UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

EARTHQUAKE DATA REPORT
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NATIONAL EARTHQUAKE INFORMATION CENTER

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EARTHQUAKE DATA REPORT

The Earthquake Data Report (EDR) is issued to those individuals and organizations Having a special need for information used in the preparation of the Preliminary Determi-nation of Epicenters (PDE) monthly listing.
Hypocentral coordinates are determined by a modified Geiger's method and may
be constrained by reported first arriving P-waves, Pdiff, and the DF branch of PKP. Data are corrected for station elevation and for the ellipticity of the Earth. Outliers may be truncated (ie., removed from the calculation) either automatically or manually. The solution is allowed to converge between rounds of automatic truncation to insure a unique result. Convergence is aided by step length damping.
The error bars of the computed hypocentral coordinates are 90% marginal confidence intervals incorporating Baysian information to stabilize estimates derived from small sam-ples (Jordan and Sverdrup, 1981). It is assumed that the travel-time errors of the data used are independent, unbiased, and have an expected standard deviation of 1 s. Monte Carlo experiments suggest that the error bars are accurate for events constrained by more than about 30 data. However, care should be exercised in interpreting these numbers in terms of absolute location accuracy because of unmodeled biases. Analysis of events with independently known coordinates indicates that most PDE determinations are accurate to a few tenths of a degree in epicentral position and 25 km in depth. For special studies, we urge that inquiry be made to this office for possible recomputation of hypocenters of interest, using more complete instrumental data.
Restricted focal depths occur in four instances. If at any point in the computation the depth becomes negative, the solution is automatically restricted at 33 km and indi-cated by "NORMAL DEPTH". If the unrestricted depth computation is unsatisfactory, and in the judgment of the reviewing geophysicist the earthquake probably has a shallow focus, a solution may be held at 33 km. These are also indicated by "NORMAL DEPTH". Tte geophysicist may restrain the depth at any value indicated by evidence from available seismograms. These are indicated by, for example, "DEPTH = 100 KM (GEOPHVSI-CIST)". If two or more pP phases are identified, and in general, yield depths within 10 km of the mean, then the depth is automatically restricted to this value and denoted by, for example, "DEPTH = 51 KM (5 DEPTH PHASES)". pP phases may also appear as unidentified second arrivals with associated travel-time residuals. Hypocentral coordinates derived from other sources, such as the California Institute of Technology, the University of California at Berkeley, and the U. S. Department of Energy are noted on the EDR. Two types of magnitude are computed: body-wave magnitude (nib) and surface-wave magnitude (Msz)- Each is a 25% trimmed mean of individual station values. Station magnitudes not used in the trimmed mean are marked with an X. This includes station magnitudes of either type which deviate significantly from the mean and surface-wave magnitudes determined frqm horizontal amplitudes. Body-wave magnitudes are computed according to the formula \og(A/T) + Q, derived by Gutenberg and Richter (1956), where A is the P-wave amplitude in micrometers, T is the period in seconds, and Q is the depth-distance factor. Surface-wave magnitudes are compute^ from the formula \og(A/T) + 1.66log(A) -1-3.3, where A is the maximum vertical surface-wave amplitude in micrometers,

T is the period in seconds, and A is the epicentral distance in degrees. Surface-wave magnitudes are determined only for earthquakes whose focal depths (taking into account the computed standard deviations) are potentially less than 50 km, for stations having 20° < A < 160°, and for reported periods of 18 < T < 22 s. No correction for focal depth is used in the MS calculation. Body-wave magnitudes are not determined from PKP arrivals or for stations having A < 5°. Amplitude values stated in this report are in nanometers (nm) for body-waves and micrometers (fan) for surf ace-waves.
The travel-time residual (observed computed) is based on the 1940 Jeffreys-Bullen
P and 1968 Bolt PKP travel-time tables. Phases not used in the computation are marked by an X. The azimuth from the epicenter to the station is measured clockwise from north. The epicentral distance is the central angle in degrees.

Hypocenter Symbols

& Indicates that parameters of the hypocenter were supplied or determined by a compu-tational procedure not normally used by the National Earthquake Information Service (NEIS). The source or nature of the determination is indicated by a 2 to 5 letter code enclosed by angle brackets and appearing in the first line of comments. A "-P" ap-pended to the code indicates that the computation is preliminary. These codes are included^with the list of abbreviations in the PDE Monthly Listing.

S$ Indicates a single network solution. A non-furnished hypocenter has been computed using data reported by a single network of stations for which the date and/or origin time cannot be confirmed from seismograms available to a NEIS analyst. Also, if we define r\ to be the geometric mean of the semi-major and semi-minor axes of the horizontal 90% confidence ellipse, then 77 ^16-0 km.

* Indicates a less reliable solution. In general^.5 < r? < 16.0 km.

? Indicates a poor solution, published for completeness of the catalog. In general, r\ > 16.0 km. This includes poor solutions computed using data reported by a single network.

The lack of any symbol indicates that 77 < 8.5 |m.

Note: On printers available to the NEIS for this publication, the symbol for degrees (°) appears as "*".

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Boit, Bruce A. (1968), Estimation of PKP Travel Times, Bull. Sets. Soc. Am., 58, pp. 1305-1324.

Gutenberg, B. and C. F. Richter (1956), Magnitude and Energy of Earthquakes, Ann. di Geofisica, 9, no. 1, pp. 1-15.

t Jeffreys, Harold and K. E. Bullen (1940), Seism&logical Tables, British Asjoc. for the
Advancement of Science, Gray Milne Trust. *

Jordan, Thomas H. and Keith A. Sverdrup (1981), Teleseismic Location Techniques and their Application to Earthquake Clusters in the South-Central Pacific, Bull. Seis. Soc. Am., 71, pp. 1105-1130.

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References

Bolt, Bruce A. (1968), Estimation of PKP Travet Tiiaes, Bull. Sets. Soc. Am., 58, pp. 1305-1324.

Gutenberg, B. and C. F. Richter (1956), Magnitu4%ajpd Energy of Earthquakes, Ann. di Geofisica, 9, no. 1, pp. 1-15.

Jeffreys, Harold and K. E. Bullen (1940), Seism0l$Q*<&l Tables, British Assoc. for the Advancement of Science, Gray Milne Trust.

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