USGS science for a changing world

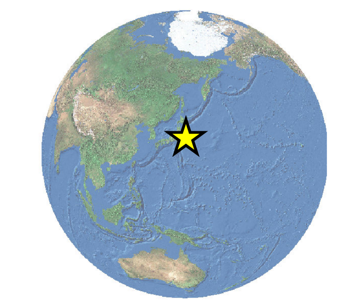
U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

EARTHQUAKE SUMMARY MAP

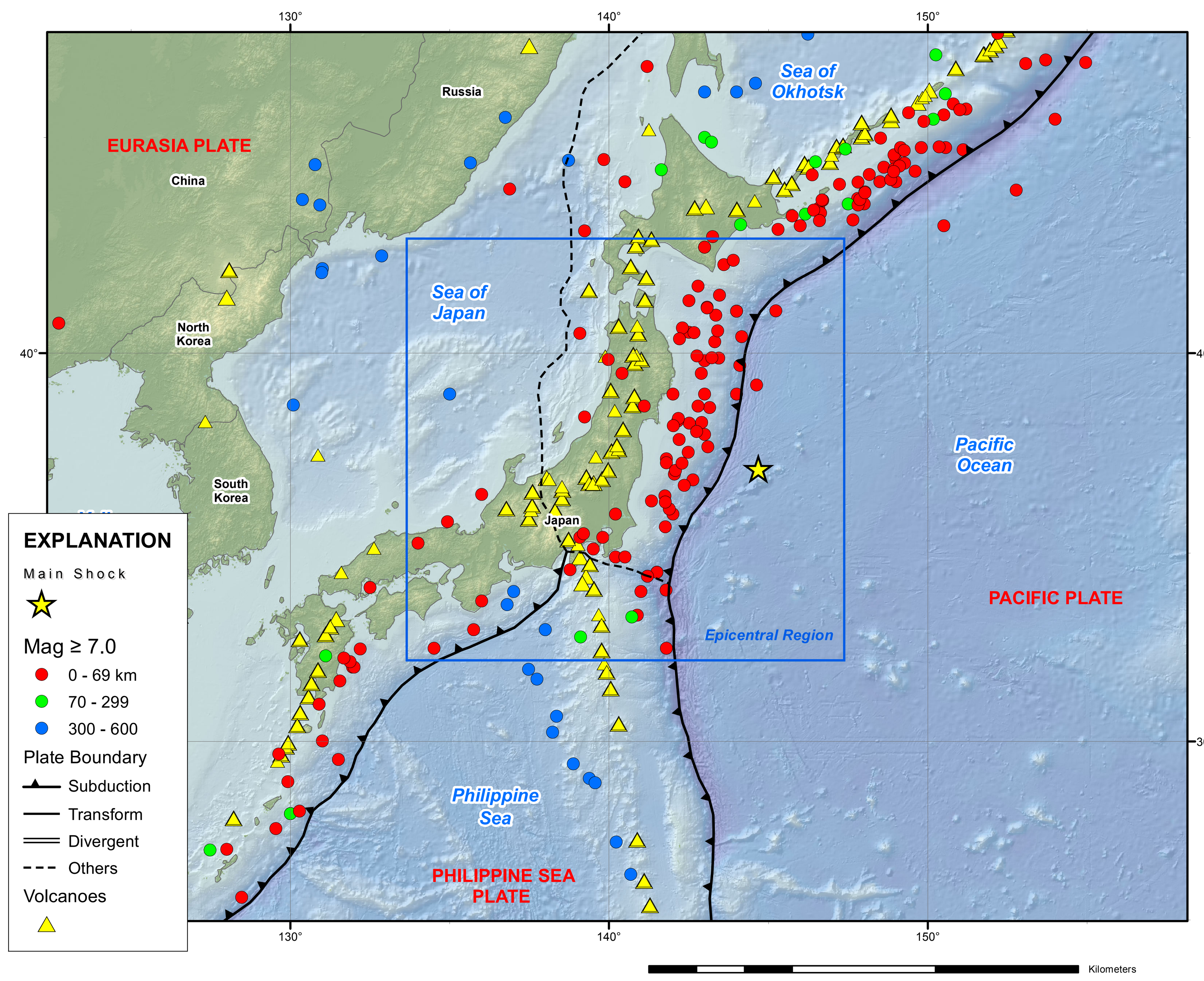
Prepared in cooperation with the Global Seismographic Network

