EARTHQUAKES IN ALASKA
April 1999

ALASKA EARTHQUAKE INFORMATION CENTER

A joint report of the Alaska State Seismologist’s Office and the U.S. Geological Survey
EARTHQUAKES IN ALASKA - April 1999

By

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with the assistance of

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February, 2003

The Alaska Earthquake Information Center is a cooperative program between the Geophysical Institute of the University of Alaska\(^1\) and the U.S. Geological Survey (Earthquake Hazards Program\(^2\)).

DISCLAIMER

This report has not been edited or reviewed for conformity with U. S. Geological Survey and State of Alaska standards and nomenclature. The data in this report are preliminary and subject to revision. Most of the earthquake parameters have been determined by AEIC. The data are released on the condition that neither the U.S. Geological Survey, nor the United States Government, nor the Geophysical Institute, University of Alaska-Fairbanks may be held liable for any damages resulting from its authorized or unauthorized use.

Alaska State Seismologist's Report 99-04-01
The Alaska Earthquake Information Center (AEIC) is a cooperative program established to monitor earthquakes in Alaska and to provide earthquake information to citizens and public officials and to the earth science community.

Most of the earthquakes located by AEIC occur in a “core” area in central and southern Alaska, between latitudes 57°N and 67°N, and longitudes 135°W and 156°W; however, this listing also includes earthquakes not located by AEIC but reported in the National Earthquake Information Center’s (NEIC) monthly Preliminary Determination of Epicenters (PDE) for a larger region between latitudes 48°N and 75°N, and longitudes 130°W to 170°E.

The magnitude level for completeness and the precision of the locations vary across the state due to uneven station spacing and to differences in earthquake depths. The data are more complete and the hypocenters are more accurate in regions where the station density is greatest. In southern and central Alaska where the majority of the stations are located, the earthquake catalogs are complete for shallow (depth < 30 km) earthquakes of about magnitude 2.0 and larger. The magnitude threshold at which the catalogs are complete increases with depth. For earthquakes deeper than 100 km in southern and central Alaska, the catalogs are complete above about magnitude 2.7. The earthquake catalogs are reasonably complete for the entire state for events greater than or equal to magnitude 4.5. Earthquakes in southern and central Alaska, where calculated hypocenters are more accurate, have horizontal (epicentral) and vertical (depth) errors (median value) of 1.1 and 1.9 km, respectively.


The seismicity shown for western Canada is not complete, and does not represent the total activity for the area. For more information on Canadian seismicity, contact: Pacific Geoscience Center, Geological Survey of Canada, P.O. Box 6000 Sidney, British Columbia, V8L 4B2 CANADA.

Cover

Failure of sediments destroyed this downtown street, breaking and dropping sections substantially, Anchorage, March 1964.

Photo from the UAF Geophysical Institute Alaska Earthquake Photograph Archive.

Bureau of Land Management photograph, BLM-6.

Acknowledgments

CONTENTS

This monthly earthquake catalog contains the following:

Highlights: A discussion of important or particularly interesting earthquakes which occurred during the month.

Maps and cross-sections: Five maps illustrating Alaska seismicity during the month. Figure 1 is a map which includes all located earthquakes for the state and surrounding region. Figure 2a focuses on earthquakes in a “core” area of central and southern Alaska, and depicts line segments for two cross-sections through the Alaska/Aleutian Wadati Benioff zone (Figures 2b and 2c). Figure 3 shows events in the “core” area larger than magnitude 3.0. Figure 4 shows all “core” events shallower than 30 km depth, and Figure 5 shows all “core” events of depth greater than or equal to 30 km.

Listings: Three listings of hypocenters are presented, as follows: first, a complete listing of all located earthquakes for the month, corresponding to the epicenters plotted in Figure 1; next, Appendix I contains a subset of the full listing restricted to only those events of magnitude 4.0 and larger; and lastly, Appendix II lists known or suspected quarry blasts during the month. These blasts have been excluded from Figures 1 - 5. Listings include, for each event: date and origin time, epicenter, depth, preferred magnitude, solution quality statistics and comments (region, alternate magnitudes, available felt reports and other remarks).

