UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

CORRELATION OF EPICENTERS WITH MAPPED FAULTS, EAST-CENTRAL ALASKA, 1968-1971

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INTRODUCTION

This report presents a mapped compilation of over 1500 earthquakes in east-central Alaska located by the seismograph network of the Geophysical Institute, University of Alaska during the period 1968-1971. It was prepared for the purpose of displaying the spatial distribution of epicenters within east-central Alaska, and indicating the relationship of the resulting pattern with known and inferred faults.

Previously published work regarding the seismicity of this region (Gutenberg and Richter, 1954; Tobin and Sykes, 1966) reflects the fact that prior to 1964, the only seismograph station operating in interior Alaska was the Worldwide Standard Station operated by the U. S. Coast and Geodetic Survey at College, Alaska (COL). Thus only large earthquakes recorded outside the State could be located, and few data were available for the interior. However, by early 1967, Dr. Eduard Berg of the Geophysical Institute, with support from the Air Force Office of Scientific Research and the National Science Foundation, had established a telemetered net of high-gain stations (operating gains were typically on the order of $1-2 \times 10^6$ at 5 Hz) in central and southern Alaska (Berg et al., 1967) and accurate epicentral locations of small events in Alaska were possible for the first time. Changes have been made in the net since then, but its configuration was essentially as shown in the index map during the time period covered by this report. Additional readings were available routinely from the Palmer tsunami warning network operated by NOAA and, at various times, from temporary recording sites installed by the Geophysical Institute.

EPICENTRAL LOCATIONS AND MAGNITUDES

Using Herrin's (1968) travel time tables for the earth model, epicenters were determined by a program written for the University of Alaska's IBM 360/40 computer which minimizes P-arrival time residuals at each station by an iterative process of least-squares. The adjustment routine is an extension of a procedure first devised by Gutenberg (Richter, 1968, pp. 693-697). It has been further modified from a similar program written by Ryall and Jones (1964) to include magnitude and depth subroutines. No distinction is made on the accompanying map regarding these parameters because the dense clustering prohibits the discrimination of different symbols.

The magnitudes of the earthquakes depicted on the map vary from a maximum of 6.5 for the Rampart earthquake (65.5°N, 150.0°W) of October 29, 1968, to a minimum of about 2.0. Magnitudes were calculated using Richter's (1958, p. 340) equation

$$M = \log A - \log A_o$$

where $\log A_o$ is selected from Richter's (p. 342) table, and A is determined by converting trace amplitudes at the various recording stations to equivalent amplitudes on standard Wood-Anderson torsion seismometers (static magnification of 2,800). Some uncertainty exists in this procedure, because the measured parameter at all stations is vertical ground motion and not the horizontal component as is recorded by torsion seismometers. However, comparison of the results obtained by this procedure with those of NOAA and other organizations indicate that the discrepancies are not serious.

Most of the events indicated on the map were shallow (depth less than 50 km) except in the Mt. McKinley area (approximately 63°N, 151°W) where focal depths of greater than 100 km are common.

Checks on the accuracy of epicentral locations have been made by the following three methods:

(1) Location of synthetic earthquakes. In this procedure an earthquake is hypothesized at some point and theoretical travel times are computed to each station. The hypothetical earthquake is then "located" by computer using different combinations of stations, and the results are compared with the postulated hypocentral coordinates. These tests give excellent agreement for synthetic earthquakes within the boundaries of the network, while the error in location increases with increasing distance away from the net. These results are similar to those of James et al. (1969).

(2) Comparison with locations obtained by the U. S. Coast and Geodetic Survey (NOAA/ERL).

(3) Studies of aftershock zones of two earthquakes for which the epicenters of the main shock were determined by the procedure described above. For the Fairbanks earthquake of June 21, 1967, studies of the aftershock zone, using up to six local stations, indicate that the initial epicenter was in error by less than 5 km. The Rampart earthquake of October 29, 1968 occurred on the northern margin of the network in operation at that time and the aftershock zone has remained active to the present. The geometry and location of the aftershock zone were determined immediately after the earthquake. Since that time, the configuration of the network has been changed by the addition of a station at Fort Yukon to the northeast of the aftershock zone and data from the NOAA station at Indian Mountain to the northwest has also been routinely available. These provide improved azimuthal coverage of the aftershock zone, but have not caused significant changes in its location or geometry.

indicating that errors in the original epicentral locations were minor.

Because the epicenters obtained for the interior by NOAA/ERL are largely dependent on readings from the present Geophysical Institute net, and are thus subject to the same sort of bias that regional structure anomalies may introduce, the absolute errors in location are probably of the same order of magnitude for both agencies. Thus, when an epicenter is established by NOAA/ERL largely on the basis of readings from the Geophysical Institute net, or when the epicenter lies within the boundaries of that net, the difference between the hypocentral coordinates given by NOAA/ERL and those established by the Geophysical Institute is usually insignificant. However, in the case of an event occurring outside the boundaries of the Geophysical Institute net for which readings at distant stations are available to NOAA/ERL, the divergence between the two computed epicenters can become large (as much as 70 km in the Gulf of Alaska, for instance), and the University of Alaska parameters must be regarded as unreliable.

Some of the events shown on the accompanying map are undoubtedly poorly located small events, recorded by perhaps as few as three stations. However, most of the epicenters shown inside the network (where this is taken to mean that portion of the map between 144° and 152°, and south of 66°) are probably accurate to within ten kilometers. Significant error can be expected outside these boundaries.

MAP COMPILATION

Data concerning the faults shown on the map were compiled and interpreted by one of the authors (F.W.) from published (see Appendix for reference list) and unpublished U. S. Geological Survey maps and reports.

The compilation was prepared on a scale of 1:250,000 so that some loss of detail is to be expected in the transition to the scale of 1:1,000,000 used in this report. Therefore, some of the fault zones are shown only schematically, as for example, the thrust zone north and northwest of Fairbanks. Many faults which have been interpreted as probably older than Cenozoic, and which show no apparent relationship to present seismicity, have also been omitted. In addition, small faults outside the boundaries of the seismograph network, where seismic data is minimal and of poor quality, are not shown.

Epicenters shown on the map were not plotted by computer, so that some inaccuracy is to be expected in individual locations. However, it is unlikely that this could effect the general pattern of seismicity which the map presents.

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Appendix - References to Fault Compilation

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