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

M7.3, 7.6, and 7.4 Moro Gulf, Mindanao, Philippines, Earthquakes of 23 July 2010





Significant Earthquakes Mag >= 7.5										
Year M	on Day	Time	Lat	Long	Dep	Mag				
1905	01 22	0243	1.000	123.000	90	7.8				
1907	06 25	1754	1.000	127.000	200	7.5				
1910	12 16	1445	4.500	126.500	0	7.6				
1911	07 12	0407	9.000	126.000	0	7.5				
1913	03 14	0845	4.500	126.500	0	7.9				
1914	10 23	0618	6.000	132.500	0	7.6				
1918	08 15	1218	5.653	123.563	35	8.2				
1924	04 14	1620	7.023	125.954	35	8.2				
1932	05 14	1311	0.258	126.169	35	8.1				
1936	04 01	0209	4.165	126.521	35	7.7				
1938	05 19	1708	-0.366	119.525	49.4	7.5				
1939	12 21	2100	-0.208	122.565	35	7.8				
1943	05 25	2307	7.500	128.000	0	7.6				
1948	01 24	1746	10.500	122.000	0	8.1				
1952	03 19	1057	9.500	127.250	0	7.7				
1955	03 31	1817	7.386	122.878	54.2	7.7				
1957	09 24	0821	5.230	127.117	35	7.7				
1968	08 10	0207	1.422	126.260	19.6	7.6				
1972	06 11	1641	3.864	124.234	330	7.8				
1975	10 31	0828	12.536	125.999	51.1	7.5				
1976	08 16	1611	6.292	124.090	57.7	8.0				
1984	11 20	0815	5.129	125.114	167	7.5				
1986	08 14	1939	1.805	126.485	30.9	7.5				
1989	12 15	1843	8.377	126.642	26.2	7.5				
1990	04 18	1339	1.186	122.799	26	7.6				
1991	06 20	0518	1.226	122.789	32.5	7.5				
1996	01 01	0805	0.725	119.932	24	7.9				
2001	01 01	0657	6.932	126.635	38.4	7.5				
2007	01 21	1127	1.065	126.282	22	7.5				
2009	01 03	1943	-0.414	132.885	17	7.6				
2010	07 23	2251	6.470	123.532	584	7.6				

TECTONIC SUMMARY

The July 23, 2010 earthquakes in the Moro Gulf, south of Mindanao, Philippines, occurred within the inclined seismic zone defining the deep limit of the Molucca Sea micro plate beneath the Celebes Sea basin. Northeastern Indonesia and southern Philippines are characterized by complex tectonics in which motions of numerous small plates accommodate the large-scale convergence between the Philippine Sea and Sunda plates. In the region of today's earthquake, the Philippine Sea plate moves west-northwest with respect to the Sunda plate at a velocity that various models would place in the 60-110 mm/year range. Locally, arcarc collision is occurring between the Sangihe microplate and the Philippine Sea plate, wedging between them the Molucca Sea micro plate, which subducts beneath both (i.e. to the east and west) and forms an inverted-U-shaped seismic zone. At the latitude of the July 23 earthquakes, the top of the Molucca Sea microplate is at a depth of about 150 km beneath the earth's surface. Seismicity within the Molucca Sea micro plate is active to depths of approximately 260 km to the east and 650 km to the west. The tectonic setting of this region is unique in that it is the only global example of an active arc-arc collision consuming an oceanic basin via subduction in two directions.

The July 23rd events occurred in response to stresses generated by the slow distortion of the Molucca Sea micro plate at depth, rather than on the shallower interfaces with the overriding Sanglehe and Philippine Sea plates, active boundaries in this region near the earth's surface.

Earthquakes that have focal depths greater than 300 km are commonly termed "deep-focus" earthquakes. Deep-focus earthquakes cause less damage on the ground surface above their foci than is the case with similar magnitude shallow-focus earthquakes, but large deep-focus earthquakes may be felt at great distance from their epicenters. The largest recorded deepfocus earthquake had a magnitude of 8.2, and occurred deep beneath Bolivia in June 1994. Over the past 50 years, approximately 50 earthquakes with magnitudes of M7 or more have occurred at depths greater than 500 km; just two of these were located in the same region as today's events.

Depth Profile (from Hamilton, 1988)



EARTHOUAKE SUMMARY MAP XXX

Prepared in cooperation with the Global Seismographic Network

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≥USGS

M 7.6, MORO GULF, MINDANAO, PHILIPPINES Origin Time: Fri 2010-07-23 22:51:12 UTC Location: 6.47°N 123.53°E Depth: 583 k

Estimated Population Exposed to Earthquake Shaking									
ESTIMATED POPULATION EXPOSURE (k = x1000)	*	20,748k*	1 54k	0	0	0	0	0	0

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ESTIMATED MERCALLI	MODIFIED	I	11-111	IV	V	VI	VII	VIII	IX	X+
PERCEIVE	DSHAKING	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
	Vulnerable Structures	none	none	none	Light	Moderate	Moderate/Heavy	Heavy	V. Heavy	V. Heavy



Overall, the population in this region resides in structures that are a mix of vulnerable and earthquake resistant construction. A magnitude 8.0 earthquake 65 km East of this one struck Moro Gulf, Philippines on August 16, 1976 (UTC), with estimated population exposures of 1,484,000 at intensity VII and 2,888,000 at intensity VI, resulting in a reported 7,079 fatalities. Recent earthquakes in this area have caused tsunamis and landslides that may have contributed to losses

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Event ID: us2010zbca

Depth Profile (from data on Epicentral Map)





- 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)
- World Slap (Hayes and Wald, 2010) BASE MAP
- NIMA and ESRI, Digital Chart of the World USGS, EROS Data Center NOAA GEBCO and GLOBE Elevation Models

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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 prepared by U.S. Geological Survey National Earthquake Information Center 26 July 2010

Map not approved for release by Director USGS