Other types of information available regularly from AEIC:

Parameters for the most recent 100 earthquakes of magnitude 2.0 and larger are available through the Internet via finger quake@giseis.alaska.edu or by sending email to quake@giseis.alaska.edu; in the latter case a return email message will contain the earthquake listing.

Weekly Seismicity Report - issued within seven days of the end of each week. These reports include highlights of recent activity, a preliminary listing of events, and epicenter maps. The first report in this formal series (33-93) is for the week of August 13-19, 1993, although weekly seismicity reports have been informally released since November 1989. The weekly reports may be found also on the WorldWide Web at http://www.giseis.alaska.edu/Seis/.

Alaska Earthquakes and AEIC Seismic Network Operations -- annual reports listing only the larger events, but including a discussion of the recorded seismicity and more detailed information about instrumentation, data processing and velocity models.

Catalog of Alaska Earthquake Focal Mechanisms - annual catalogs of focal mechanisms determined from initial P-wave polarities recorded by the regional seismograph network, as well as source mechanisms determined independently by NEIC and other seismic observatories.
HIGHLIGHTS

During April, 1999, the Alaska Earthquake Information Center located 390 earthquakes, 22 of which had magnitudes greater than 4.0. The largest event occurred on April 18 in the Kenai Peninsula region of Alaska (5.4 M). Earthquakes of particular interest during the month are discussed below:

April 18, 15:05:58 UTC (7:05 a.m. AST), ML 5.4, 60.283° -151.699°, depth=54 km:

A moderate earthquake occurred in the Kenai Peninsula region and was felt in Homer, Palmer and Anchorage. The focal mechanism for this event indicates left lateral strike-slip faulting. This is consistent with the stress field due to the convergence of the North American and Pacific tectonic plates.
Figure 2b: April 1999 -- Cross-sections from Figure 2a

2b: Cross-sections of 100 km width centered on sections A-A' and B-B', shown in figure 2a. The A-A' section illustrates the Wadati-Benioff Zone to its northernmost extent beneath southcentral Alaska. The B-B' section depicts the Wadati-Benioff Zone beneath the Cook Inlet crossing the volcano arc.
Figure 3: April 1999 -- Magnitude 3.0 and Greater
Figure 4: April 1999 -- Earthquake Depth < 30 km
Figure 5: April 1999 -- Earthquake Depth >= 30 km
Monthly Listing of Earthquake Hypocenters in Alaska

Events are listed in chronological order. The following data are given for each event:

