USGS science for a changing world

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

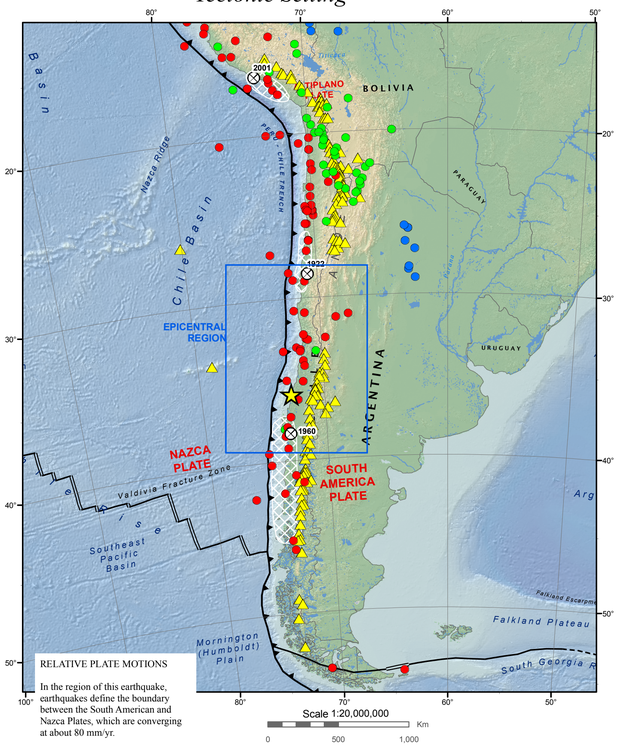
EARTHQUAKE SUMMARY MAP

M8.8 Maule, Chile, Earthquake of 27 February 2010

Prepared in cooperation with the Global Seismographic Network

GSN

Tectonic Setting



EXPLANATION

Great Rupture
- Year
- Area

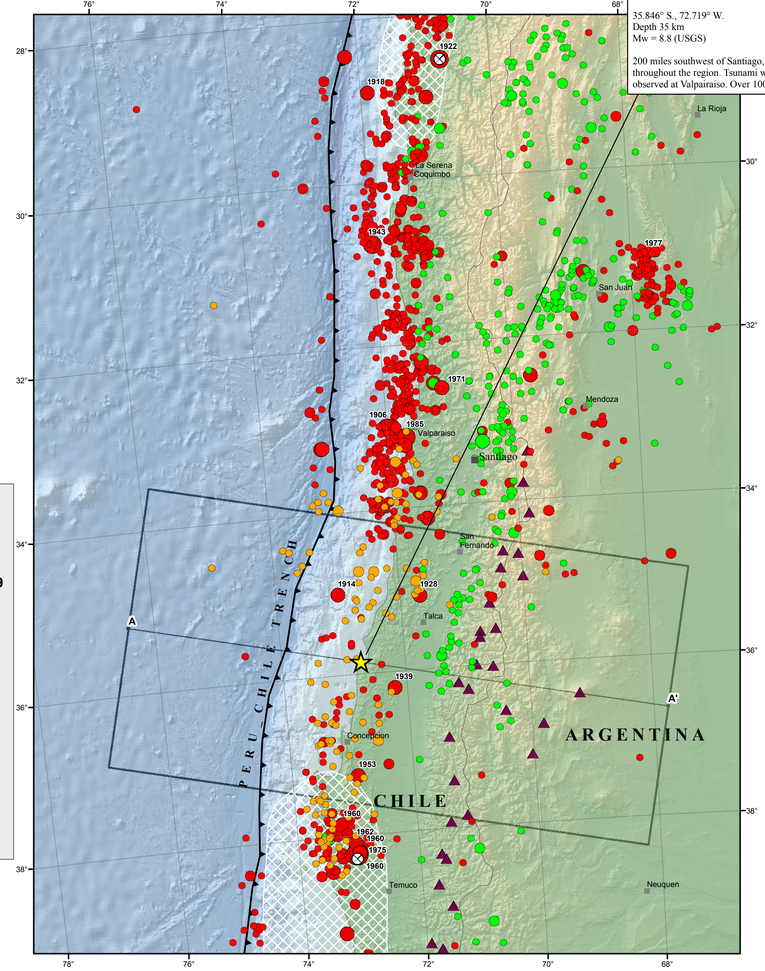
Mag ≥ 7.0
- 0 - 69 km
- 70 - 299
- 300 - 600

Plate Boundaries
- Subduction
- Transform
- Divergent
- Others
- Active Volcanoes

RELATIVE PLATE MOTIONS

In the region of this earthquake, earthquakes define the boundary between the South American and Nazca Plates, which are converging at about 80 mm/yr.