GSN

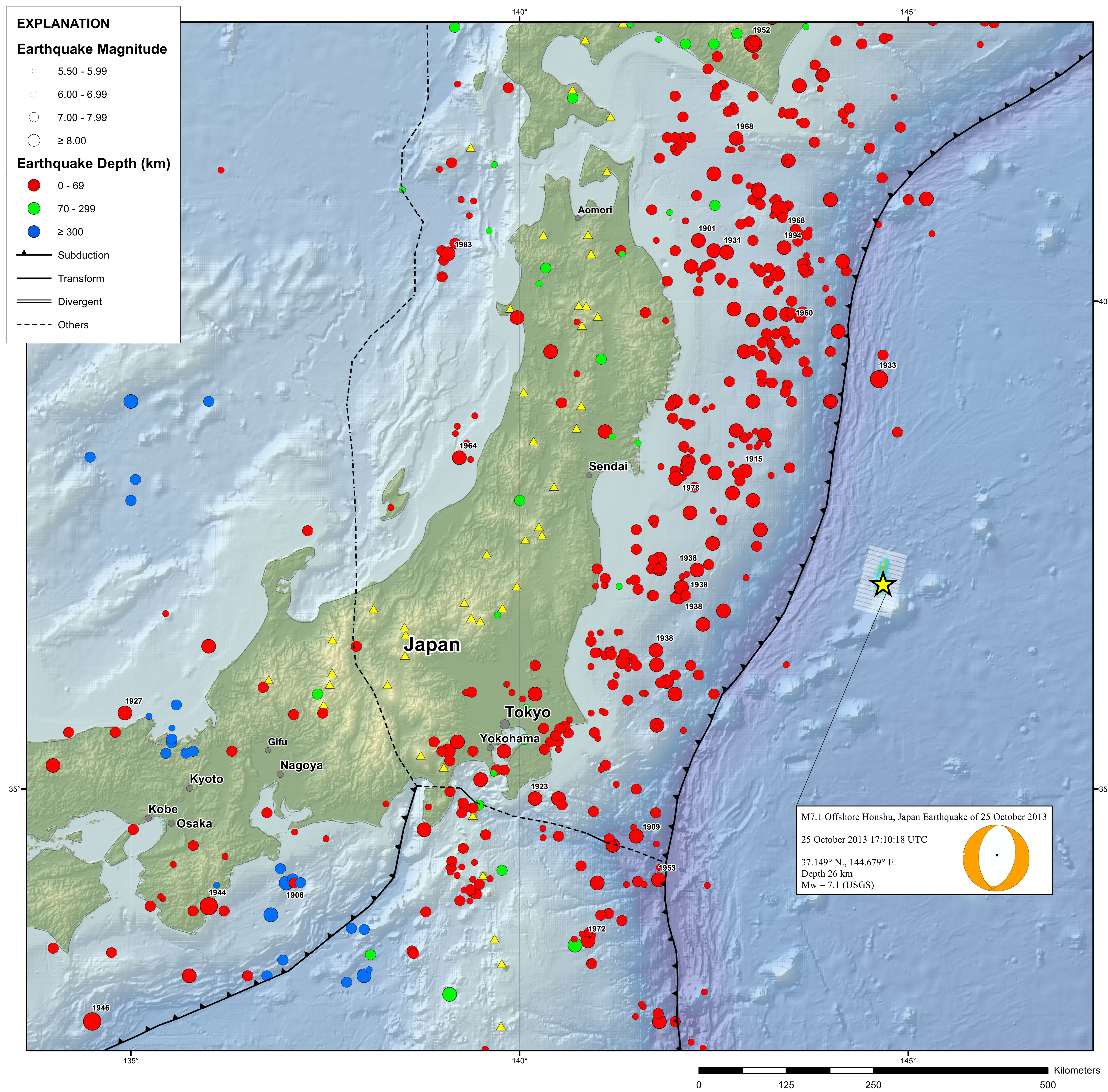
M7.1 Offshore Honshu, Japan Earthquake of 25 October 2013