1. DATE AND TIME in Coordinated Universal Time (UTC): year (YR), month (MO), day (DY), Julian day (JDAY), hour (HR), minute (MN) and second (SEC). To convert to Alaska Standard Time (AST) or Alaska Daylight Time (ADT) subtract 9 or 8 hours, respectively.
2. LATITUDE and LONGITUDE of epicenter in degrees (DEG). South and west = negative.
3. DEPTH, depth of focus in kilometers. Symbols after the depth indicate the following:
   - N = Depth was fixed at 33 km for earthquakes whose character on seismograms indicates a shallow focus but whose depth is not satisfactorily determined by the data.
   - D = Depth was restrained by the computer program based on 2 or more compatible pP phases and/or unidentified secondary arrivals used as pP.
   - G = Depth was fixed at other than 33 km.
   - * or ? = Less well-constrained free depth determined by NEIC. For detailed explanation see January 1993 Preliminary Determination of Epicenters.
4. PREF MAG, the AEIC ML is the preferred magnitude, unless it is unavailable or when the National Earthquake Information Service (NEIS) mb ≥ 4.5 or Ms ≥ 6.8. For preferred magnitudes other than AEIC ML a letter code after the magnitude indicates the type as follows:
   - mb = Body-wave magnitude (Mb) computed by NEIS.
   - Ms = Surface wave magnitude (MS) computed by NEIS.
   - A = Local magnitude (ML) from Alaska Tsunami Warning Center, Palmer, Alaska (PMR).
   - C = Local magnitude (ML) from Pacific Geoscience Centre, Sidney, British Columbia, Canada (PGC).
   - D = Duration magnitude (MD) from AEIC.
   - L = Duration magnitude (MD) from Columbia University, Lamont-Doherty Earth Observatory, Palisades, New York (PAL).
5. RMS, root-mean-square traveltime residual in seconds:
   \[
   RMS = \sqrt{\frac{\sum_{i=1}^{N} W_i \times R_i^2}{N}}
   \]
   Where R_i is the observed minus computed time of the i-th observation. W_i is the corresponding weight of the observation, and weights are normalized so that their sum equals N, the total number of P, S, and S-P observations used in the solution.
6. SEH, standard error in the horizontal direction with least control in kilometers.
7. SEZ, standard error of depth in kilometers.
8. GAP, largest azimuthal separation between stations in degrees with respect to the epicenter.
9. PHASES, number of P and S phases used in the solution.
10. MIN DIS, epicentral distance in kilometers to the station closest to the epicenter.
11. Q, quality of the hypocenter. This index is a measure of the precision of the hypocenter and is calculated from SEH and SEZ:
   - Qa = Larger of SEH and SEZ (km)
     - A ≤ 1.34
     - B ≤ 2.67
     - C ≤ 5.35
     - D > 5.35
12. T, event type as follows:
   - E - Local or regional tectonic earthquake located by AEIC.
   - A - Volcano-tectonic earthquake located by AEIC.
   - B - Long period volcano earthquake located by AEIC.
   - R - Regional event not located by AEIC.
   - Q - Known or suspected quarry or mine blast located by AEIC.
13. COMMENTS, symbols and abbreviations used in comments:
   - BRK - University of California, Berkeley.
   - Mo - Seismic moment.
   - PAL - Columbia University, Lamont-Doherty Earth Observatory, Palisades, New York.
   - PAS - California Institute of Technology, Pasadena.
   - PGC - Pacific Geoscience Centre, Sidney, British Columbia, Canada.
   - PMR - Alaska Tsunami Warning Center, Palmer, Alaska.
   - PPT - Laboratoire de Geophysique, Papeete, French Polynesia.
   - SPEC - An NEIS solution based on use of dense local networks, a local crustal model, or other methods not routinely applied in calculating the hypocenter parameters.

Errors and uncertainties in the reported parameters may result from random errors present in the phase data, or from systematic errors introduced either by the velocity models used to locate the earthquakes or by poor geometrical distribution of recording stations about the source.
One should be particularly cautious using solutions that have GAP > 180 degrees, P < 6, S = 0 , MIN DIS > DEPTH, RMS > 0.75s, SEH > 5km, or SEZ > 10km. Solutions with A and B quality are generally more reliable, but this does not guarantee that the accuracy of the solutions is within the limits implied by SEH and SEZ. Catalogs prior to January 1998 have printed SEH and SEZ values that are too large by a factor of 1.87.
### AEIC Monthly Earthquake Listing.

<table>
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<th>LON</th>
<th>DEPTH</th>
<th>MAG</th>
<th>RMS</th>
<th>SEH</th>
<th>SEZ</th>
<th>GAP</th>
<th>PHASES</th>
<th>MIN</th>
<th>Q</th>
<th>T</th>
<th>REGION</th>
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<td>85.77</td>
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<td>1.78</td>
<td>3.17</td>
<td>121.0</td>
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</tr>
</tbody>
</table>