Epicentral Region



Offshore Maule, Chile

27 February 2010 6:34:14 UTC

35.846° S., 72.719° W.
Depth 35 km
Mw = 8.8 (USGS)

200 miles southwest of Santiago, Chile, Intensity VIII-IX felt throughout the region. Tsunami with wave height up to 2.5 m observed at Valparaiso. Over 1000 people killed.

EXPLANATION
- Main Shock
- Aftershocks (42 hours)

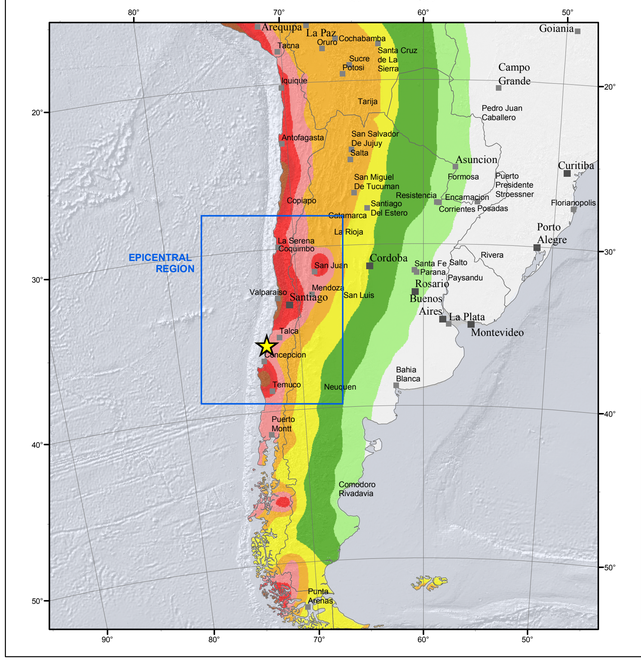
Earthquakes 1900 - 2009
- M 4.00 - 5.99
- M 6.00 - 6.99
- M 7.00 - 7.99
- M >= 8.00

Earthquake Depth
- 0 - 69
- 70 - 299
- 300 - 700

Great Rupture
- Year
- Area
- Active Volcanoes

Note on earthquakes: From 1900 - 1963, earthquakes shown are from Centennial Catalog, magnitudes greater than 5.5. From 1964 - 2002, earthquakes are from HDF catalog, magnitudes greater than 4.5. From 2003 to present, earthquakes are from NEIC, magnitudes greater than 4.5.

Seismic Hazard



Peak Ground Acceleration m/sec2**

.2
.4
.8
1.6
2.4
3.2
4.0
4.8
9.8

TECTONIC SUMMARY

This earthquake occurred at the boundary between the Nazca and South American tectonic plates. The two plates are converging at a rate of 80 mm per year. The earthquake occurred as thrust-faulting on the interface between the two plates, with the Nazca plate moving down and landward below the South American plate.

Coastal Chile has a history of very large earthquakes. Since 1973, there have been 13 events of magnitude 7.0 or greater. The February 27 shock originated about 230 km north of the source region of the magnitude 9.5 earthquake of May, 1960 – the largest instrumentally recorded earthquake in the world. This magnitude 9.5 earthquake killed 1655 people in southern Chile and unleashed a tsunami that crossed the Pacific, killing 61 people in Hawaii, Japan, and the Philippines.

Approximately 870 km to the north of the February 27 earthquake is the source region of the magnitude 8.5 earthquake of November, 1922. This great quake significantly impacted central Chile, killing several hundred people and causing severe property damage. The 1922 quake generated a 9-meter local tsunami that inundated the Chile coast near the town of Coquimbo; the tsunami also crossed the Pacific, washing away boats in Hilo harbor, Hawaii. The magnitude 8.8 earthquake of February 27, 2010 ruptured the portion of the South American subduction zone separating these two massive historical earthquakes.

A large vigorous aftershock sequence can be expected from this earthquake.