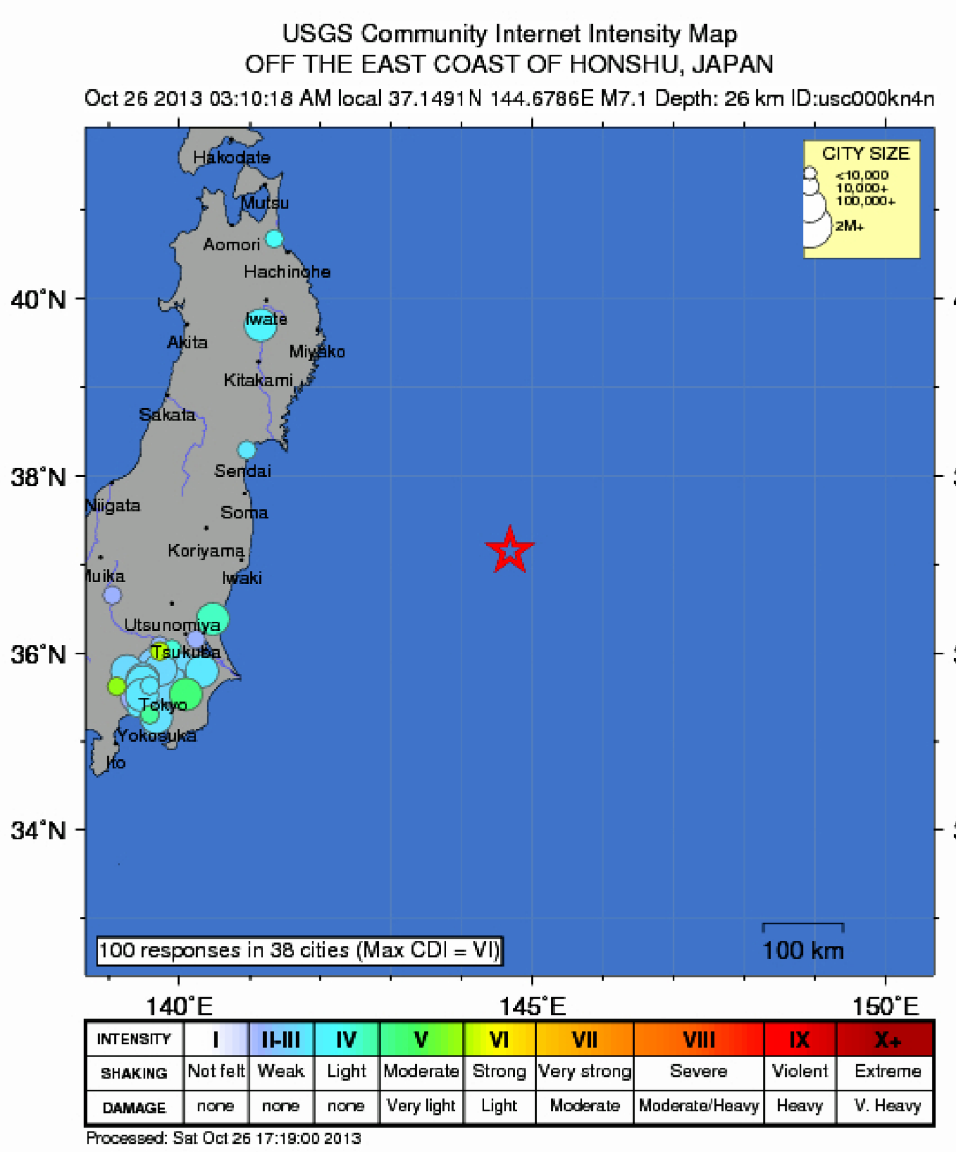
Tectonic Setting



