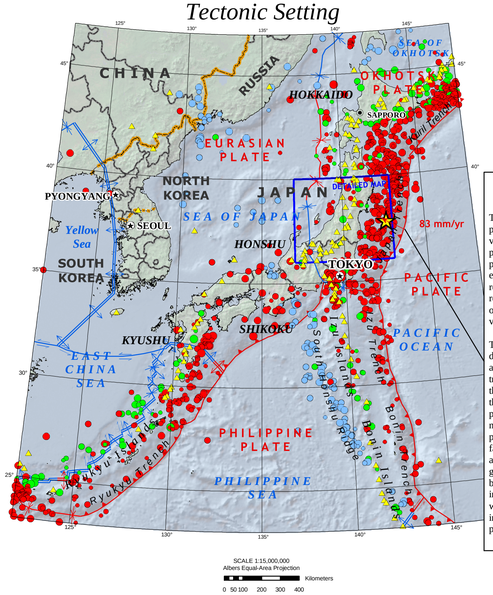
M7.0 Near East Coast of Honshu, Japan Earthquake of 31 October 2003

Tectonic Setting

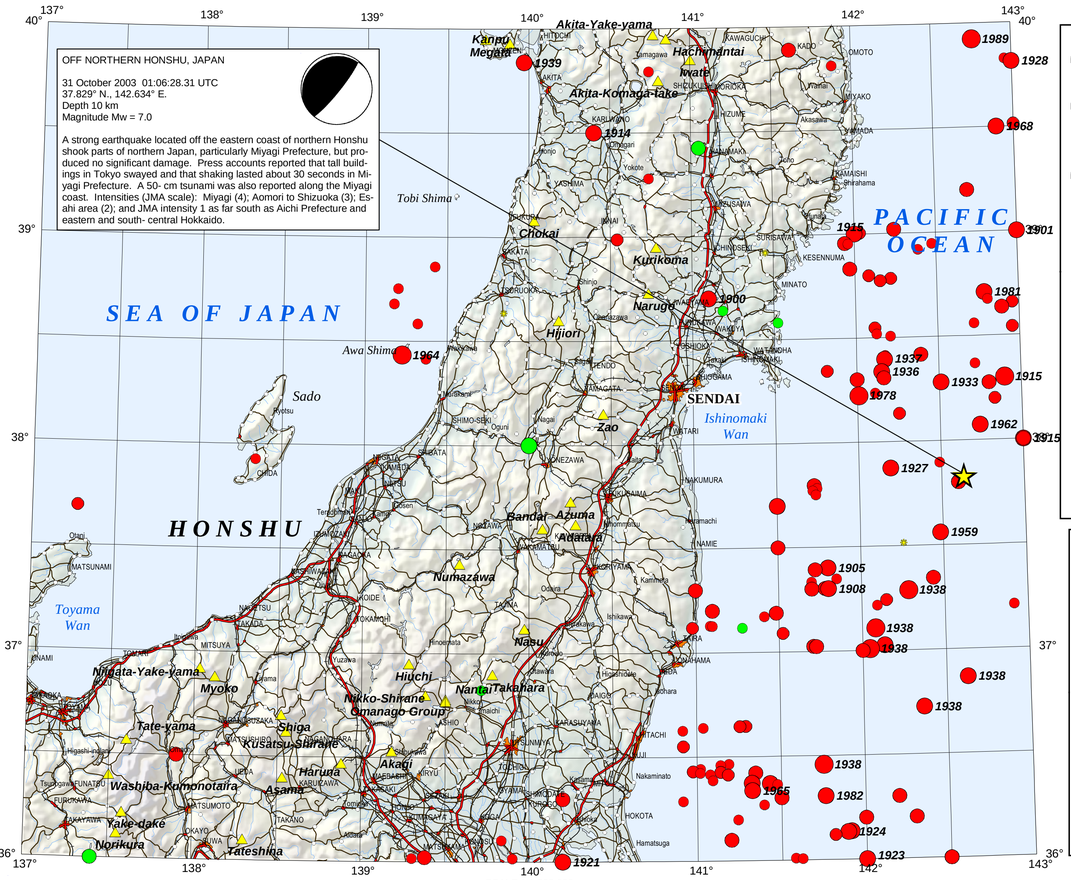


RELATIVE PLATE MOTIONS

The relative motion of adjacent tectonic plates is depicted on the map by short vectors located at selected points on the plate boundary. In this presentation, one plate (the fixed reference plate) is assumed to be rigid. The vector therefore represents the direction of the moving plate relative to the reference plate. The rate of relative motion is labelled next to the vector.

