EARTHQUAKES IN ALASKA
February 2001
ALASKA EARTHQUAKE INFORMATION CENTER

Disrupted tree zone
3 to 5 m wide

SS-RL 4 to 6 m

A report of the Alaska State Seismologist’s Office
EARTHQUAKES IN ALASKA - February 2001

By

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with the assistance of

T. Cox and L. Rao

June, 2005

The Alaska Earthquake Information Center is a cooperative program between the Geophysical Institute of the University of Alaska and the U.S. Geological Survey with the support from the Earthquake Hazards Program.

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.
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

Aerial view of the projected surface rupture of the 1958 magnitude 7.9 Lituya Bay earthquake. Estimated rupture length is up to 280 km with the surface displacements of 3.5 to 6.5 m. Photograph by Lloyd Cluff and George Plafker.

Acknowledgments

Supplemental data provided by the United States Geological Survey, National Earthquake Information Center, Golden, Colorado; the Geological Survey of Canada, Pacific Geoscience Centre, Sidney, British Columbia; the Alaska Volcano Observatory, Anchorage, Alaska; and the National Oceanic and Atmospheric Administration, National Weather Service, Alaska Tsunami Warning Center, Palmer, Alaska.
CONTENTS

This monthly earthquake catalog contains the following:

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

Summary plot: A plot with the earthquake statistics: time-magnitude plot, number of located events per day, cumulative number of located events, depth histogram, frequency-magnitude relationship for the Aleutian and mainland Alaska events.

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 (Figure 2b). 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 1 contains a subset of the full listing restricted to only those events of magnitude 4.0 and larger; and lastly, Appendix 2 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 (http://www.aeic.alaska.edu/cgi-bin/quake_finger.pl) OR by sending email to quake@giseis.alaska.edu; in the latter case a return email message will contain the earthquake listing.

Weekly and Monthly Seismicity Reports - issued within seven days of the end of each week and month, respectively. These reports include highlights of recent activity, a preliminary listing of events, and epicenter maps. The weekly and monthly reports may be found on the Internet at http://www.aeic.alaska.edu/.

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.
During February, 2001, the Alaska Earthquake Information Center located 527 events, twenty seven of which had magnitudes equal to or greater than 4.0 and two were suspected quarry blasts. The largest event was on February 17 in the Queen Charlotte Islands region (M6.2). Four events were felt. Earthquakes of particular interest during the month are discussed below:

**February 1, 18:19:30 UTC (9:18 am AST), M\textsubscript{W} 6.0 (m\textsubscript{b} 5.6, M\textsubscript{S} 5.6), 51.437\textdegree N 177.797\textdegree W, depth=33.0 km (fixed):**

A strong earthquake occurred in the Andreanof Islands region of Aleutian Islands and was located 111 km (69 miles) SW of Adak and 274 km (171 miles) WSW of Atka. It was felt strongly at Adak and Atka. The earthquake source mechanism from the waveform radiation pattern indicates reverse faulting consistent with the underthrusting motion on the plate interface between the subducting Pacific and overriding North American plates. A 1957 M8.6 earthquake ruptured the plate interface westward of the current event location.

**February 17, 20:11:29 UTC (11:29 am AST), M\textsubscript{W} 6.2 (m\textsubscript{b} 5.5, M\textsubscript{S} 5.9, M\textsubscript{L} 6.3), 53.987\textdegree N 133.611\textdegree W, depth=10.78 km:**

A strong earthquake occurred in the Queen Charlotte Islands region and was located 125 km (78 miles) SSW of Hydeburg and 145 km (91 miles) SSW of Craig. It was felt in Craig, Ketchikan, Hydeburg and vicinity. The AEIC located 7 aftershocks through the end of the month. The largest aftershock (M5.0) occurred about an hour after the mainshock. The earthquake source mechanism from the waveform radiation pattern indicates strike-slip faulting consistent with the right-lateral rupture along the Queen Charlotte fault. This segment of the fault was ruptured in a M8.1 earthquake in 1949.
SUMMARY PLOT

A summary plot of events with magnitudes. The lower left panel shows number of the located events per day, their magnitudes, and the cumulative number. The upper left panel is the depth histogram. The right panel shows the frequency-magnitude distribution of the Aleutian Island seismicity (upper plot) and the mainland Alaska earthquakes (lower plot) with the b-value and magnitude of completeness estimates.

2001/2/1 – 2001/2/28: 507 earthquakes

Aleutian Islands, b (M>2.4) = 0.37 +/- 0.08

Mainland Alaska, b (M > 1.9) = 0.59 +/- 0.04
Figure 2a: February 2001 -- South Central Alaska Seismicity

449 events plotted
- Depth <= 30
- 30 < Depth <= 75
- 75 < Depth <= 125
- Depth > 125

Alaska Earthquake Information Center
UAF Geophysical Institute
U.S. Geological Survey

- No M
- M = 2.0
- M = 3.0
- M = 4.0
- M = 5.0

* Volcano

Gulf of Alaska

0 kilometers

0
200

Gulf of Alaska
Figure 2b: February 2001 -- Cross-sections from Figure 2a

Distance Along Profile A - A’ (km)

Distance Along Profile B - B’ (km)
Figure 4: February 2001 -- Earthquake Depth < 30 km