Epicentral Region

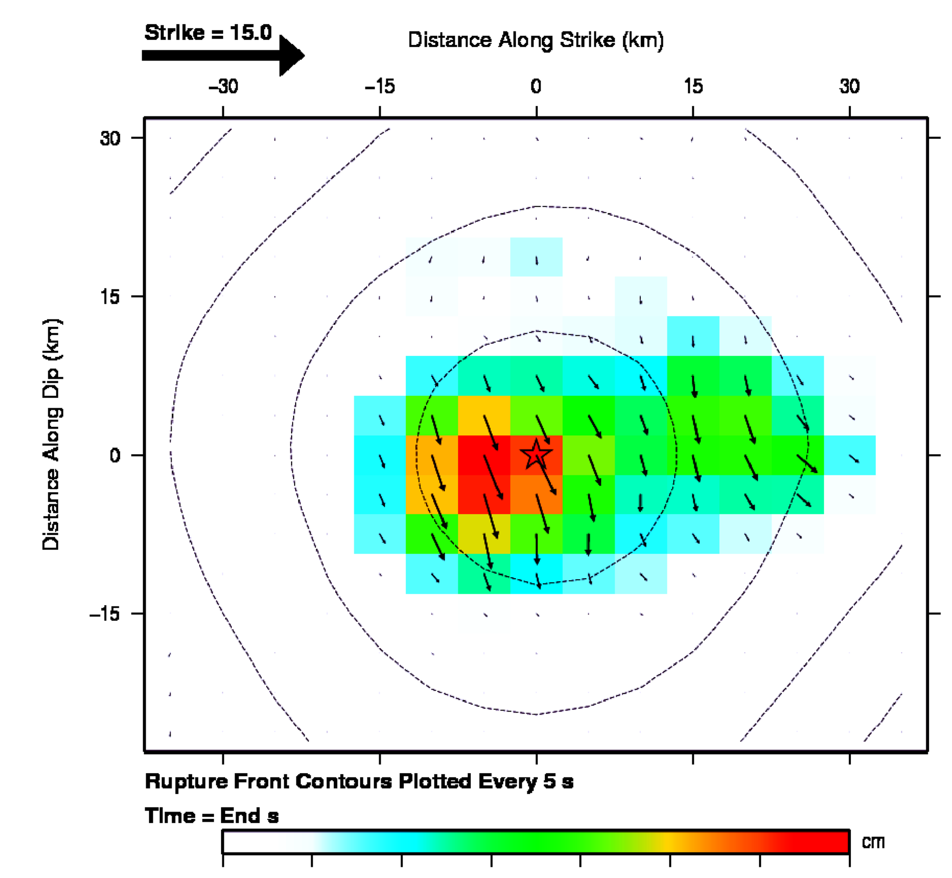


Did You Feel It?

