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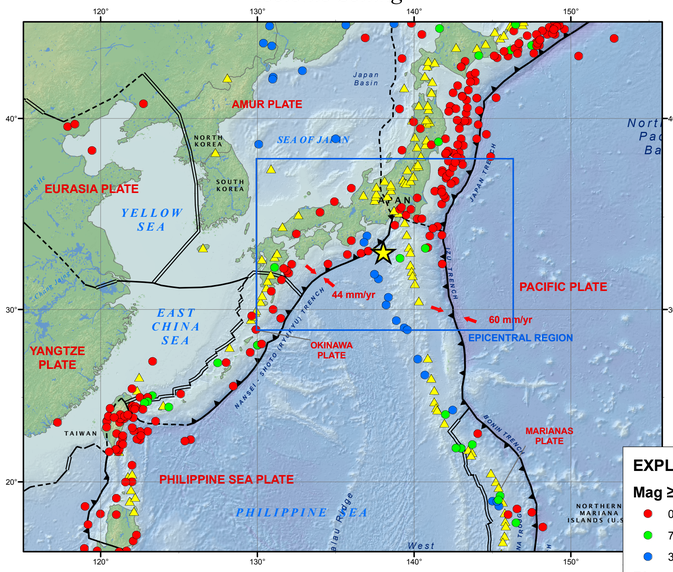
U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

EARTHQUAKE SUMMARY MAP XXX

Prepared in cooperation with the Global Seismographic Network
GSN

M7.1 Izu Islands, Japan, Earthquake of 9 August 2009

Tectonic Setting



RELATIVE PLATE MOTIONS

The red vectors represents the motion of the Pacific Plate relative to the Philippine Plate, and the Philippine Plate relative to the Eurasia Plate in the region. The motion of the Pacific Plate is generally 60 mm/yr north westward with respect to the Philippine Plate. The motion of the Philippine Plate is generally 44 mm/yr north westward with respect to the Eurasia Plate.

Scale 1:20,000,000

0 195 390 780 1,170 1,560 Kilometers

EXPLANATION

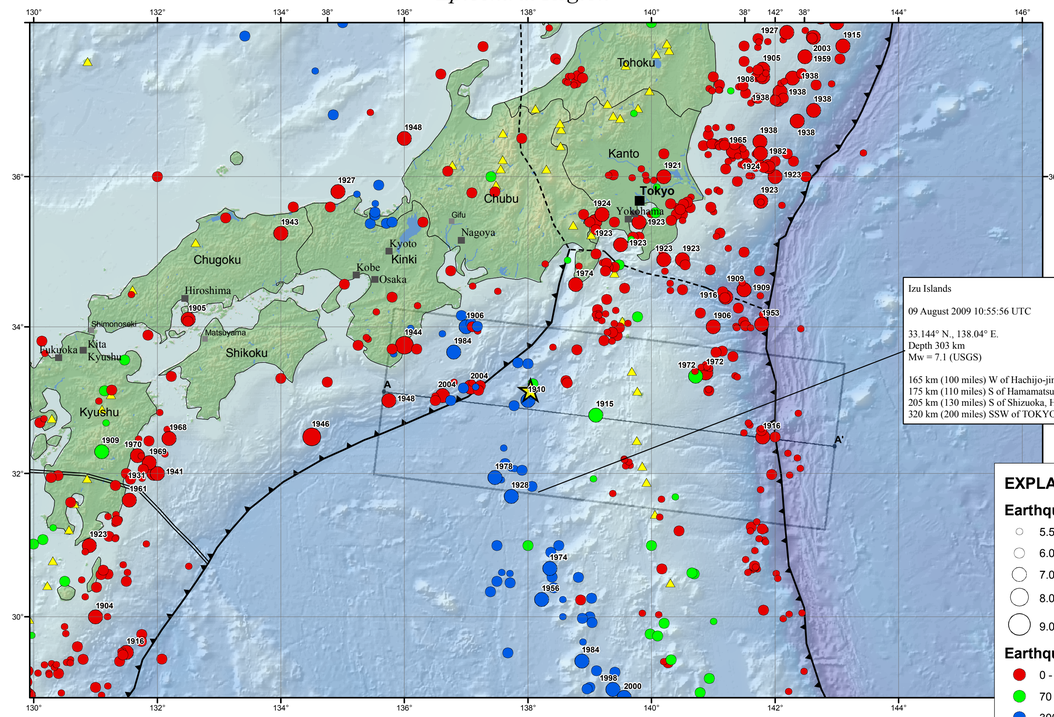
Mag ≥ 7.0

- 0 - 69 km
- 70 - 299
- 300 - 600

Plate Boundaries

- Subduction
- Transform
- Divergent
- Others

Epicentral Region



Izu Islands

09 August 2009 10:55:56 UTC

33.144° N., 138.04° E.
Depth 303 km
Mw = 7.1 (USGS)

