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

EARTHQUAKE SUMMARY MAP

Prepared in cooperation with the
Global Seismographic Network
GSN

USGS
science for a changing world

M7.1 Bohol Island, Philippines Earthquake of 15 October 2013
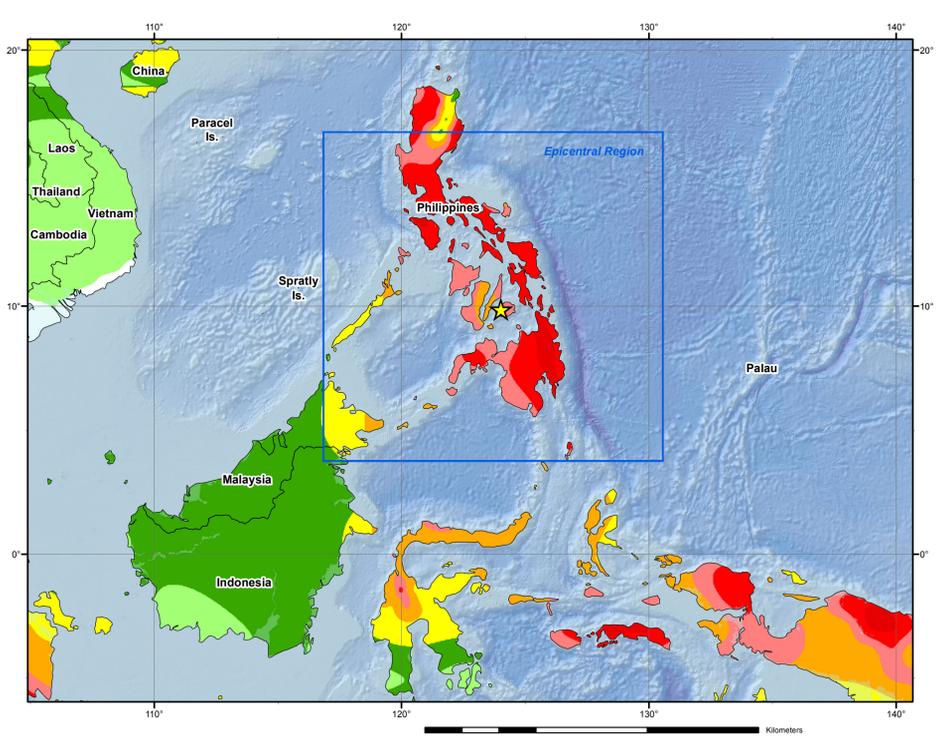
Tectonic Setting

Epicentral Region

Seismic Hazard

PAGER

Did You Feel It?