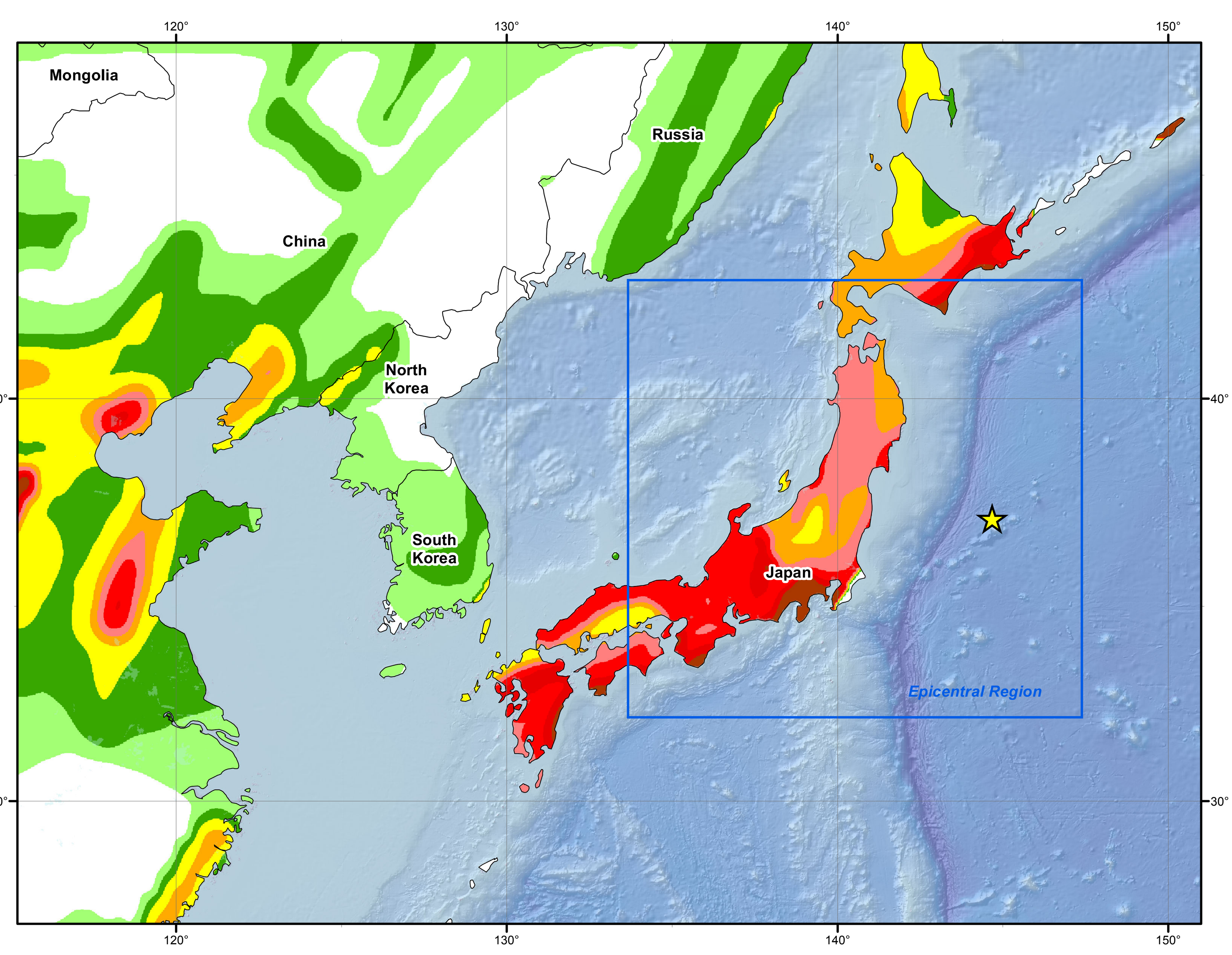


Finite Fault Model

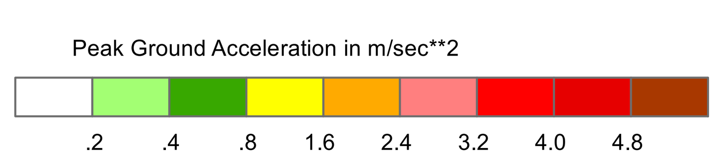
Distribution of the amplitude and direction of slip for subfault elements of the fault rupture model are determined from the inversion of teleseismic body waveforms and long period surface waves. Arrows indicate the amplitude and direction of slip (of the hanging wall with respect to the foot wall); the slip is also colored by magnitude.The view of the rupture plane is from above. The strike of the fault rupture plane is N15NE and the dip is 45 ESE. The dimensions of the subfault elements are 5 km in the strike direction and 3.8 km in the dip direction.The rupture surface is approximately 40 km along strike and 22 km downdip. The seismic moment release based upon this plane is 6.91e+26 dyne.cm.



Seismic Hazard



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.