169 events plotted
- Depth <= 30
- 30 < Depth <= 75
- 75 < Depth <= 125
- Depth > 125

Alaska Earthquake Information Center
UAF Geophysical Institute
U.S. Geological Survey

- No M
- M = 2.0
- M = 3.0
- M = 4.0
- M = 5.0

Volcano

Gulf of Alaska
200 kilometers
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), 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) and minutes (MIN).
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 Center (NEIC) 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:

\[ RMS = \sqrt{\frac{\sum_{i=1}^{N} W_i R_i^2}{N}} \]

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:

\[ Q \begin{cases} \text{Larger of SEH and SEZ (km)} \\ A & \leq 1.34 \\ B & \leq 2.67 \\ C & \leq 5.35 \\ D & > 5.35 \end{cases} \]

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, PHASES < 6, MIN DIS > DEPTH, RMS > 1s, 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.
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<th>SEZ</th>
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**AEIC Monthly Earthquake Listing.**

Felt strongly in Adka and Atka.
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<th>Longitude</th>
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<th>Bearing (degrees)</th>
<th>Heading (degrees)</th>
<th>Pressure (mb)</th>
<th>Temperature (F)</th>
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APPENDIX 1.
Earthquakes with a magnitude of 4.0 and greater.
This listing is a subset of earthquakes from the complete monthly listing.

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01 02 1 (032) 18:19:30.390 51.437 -177.797 33.00D 5.6 R ANDREANOF IS., ALEUTIAN IS.
01 02 2 (033) 04:18:08.610 51.722 179.568 59.20 4.9 R RAT ISLANDS, ALEUTIAN IS.
01 02 2 (032) 13:02:55.130 51.988 -176.205 84.00 4.3 R ANDREANOF IS., ALEUTIAN IS.
01 02 3 (034) 06:42:54.050 52.509 -170.099 33.00D 4.1 R FOX ISLANDS, ALEUTIAN IS.
01 02 5 (036) 03:49:06.980 54.433 -131.149 10.00G 5.3 R SOUTHERN YUKON TERR., CAN.
01 02 5 (036) 13:33:39.130 52.505 170.211 33.00D 4.3 R NEAR ISLANDS, ALEUTIAN IS.
01 02 6 (037) 11:41:02.910 51.384 -176.767 33.00D 4.4 R ANDREANOF IS., ALEUTIAN IS.
01 02 9 (040) 14:59:52.997 59.184 -153.630 96.87 4.7 R SOUTHERN ALASKA
01 02 11 (042) 21:50:32.669 56.927 -153.364 37.98 5.3 R KODIAK ISLAND REGION
01 02 14 (045) 05:22:57.480 51.681 175.479 33.00D 4.0 R RAT ISLANDS, ALEUTIAN IS.
01 02 16 (047) 09:50:41.042 53.761 -164.144 8.03 4.3 R KOMANDORSKY IS. REGION
01 02 17 (048) 20:11:29.588 53.987 -133.612 10.78 5.5 R QUEEN CHARLOTTE IS. REGION
01 02 17 (048) 20:39:15.169 53.986 -133.501 19.42 4.3 R QUEEN CHARLOTTE IS. REGION
01 02 17 (048) 21:17:14.563 53.982 -133.654 6.39 4.3 R QUEEN CHARLOTTE IS. REGION
01 02 17 (048) 21:19:05.723 53.839 -133.424 6.99 5.0 0.89 4.76 3.67 228.6 127.2 23.60 R KODIAK ISLAND REGION
01 02 17 (048) 23:59:53.000 53.910 -133.810 1.00G 4.3 R QUEEN CHARLOTTE IS. REGION
01 02 19 (050) 11:57:36.040 51.271 179.288 33.00D 4.7 R RAT ISLANDS, ALEUTIAN IS.
01 02 23 (054) 23:53:26.460 53.760 169.005 33.00D 5.2 R KOMANDORSKY IS. REGION
01 02 24 (055) 03:10:26.010 54.133 169.248 33.00D 4.1 R KOMANDORSKY IS. REGION
01 02 24 (055) 03:32:46.387 58.014 -153.902 54.71 4.4 0.60 1.54 0.62 127.4 76 71.38 R KODIAK ISLAND REGION
01 02 25 (056) 08:18:18.000 72.480 -131.330 35.00G 4.6 R BEAUFORT SEA
01 02 22 (058) 07:53:46.021 50.967 179.343 66.05 4.5 1.32 51.81 927.63 229.4 22 253.40 R RAT ISLANDS, ALEUTIAN IS.
01 02 22 (058) 07:46:03.598 50.861 179.414 49.49 4.0 0.36 137.11 2035.33 232.7 19 253.51 R RAT ISLANDS, ALEUTIAN IS.
01 02 22 (058) 18:53:46.220 53.810 168.932 33.00D 4.4 R KOMANDORSKY IS. REGION
01 02 22 (058) 19:56:38.892 53.679 -163.894 8.35 4.4 0.51 2.21 2.01 217.2 37 104.19 R UNIMAK ISLAND REGION
APPENDIX 2.
Known or suspected quarry blasts located by the AEIC.
This listing is a subset of earthquakes from the complete monthly listing.

<table>
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<th>DATE</th>
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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>
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<th>MIN</th>
<th>Q</th>
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