165 km (100 miles) W of Hachijo-jima, Izu Islands, Japan
175 km (110 miles) S of Hamamatsu, Honshu, Japan
205 km (130 miles) S of Shizuoka, Honshu, Japan
320 km (200 miles) SSW of TOKYO, Japan

EXPLANATION

Earthquake Magnitude

- 5.50 - 5.99
- 6.00 - 6.99
- 7.00 - 7.99
- 8.00 - 8.99
- 9.00 - 9.99

Earthquake Depth

- 0 - 69
- 70 - 299
- 300 - 700

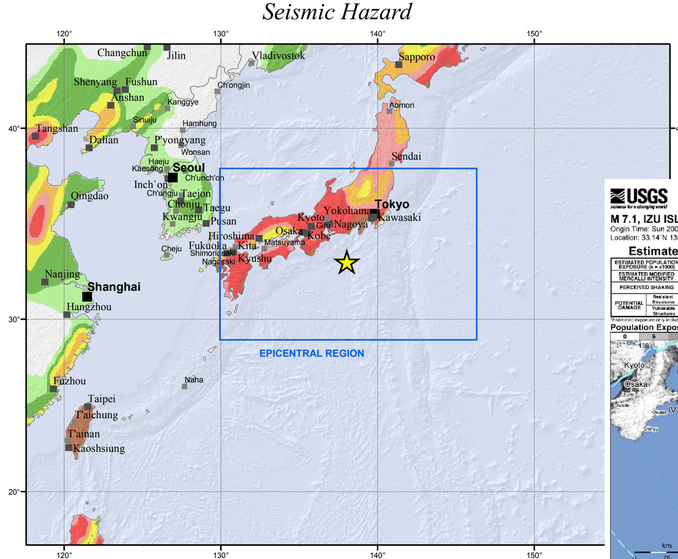
Scale 1:5,073,234

0 75 150 300 450 600 Kilometers

Significant Earthquakes Mag >= 7.0

Year	Mon	Day	Time	Lat	Long	Dep	Mag
1904	08	24	2059	30.000	131.000	35	7.1
1905	06	02	0539	34.100	132.500	55	7.0
1905	07	06	1621	37.400	141.800	35	7.1
1906	01	21	1349	34.000	137.000	350	7.7
1906	09	07	1852	34.000	141.000	35	7.0
1908	01	15	1256	37.300	141.800	35	7.3
1909	03	12	2319	34.500	141.500	35	7.1
1909	03	13	1429	34.500	141.500	35	7.6
1909	11	10	0613	32.300	131.100	150	7.5
1910	02	12	1810	33.000	138.000	350	7.2
1915	10	08	1536	32.800	139.100	200	7.0
1915	11	18	0404	37.700	143.100	35	7.0
1916	02	01	0736	29.500	131.500	0	7.4
1916	04	21	1131	32.500	141.800	35	7.0
1916	09	15	0701	34.400	141.200	35	7.1
1921	12	08	1231	36.000	140.200	35	7.0
1923	06	01	1724	35.674	141.767	35	7.1
1923	06	01	2014	36.000	142.000	35	7.1
1923	07	13	1113	31.000	130.900	35	7.1
1923	09	01	0258	35.405	139.084	35	7.9
1923	09	01	0303	35.100	139.500	35	7.3
1923	09	01	0348	35.400	139.800	35	7.0
1923	09	02	0246	34.900	140.200	35	7.6
1923	09	02	0927	34.900	140.500	35	7.1
1924	01	14	2050	35.500	139.200	5	7.3
1924	08	14	1802	36.133	141.892	35	7.0
1927	03	07	0927	35.802	134.924	9.6	7.6
1927	08	05	2112	37.873	142.191	35	7.1
1928	03	29	0506	31.682	137.730	433	7.0
1931	11	02	1003	32.003	131.945	42.2	7.5
1938	05	23	0718	36.458	141.755	35	7.7
1938	11	05	0843	37.009	142.045	35	7.9
1938	11	05	1050	37.108	142.081	35	7.8
1938	11	06	0853	37.287	142.283	35	7.7
1938	11	06	2138	36.867	142.625	35	7.0
1938	11	13	2231	36.727	142.360	35	7.0
1941	11	18	1646	32.000	132.000	0	7.7
1943	09	10	0836	35.250	134.000	0	7.0
1944	12	07	0435	33.750	136.000	0	8.1
1946	12	20	1919	32.500	134.500	0	8.1
1948	04	17	1611	33.000	135.750	0	7.2
1948	06	28	0713	36.500	136.000	0	7.0
1953	11	25	1748	34.034	141.786	35	7.9
1956	02	18	0734	30.244	138.222	486	7.1
1959	01	22	0510	37.560	142.483	35	7.2
1961	02	26	1810	31.632	131.548	49.9	7.7
1965	09	17	1621	36.336	141.327	43.5	7.1
1968	04	01	0042	32.482	132.192	30.2	7.5
1969	04	21	0719	32.149	131.868	37.1	7.0
1970	07	25	2241	32.246	131.680	45.6	7.0
1972	02	29	0923	33.377	140.881	58.8	7.5