TECTONIC SUMMARY

The October 25, 2013 M 7.1 earthquake offshore of Honshu, Japan occurred as the result of normal faulting in the shallow oceanic crust of the Pacific plate. The earthquake occurred outboard (east) of the Japan Trench, which marks the seafloor expression of the subduction zone plate boundary between the Pacific and North America plates, and is immediately up-dip of the source region of the March 2011 M 9.0 Tohoku earthquake. At the latitude of this earthquake, the Pacific plate moves westwards with respect to the North America plate at a rate of 83 mm/yr before subducting beneath the island of Honshu. Note that some authors divide this region into several microplates that together define the relative motions between the larger Pacific, North America and Eurasia plates; these include the Okhotsk and Amur microplates that are respectively part of North America and Eurasia.

The location, depth, and focal mechanism of the October 25 2013 event are consistent with normal faulting rupture near the outer-arc high of the Japan Trench. In this region, normal faulting is encouraged by both the bending of the Pacific plate as it enters the subduction zone, and by stresses transferred from the locked subduction thrust interface to the west. Since the March 2011 Tohoku earthquake, two large events of M 7.7 and M 7.3 have occurred in the vicinity of the October 25, 2013 earthquake. The M 7.7 event, on March 11, 2011, was also a normal faulting event near the outer-arc high and occurred 95 km north of the October 25 event. The M 7.3 event, on December 7, 2012, was a more complex earthquake resulting from thrust motion near the trench 100 km to the northwest of the October 25 earthquake. Since March 2011, 10 additional events, ranging in magnitude from M 6.1-6.4, have occurred in this region east of the Japan Trench.

Significant Earthquakes Mag >= 7.5

Year	Mon	Day	Time	Lat	Long	Dep	Mag
1901	08	09	1833	40.600	142.300	35	7.5
1906	01	21	1349	34.000	137.000	350	7.7
1909	03	13	1429	34.500	141.500	35	7.6
1915	11	01	0724	38.300	142.900	35	7.5
1923	09	01	0258	35.405	139.084	35	7.9
1923	09	02	0246	34.900	140.200	35	7.6
1927	03	07	0927	35.802	134.924	9.6	7.6
1931	03	09	0348	40.484	142.664	35	7.7
1933	03	02	1731	39.224	144.622	35	8.4
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
1944	12	07	0435	33.750	136.000	0	8.1
1946	12	20	1919	32.500	134.500	0	8.1
1952	03	04	0122	42.500	143.000	0	8.1
1953	11	25	1748	34.034	141.786	35	7.9
1960	03	20	1707	39.871	143.435	2.1	7.8
1964	06	16	0401	38.434	139.226	13.1	7.5
1968	05	16	0049	40.903	143.346	25.8	8.3
1968	05	16	1039	41.593	142.786	11.8	7.8
1972	02	29	0923	33.377	140.881	58.8	7.5
1978	06	12	0814	38.224	142.009	53.3	7.7
1983	05	26	0300	40.468	139.080	20	7.7
1994	12	28	1219	40.530	143.403	29.2	7.8
2003	09	25	1950	41.815	143.910	27	8.3
2011	03	09	0245	38.435	142.842	32	7.5
2011	03	11	0546	38.297	142.373	29	9.1
2011	03	11	0615	36.271	141.107	48	7.9
2011	03	11	0625	38.058	144.590	18	7.7

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)
EHB catalog (Engdahl et al., 1998)
HDF (unpublished earthquake catalog, Engdahl, 2003)
Global Seismic Hazard Assessment Program

PLATE TECTONICS AND FAULT MODEL
PB2002 (Bird, 2003)
Ji, C., D.J. Wald, and D.V. Helmberger, Source description of the 1999 Hector Mine, California earthquake; Part I: Wavelet domain inversion theory and resolution analysis, Bull. Seism. Soc. Am., Vol 92, No. 4. pp. 1192-1207, 2002.
DeMets, C., Gordon, R.G., Argus, D.F., 2010. Geologically current plate motions, Geophys. J. Int. 181, 1-80.

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 Villasenor, 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 Academic 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.

DISCLAIMER

Map updated by U.S. Geological Survey National Earthquake Information Center
25 October 2013
http://earthquake.usgs.gov/
Map not approved for release by Director USGS