Finite Fault Model

EXPLANATION

Main Shock
☆

Mag ≥ 7.0
- 🔴 0 - 69 km
- 🟢 70 - 299
- 🔵 300 - 600

Plate Boundary
- Subduction
- Transform
- Divergent
- Others

Volcanoes
- 🔺

EXPLANATION

Earthquake Magnitude
- 5.50 - 5.99
- 6.00 - 6.99
- 7.00 - 7.99
- ≥ 8.00

Earthquake Depth (km)
- 🔴 0 - 69
- 🟢 70 - 299
- 🔵 ≥ 300

- ▲ Subduction
- Transform
- Divergent
- — — Others
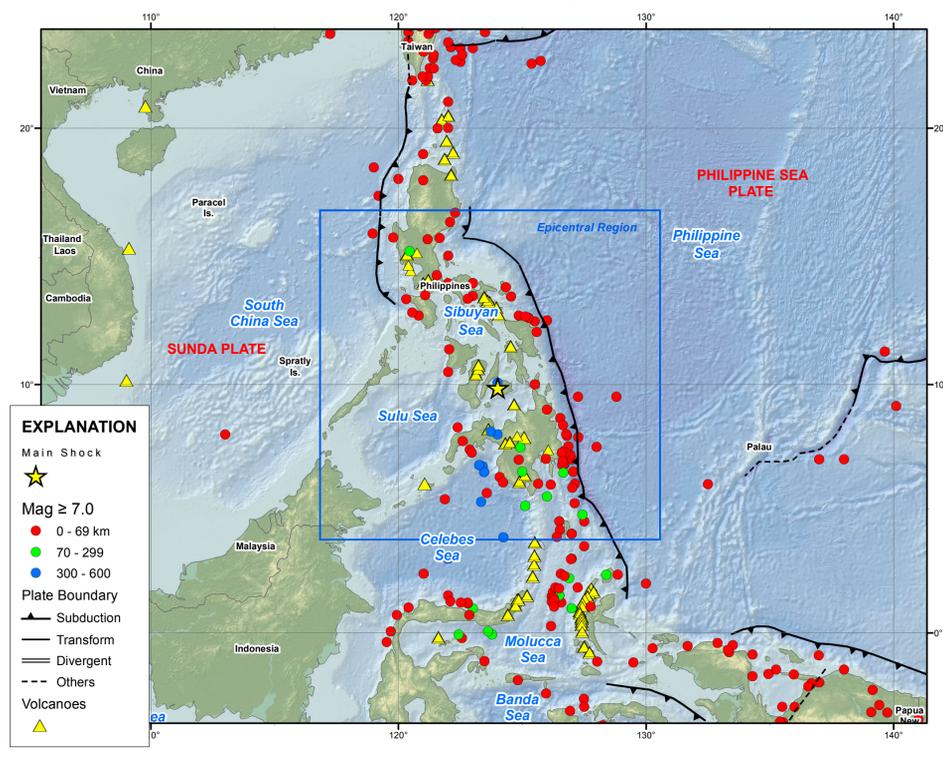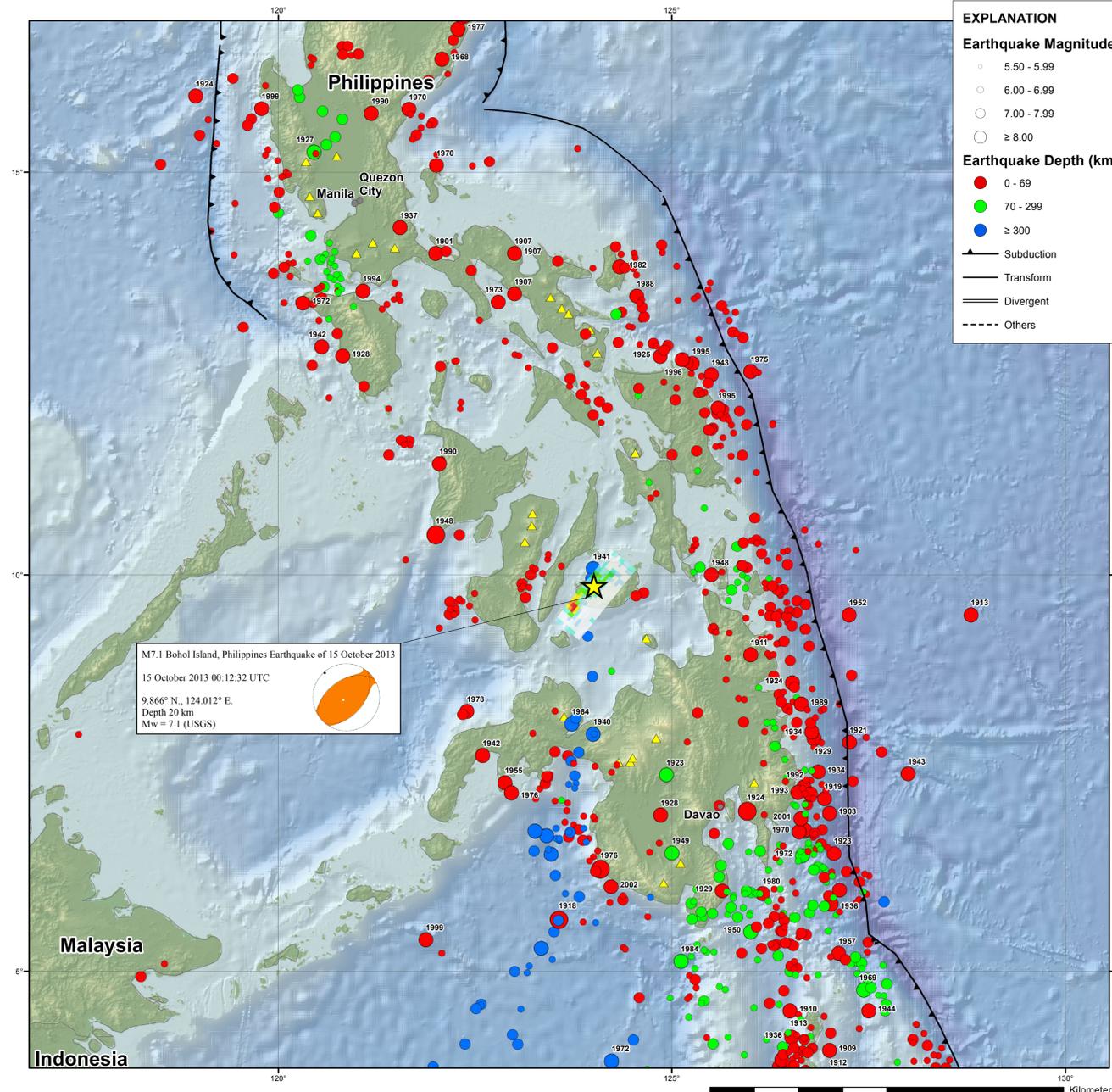
M7.1 Bohol Island, Philippines Earthquake of 15 October 2013