Significant Earthquakes Mag >= 7.5

Year	Mon	Day	Time	Lat	Long	Dep	Mag
1906	08	17	0040	-33.000	-72.000	0	8.2
1914	01	30	0336	-35.000	-73.000	0	7.5
1928	12	01	0406	-35.086	-71.683	35	7.7
1939	01	25	0332	-36.200	-72.200	0	7.7
1943	04	06	1607	-30.750	-72.000	0	8.2
1953	05	06	1716	-37.254	-72.920	68.4	7.5
1960	05	21	1002	-37.872	-73.243	35	8.2
1960	05	22	1856	-38.147	-72.984	35	7.9
1960	05	22	1911	-38.235	-73.047	35	9.5
1962	02	14	0636	-38.091	-73.050	32.9	7.5
1971	07	09	0303	-32.558	-71.085	59	7.8
1975	05	10	1427	-38.215	-72.999	28	7.7
1977	11	23	0926	-31.083	-67.778	18.3	7.5
1985	03	03	2247	-33.132	-71.708	40	8.0

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GSN USAID FROM THE AMERICAN PEOPLE

M 8.8, OFFSHORE MAULE, CHILE

Origin Time: Sat 2010-02-27 06:34:14 UTC
Location: 35.85°S 72.72°W Depth: 35 km

PAGER
Version 6

Created: 9 hours, 10 minutes after earthquake

Estimated Population Exposed to Earthquake Shaking

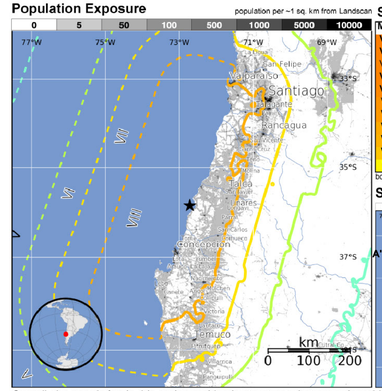
ESTIMATED POPULATION EXPOSURE (k = x1000)		- -*	- -*	454k*	1,667k*	527k*	7,578k	5,124k	0	0
ESTIMATED MODIFIED MERCALLI INTENSITY		I	II-III	IV	V	VI	VII	VIII	IX	X+
PERCEIVED SHAKING		Not felt	Weak	Light	Moderate	Strong	Very Strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	Resistant Structures	none	none	none	V. Light	Light	Moderate	Moderate/Heavy	Heavy	V. Heavy
	Vulnerable Structures	none	none	none	Light	Moderate	Moderate/Heavy	Heavy	V. Heavy	V. Heavy

*Estimated exposure only includes population within the map area.

Population Exposure

population per ~1 sq. km from Landscan

0	5	50	100	500	1000	5000	10000

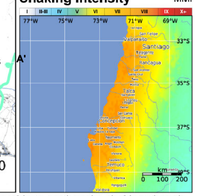


Selected City Exposure

MMI	City	Population
VIII	Araucо	25k
VIII	Lota	50k
VIII	Constitucion	38k
VIII	Concepcion	215k
VIII	Canete	20k
VII	Melipilla	63k
VII	Talca	197k
VII	Rancagua	213k
VII	Temuco	238k
VII	Santiago	4,837k
VI	Valparaiso	282k

bold cities appear on map (k = x1000)

Shaking Intensity MMI



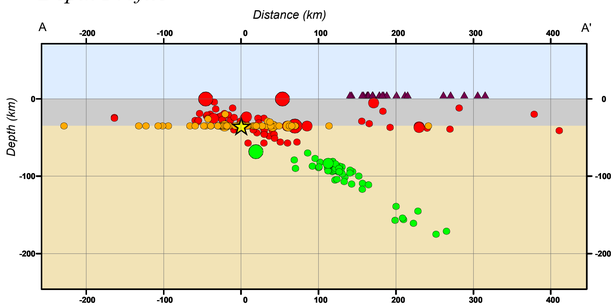
Overall, the population in this region resides in structures that are vulnerable to earthquake shaking, though some resistant structures exist. On May 22, 1960 (UTC), a magnitude 9.5 earthquake 273 km South of this one struck Valdivia, Chile, with estimated population exposures of 230,000 at intensity VIII and 216,000 at intensity IX , resulting in a reported 3263 deaths from the earthquake and tsunami. Recent earthquakes in this area have caused tsunamis, landslides, and liquefaction that may have contributed to losses.

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

http://earthquake.usgs.gov/pager

Event ID: us2010tfan

Depth Profile



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)

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.

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
1 March 2010
Map not approved for release by Director USGS