The components of the vector perpendicular and parallel to the plate margin approximate convergent/divergent and transverse direction of motion between the plates, respectively. As viewed from the fixed plate, an inward directed component suggests convergence at and near the plate boundary that may be expressed as crustal folding, uplift, thrust faulting, or plate subduction. Similarly, an outward directed component suggests plate divergence such as would be expected at a zone of crustal spreading. Transcurrent or transform faulting would be expected when the predominant vector component is parallel to the plate margin.

Epicentral Area



EXPLANATION

Main Shock
31 October 2003

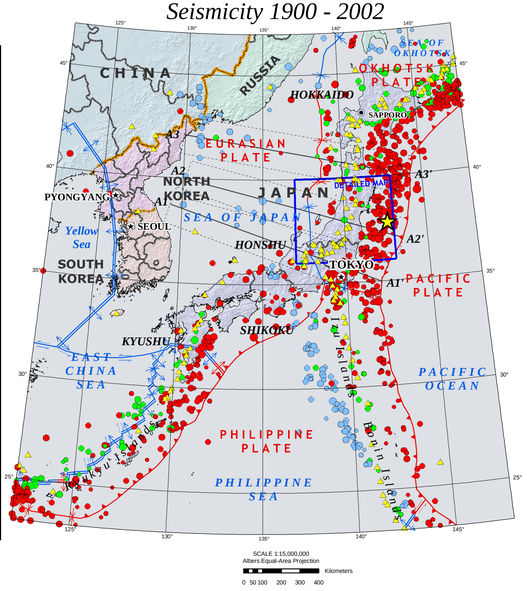
Depth Classes
- 0 - 69 km
- 70 - 299
- 300 - 700

Magnitude Classes
- 5.00 - 5.49
- 5.50 - 5.99
- 6.00 - 6.49
- 6.50 - 6.99
- 7.00 - 7.49
- 7.50 - 8.00

Plate Boundary
- Continental Convergent
- Continental Rift
- Continental LL Transform
- Continental RL Transform
- Oceanic Convergent
- Oceanic Spreading
- Oceanic LL Transform
- Oceanic RL Transform
- Subduction

Volcano

Seismicity 1900 - 2002



EXPLANATION

Main Shock
31 October 2003

Aftershocks

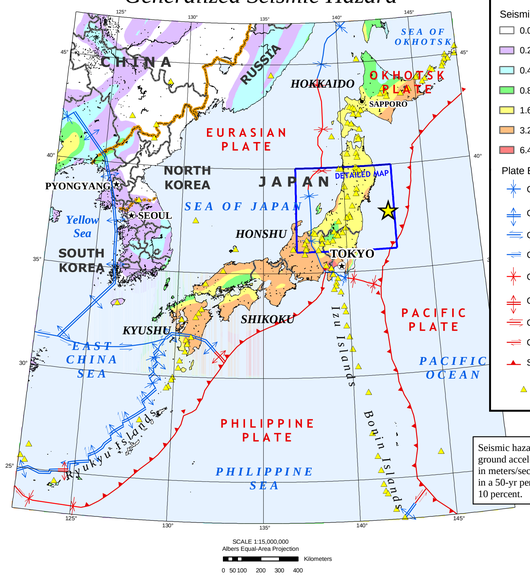
Urban Area
SENDAI

Populated Place
Ishikawa

Highway
- Freeway
- Connector
- Major Road
- Railroad

Volcano
Azuma

Generalized Seismic Hazard



EXPLANATION

Main Shock
31 October 2003

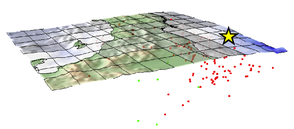
Seismic Hazard
- 0.0 - 0.2 m/sec²
- 0.2 - 0.4
- 0.4 - 0.8
- 0.8 - 1.6
- 1.6 - 3.2
- 3.2 - 6.4
- 6.4 - 9.4

Plate Boundary
- Continental Convergent
- Continental Rift
- Continental LL Transform
- Continental RL Transform
- Oceanic Convergent
- Oceanic Spreading
- Oceanic LL Transform
- Oceanic RL Transform
- Subduction

Volcano

Seismic hazard is expressed as peak ground acceleration (PGA) on firm rock, in meters/sec², expected to be exceeded in a 50-yr period with a probability of 10 percent.