15 October 2013 00:12:32 UTC

9.866° N., 124.012° E.
Depth 20 km
Mw = 7.1 (USGS)

PHILIPPINE SEA PLATE

SUNDA PLATE

Philippines

Quezon
Manila City

Davao

Malaysia

Indonesia

Peak Ground Acceleration in m/sec**2

.2   .4   .8   1.6   2.4   3.2   4.0   4.8

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 15, 2013 M 7.1 earthquake near the city of Catigbian on Bohol Island, Philippines, occurred as the result of shallow reverse faulting on a moderately inclined fault dipping either to the northwest, or to the southeast. The depth of the event indicates it ruptured a fault within the crust of the Sunda plate, rather than on the deeper subduction zone plate boundary interface. At the latitude of this earthquake, the Philippine Sea plate moves towards the west-northwest with respect to the Sunda plate at a rate of approximately 10 cm/yr, subducting beneath the Philippine Islands several hundred kilometers to the east of the October 15 earthquake at the Philippine Trench.

The Philippine Islands straddle a region of complex tectonics at the intersection of three major tectonic plates (the Philippine Sea, Sunda and Eurasia plates). As such, the islands are familiar with large and damaging earthquakes, and the region within 500 km of the October 15 earthquake has hosted 19 events of M6 or greater, a dozen of which have been shallow (0-70 km). One of these, a M 6.8 earthquake 70 km to the east of the October 15, 2013 event in 1990, caused several casualties.
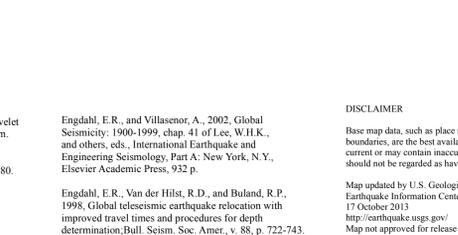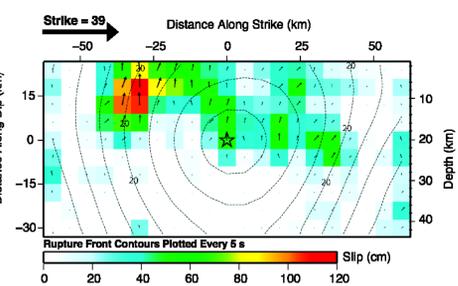
Significant Earthquakes Mag >= 7.1