1972	12	04	1016	33.331	140.713	70.6	7.3
1974	05	08	2333	34.569	138.773	10.7	7.2
1974	11	29	2205	30.682	138.354	424	7.1
1978	03	07	0248	31.945	137.467	442	7.1
1982	07	23	1423	36.307	141.763	27.4	7.0
1984	01	01	0903	33.659	136.800	385	7.2
1984	03	06	0217	29.374	138.872	459	7.4
1998	08	20	0640	28.974	139.376	428	7.1
2000	08	06	0727	28.859	139.556	398	7.3
2003	10	31	0106	37.812	142.619	10	7.0
2004	09	05	1007	33.070	136.618	14	7.2
2004	09	05	1457	33.184	137.071	10	7.4

Seismic Hazard



Seismic hazard is expressed as peak ground acceleration (PGA) on firm rock, in meters/sec^2, expected to be exceeded in a 50-yr period with a probability of 10 percent.

Scale 1:20,000,000

0 195 390 780 1,170 1,560 Kilometers

Peak Ground Acceleration in m/sec**2

.2 .4 .8 1.6 2.4 3.2 4.0 4.8

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M 7.1, IZU ISLANDS, JAPAN REGION
Origin Time: Sun 2009-08-09 10:55:55 UTC
Location: 33.14°N 138.04°E Depth: 303 km

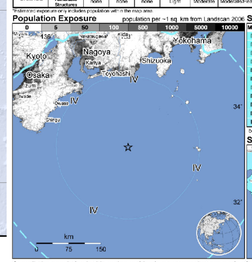
PAGER
Version 1
Created: 13 min. 55 sec after origin of quake

Estimated Population Exposed to Earthquake Shaking

ESTIMATED POPULATION EXPOSURE (k = x1000)		2,460k*	40,420k	0	0	0	0	0	0
ESTIMATED MODIFIED MERCALLI INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+
PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE: Resistant Structures	none	none	none	V. Light	Light	Moderate	Moderate/Heavy	Heavy	V. Heavy
POTENTIAL DAMAGE: Vulnerable Structures	none	none	none	Light	Moderate	Moderate/Heavy	Heavy	V. Heavy	V. Heavy

*Estimated exposure only to populated places (at > 1 per sq. km from Landscan 2008)

Population Exposure population per ~1 sq. km from Landscan 2008



Selected City Exposure

MMI	City	Population
IV	Oyama	21k
IV	Isata	88k
IV	Hamamatsu	609k
IV	Tahara	38k
IV	Ise	97k
IV	Toyohashi	378k
IV	Hamakita	66k
IV	Nagoya	2,191k
IV	Osaka	2,692k
IV	Yokohama	3,674k
III	Kobe	1,528k

bold cities appear on map (k = x1000)

Shaking Intensity

Overall, the population in this region resides in structures that are a mix of vulnerable and earthquake resistant construction. A magnitude 5.9 earthquake occurred near the Kobe, Japan, region 321 km northwest of the location of this earthquake on January 16, 1995 (UTC), with estimated population exposures of 1,740,000 at intensity IX or greater and 3,178,000 at intensity VIII, resulting in an estimated 6,432 fatalities. Recent earthquakes in this area have caused, tsunamis, landslides and fires that may have contributed to losses.