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**Notes:**
- AEIC Monthly Earthquake Listing.
- Various locations and times are listed, detailing earthquake magnitudes, depths, and regions.
- Regions include SOUTHERN ALASKA, CENTRAL ALASKA, E. ALASKA, and more.
- Data includes date, latitude, longitude, depth, magnitude, and other relevant parameters.
<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Latitude</th>
<th>Longitude</th>
<th>Temperature</th>
<th>Humidity</th>
<th>Pressure</th>
<th>Wind Speed</th>
<th>Wind Direction</th>
<th>Precipitation</th>
<th>Classification</th>
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<td>1.90</td>
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<td>5.43</td>
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<td>85.5</td>
<td>B E CENTRAL ALASKA</td>
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<td>56.035</td>
<td>-151.370</td>
<td>119.18</td>
<td>1.9</td>
<td>7.82</td>
<td>3.96</td>
<td>259.0</td>
<td>83.7</td>
<td>D E KENAI PENINSULA</td>
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<td>06:20:54.180</td>
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<td>-151.370</td>
<td>119.18</td>
<td>1.9</td>
<td>7.82</td>
<td>3.96</td>
<td>259.0</td>
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<td>D E KENAI PENINSULA</td>
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<tr>
<td>99 04 21 (111) 21:03:45.260</td>
<td>06:20:54.180</td>
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<td>1.9</td>
<td>7.82</td>
<td>3.96</td>
<td>259.0</td>
<td>83.7</td>
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<tr>
<td>99 04 21 (111) 21:03:45.260</td>
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<td>56.035</td>
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<td>119.18</td>
<td>1.9</td>
<td>7.82</td>
<td>3.96</td>
<td>259.0</td>
<td>83.7</td>
<td>D E KENAI PENINSULA</td>
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<tr>
<td>99 04 21 (111) 21:03:45.260</td>
<td>06:20:54.180</td>
<td>56.035</td>
<td>-151.370</td>
<td>119.18</td>
<td>1.9</td>
<td>7.82</td>
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<td>83.7</td>
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<td>99 04 21 (111) 21:03:45.260</td>
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<td>-151.370</td>
<td>119.18</td>
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<td>7.82</td>
<td>3.96</td>
<td>259.0</td>
<td>83.7</td>
<td>D E KENAI PENINSULA</td>
</tr>
</tbody>
</table>

### Additional Information

- **KODIAK ISLAND REGION**: Includes Kodiak Island and surrounding coastal areas.
- **CENTRAL ALASKA**: Includes areas such as Anchorage and Chugiak.
- **SOUTHERN ALASKA**: Includes areas such as Juneau and Sitka.
- **SOUTHEASTERN ALASKA**: Includes areas such as Ketchikan and Juneau.
- **KENAI PENINSULA, ALASKA**: Includes areas such as Homer and Seward.
- **SOUTHERN ALASKA**: Includes areas such as Juneau and Sitka.
- **CENTRAL ALASKA**: Includes areas such as Anchorage and Chugiak.
- **SOUTHERN ALASKA**: Includes areas such as Juneau and Sitka.
- **CENTRAL ALASKA**: Includes areas such as Anchorage and Chugiak.
- **SOUTHERN ALASKA**: Includes areas such as Juneau and Sitka.
- **CENTRAL ALASKA**: Includes areas such as Anchorage and Chugiak.
- **SOUTHERN ALASKA**: Includes areas such as Juneau and Sitka.
- **CENTRAL ALASKA**: Includes areas such as Anchorage and Chugiak.
- **SOUTHERN ALASKA**: Includes areas such as Juneau and Sitka.
APPENDIX 1.

Earthquakes with a magnitude of 4.0 and greater.
This listing is a subset of earthquakes from the complete monthly listing.

<table>
<thead>
<tr>
<th>DATE</th>
<th>LAT</th>
<th>LON</th>
<th>DEPTH</th>
<th>MAG</th>
<th>RMS</th>
<th>SEH</th>
<th>SEZ</th>
<th>GAP</th>
<th>PHASES</th>
<th>MIN</th>
<th>Q</th>
<th>T</th>
<th>REGION</th>
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<tbody>
<tr>
<td>99 04 2 (092) 06:39:59.790</td>
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<td>-137.332</td>
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<td>4.0</td>
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<td>33.00</td>
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<td>R</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<td>1.21</td>
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<td>29.37</td>
<td>33.34</td>
<td>227.0</td>
<td>16</td>
<td>144.32</td>
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<td>E</td>
<td>EASTERN SIBERIA</td>
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<td>1.86</td>
<td>50.0</td>
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APPENDIX 2.
Known or suspected quarry blasts located by the AEIC.
This listing is a subset of earthquakes from the complete monthly listing.

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<th>SEZ</th>
<th>GAP</th>
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<th>MIN</th>
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there were no suspected quarry blasts recorded in April 1999