Perspective View



Vertical Exaggeration 3X

DATA SOURCES

EARTHQUAKES AND SEISMIC HAZARD
USGS, National Earthquake Information Center
NOAA, National Geophysical Data Center
IASPEI, Centennial Catalog (1900 - 1999)
Handbook of Seismology and Earthquake Engineering
Global Seismic Hazard Assessment Program

PLATE TECTONICS
Bird, P., 2003, An updated digital model of plate boundaries: Geochem. Geophys. Geosyst., v. 4, no. 3, pp. 1027 - 1080.

BASE MAP
NIMA and ESRI, Digital Chart of the World
USGS, EROS Data Center

NEWS SOURCE

Guardian Unlimited http://www.guardian.co.uk

DISCUSSION

The preliminary location and focal-mechanism of this earthquake imply that it occurred as the result of thrust-faulting on the plate interface between the overriding Okhotsk plate (between the Pacific Ocean and the Eurasian landmass) and the subducting Pacific plate. The Pacific plate is moving west-northwest at a rate of about 83 mm per year relative to the Okhotsk plate. In addition to experiencing great thrust earthquakes that originate on the interface between the plates, western Honshu experiences great earthquakes that originate from the interior of subducted Pacific plate. Extremely deadly and destructive earthquakes have struck this part of Honshu in the past 400 years; in the past century, the earthquakes of 1925, 1964, 1978, and 1995 are notable for causing costly property damages.

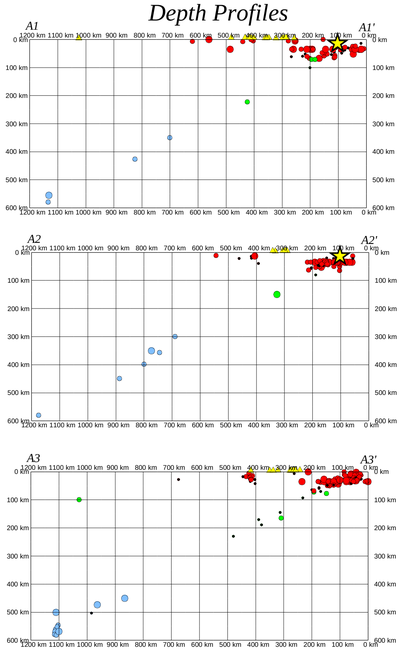
MAJOR EARTHQUAKES 1900 - 1999
EPICENTRAL AREA

YR	MO	DY	LAT	LON	DEPTH	MAG
1900	5	11	38.700	141.100	5.0	7.0
1901	6	15	39.000	143.000	35.0	7.0
1905	7	6	37.400	141.800	35.0	7.1
1908	1	15	37.300	141.800	35.0	7.3
1914	3	14	39.500	140.400	5.0	7.0
1915	3	8	39.000	142.000	0.0	7.0
1915	11	1	38.300	142.900	35.0	7.5
1915	11	1	38.000	143.000	35.0	7.0
1921	12	8	36.000	140.200	35.0	7.0
1923	6	1	36.000	142.000	35.0	7.1
1924	8	14	36.133	141.892	35.0	7.0
1927	8	5	37.873	142.191	35.0	7.1
1928	5	27	39.813	142.990	35.0	7.1
1933	6	18	38.280	142.510	35.0	7.2
1936	11	2	38.337	142.151	35.0	7.1
1937	7	26	38.396	142.170	35.0	7.1
1938	5	23	36.458	141.755	35.0	7.7
1938	11	5	37.108	142.081	35.0	7.8
1938	11	5	37.009	142.045	35.0	7.9
1938	11	6	37.287	142.283	35.0	7.7
1938	11	6	36.867	142.625	35.0	7.0
1938	11	13	36.727	142.360	35.0	7.0
1939	5	1	39.839	139.969	35.0	7.0
1959	1	22	37.560	142.483	35.0	7.2
1962	4	12	38.073	142.741	24.5	7.2
1964	6	16	38.434	139.226	13.1	7.5
1965	9	17	36.336	141.327	43.5	7.1
1968	6	12	39.501	142.893	31.2	7.1
1978	6	12	38.224	142.009	53.3	7.7
1981	1	18	38.708	142.788	47.3	7.0
1982	7	23	36.307	141.763	27.4	7.0
1989	11	1	39.923	142.757	29.0	7.4

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.

Depth Profiles



EXPLANATION

Main Shock
31 October 2003

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

Magnitude Classes
- 5.0 - 5.9
- 6.0 - 6.9
- 7.0 - 7.9

Volcano

Map prepared by U.S. Geological Survey
National Earthquake Information Center
20 November 2003
Map not approved for release by Director USGS