.2, F6.2, 24X, I2 )
   IF( (A0 .EQ. 0.0) .OR. (00 .EQ. 0.0) ) GO TO 1
C   IF( NDONE .GT. 25 ) STOP
   NDONE = NDONE+1
   NEXT = 1
   MAXI = INT+1
   MAXISO = MAXI-3
   IO = 1
   L = 0
   DO 88 I = 1, 13
88   LIMIT(I) = 9999
   PRINT 188, IREC
188  FORMAT( 1H0, 8A10 )
   GO TO 3
199  FORMAT( 1H0, A10, 13( /, 1X, 4( I7, 5I5) ) )
90   CALL CLOSRW( 0 )
   ENDFILE 13
   STOP
   END

```

1960CC
1960
1960

LIMIT

*Q

APPENDIX E

EXPLANATION OF FORMAT OF ACCOMPANYING MAGNETIC TAPE EARTHQUAKE INTENSITY FILE

<u>Column</u>	<u>Explanation</u>
1-15	Date of epicenter
16	Hours between GMT and local time
17	Blank
18-22	Source latitude; example, 37.15
23-28	Source longitude; example, 127.20
29	E or blank; E = East longitude, blank = West longitude
30-32	Magnitude; example, 5.8
33-36	Depth in kilometers; example, 013
37-41	Blank
42-46	Effect latitude; example, 34.90
47-52	Effect longitude; example, 117.40
53-54	Published intensity; example, 06
55-56	State code; example, 05
57-80	City
81-82	Brazee's revised intensity
83-84	Maximum U.S. intensity for epicenter
85	Location of epicenter; blank = U.S., A = Atlantic, P = Pacific, C = Canada, M = Mexico
86-90	Blank