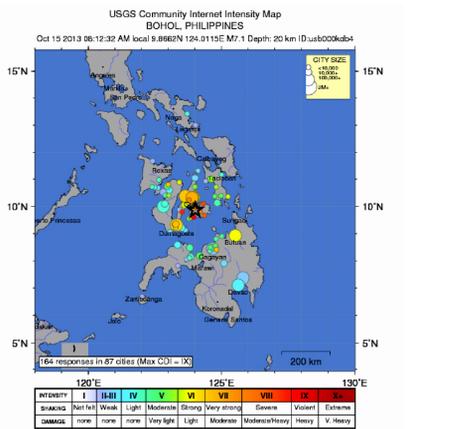| Year	Mon	Day	Time	Lat	Long	Dep	Mag
1903	12	28	0256	7.000	127.000	0	7.1
1907	04	18	2059	14.000	123.000	0	7.1
1909	04	25	2236	4.500	127.000	100	7.1
1910	12	16	1445	4.500	126.500	0	7.6
1911	07	12	0407	9.000	126.000	0	7.5
1911	12	15	0055	4.000	127.000	0	7.2
1913	03	14	0845	4.500	126.500	0	7.9
1913	03	24	1756	9.500	128.800	0	7.2
1918	02	07	0520	5.700	123.800	218	7.2
1918	08	15	1218	5.653	123.563	35	8.2
1919	01	01	0133	7.184	126.937	35	7.1
1921	11	11	1836	7.897	127.257	35	7.1
1923	03	02	1648	7.487	124.928	86.6	7.1
1924	04	14	1620	7.023	125.954	35	8.2
1924	08	30	0305	8.645	126.531	35	7.2
1925	11	13	1214	12.726	124.849	35	7.2
1927	04	19	1730	15.250	120.454	139	7.1
1929	05	12	1137	6.977	126.857	35	7.3
1929	06	04	1515	6.021	125.639	35	7.1
1936	01	09	1024	7.945	126.806	35	7.1
1934	04	15	2215	7.526	126.857	35	7.1
1936	04	01	0209	4.165	126.521	35	7.3
1937	05	07	1855	5.856	127.024	35	7.3
1937	08	20	1159	14.318	121.547	35	7.3
1942	04	08	1540	12.846	120.553	413	7.3
1942	10	20	2321	7.731	122.595	35	7.2
1943	05	03	0159	12.600	125.000	0	7.2
1943	05	25	2307	7.500	128.000	0	7.6
1948	01	24	1746	10.500	122.000	0	8.1
2009	04	30	0133	6.500	125.000	130	7.3
1946	03	03	1057	9.500	127.100	35	7.7
1952	03	31	1817	7.386	122.878	54.2	7.7
1957	09	24	0621	3.250	127.117	35	7.7
1968	08	01	2019	16.384	122.078	52.2	7.7
1969	01	30	1029	4.767	127.435	79.6	7.1
1970	01	10	1207	6.788	126.687	61.4	7.1
1970	03	30	1646	6.767	126.616	63.8	7.1
1970	04	07	0536	15.772	121.659	28.3	7.2
1971	02	08	0726	15.721	121.181	24.9	7.7
1972	01	11	1641	3.864	124.234	330	7.8
1972	12	02	0019	6.466	126.657	82.1	7.4
1975	10	31	0828	12.536	125.999	51.1	7.5
1976	08	16	1611	6.292	124.090	57.7	8.0
1977	03	18	0419	7.261	122.961	21.2	7.1
1977	03	18	2143	16.753	122.283	34	7.3
1982	01	11	0610	13.835	124.336	32.6	7.1
1984	03	05	0333	8.127	123.728	632	7.3
1984	11	20	0815	5.129	125.114	167	7.5
1988	02	24	0352	13.474	124.551	25	7.3
1989	12	15	1843	8.377	126.642	26.2	7.5
1990	06	14	0740	11.390	122.046	18.1	7.1
1990	07	16	0726	15.721	121.181	24.9	7.7
1991	05	01	0949	7.332	126.676	34.9	7.1
1992	05	17	1015	7.245	126.759	28.7	7.2
1994	11	14	1915	13.537	121.075	32	7.1
1995	04	21	0034	12.058	125.187	22.7	7.2
1995	05	05	0353	12.639	125.257	18.1	7.1
1996	06	11	1822	12.686	125.130	29.6	7.1
2001	01	01	0657	6.932	126.635	38.4	7.5
2002	03	05	2116	6.073	124.208	57.7	8.0
2005	02	05	1223	5.293	123.337	525	7.1
2010	07	23	2208	6.718	123.949	607	7.6
2010	07	23	2251	6.485	123.487	585	7.6
2010	07	23	2315	6.776	123.260	640	7.4
2013	10	15	0012	9.866	124.012	20	7.1

DATA SOURCES

EARTHQUAKES AND SEISMIC HAZARD
USGS, National Earthquake Information Center
NOAA, National Geophysical Data Center
IASPEI, Centennial Catalog (1900 - 1999) and extensions (Engdahl et al., 1998)
EHB catalog (Engdahl et al., 1998)
HDF (unpublished earthquake catalog, Engdahl, 2010)
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.

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.

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

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.

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

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.

Strike = 39

Distance Along Strike (km)

Rupture Front Contours Plotted Every 5 s

Slip (cm)
0   20   40   60   80   100   120

Did You Feel It?

USGS Community Internet Intensity Map
BOHOL, PHILIPPINES
Oct 15 2013 08:12:32 AM local 9.8662N 124.0115E M7.1 Depth: 20 km ID:usb000kdb4

INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+
SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	V. Heavy