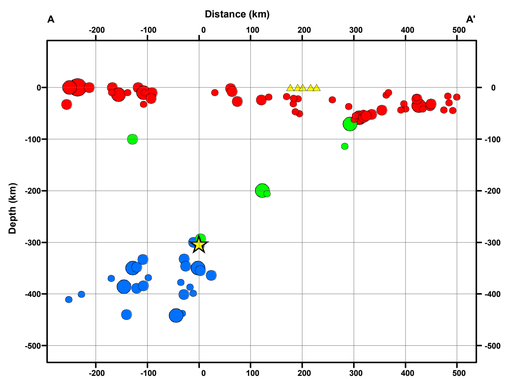
The information was automatically generated and has not been reviewed by a seismologist.

http://earthquake.usgs.gov/pager

Event ID: us2009xaaz

TECTONIC SUMMARY

The magnitude 7.1 earthquake of August 9, 2009, occurred off the south coast of Honshu within the Izu-Bonin subduction system. This system extends 1,200 km from southern Honshu to the Mariana Islands and constitutes part of the boundary between the Pacific plate and the Philippine Sea plate. The Pacific plate moves westwards relative to the Philippine Sea plate with a velocity of about 50 mm/y and subducts beneath it at the Izu-Bonin trench. The earthquake occurred at depth within the westward dipping Pacific plate, well beneath the overriding Philippine Sea plate. Subduction of the Pacific plate along the northern and western margins of the Pacific Ocean generates a large amount of seismicity. Earthquakes typically occur as thrust faulting on interfaces that separate the subducting Pacific plate from the overriding plates, and earthquakes occur within the subducting or overriding plates as the result of stresses associated with intraplate deformation. The August 9, 2009, earthquake was an intraplate event. Its focal depth of 303 km classifies it is a "deep" earthquake, an earthquake with depth greater than or equal to 300 km. Earthquakes have been accurately located to depths of 450 km in the section of the Izu-Bonin subduction system within which the August 9 earthquake occurred. Due to its great depth, the August 9 earthquake did not cause any damage and no damaging tsunami was generated.



DISCLAIMER

Base map data, such as place names and political boundaries, are the best available but may not be current or may contain inaccuracies and therefore should not be regarded as having official significance.

DATA SOURCES

EARTHQUAKES AND SEISMIC HAZARD
USGS, National Earthquake Information Center
NOAA, National Geophysical Data Center
IASPEI, Centennial Catalog (1900 - 1999) and extensions (Engdahl and Villaseñor, 2002)
HDF (unpublished earthquake catalog) (Engdahl, 2003)
Global Seismic Hazard Assessment Program

PLATE TECTONICS AND FAULT MODEL
PB2002 (Bird, 2003)
Finite Fault Model, Chen Ji, UC Santa Barbara (2007)

BASE MAP
NIMA and ESRI, Digital Chart of the World
USGS, EROS Data Center
NOAA GEBCO and GLOBE Elevation Models

REFERENCES

Bird, P., 2003, An updated digital model of plate boundaries: Geochem. Geophys. Geosyst., v. 4, no. 3, pp. 1027- 80.

Engdahl, E.R. and Villaseñor, A., 2002, Global Seismicity: 1900 - 1999, chap. 41 of Lee, W.H.K., and others,eds., International Earthquake and Engineering Seismology, Part A : New York, N.Y., Elsevier Academeic Press, 932 p.

Engdahl, E.R., Van der Hilst, R.D., and Buland, R.P., 1998, Global teleseismic earthquake relocation with improved travel times and procedures for depth determination: Bull. Seism. Soc. Amer., v. 88, p. 722-743.

The GEBCO_08 Grid, version 20090202, http://www.gebco.net

Map prepared by U.S. Geological Survey
National Earthquake Information Center
10 August 2009
Map not approved for release by Director USGS