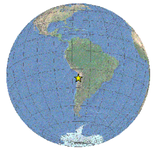
U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

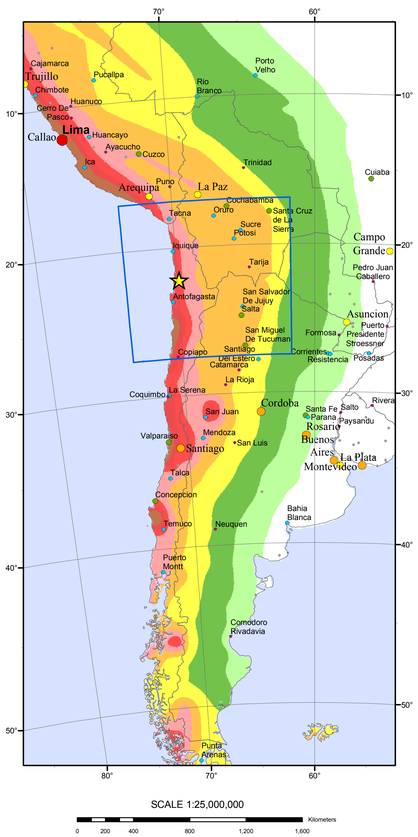
M7.7 Northern Chile, Earthquake of 14 November 2007



Prepared in cooperation with the Global Seismographic Network

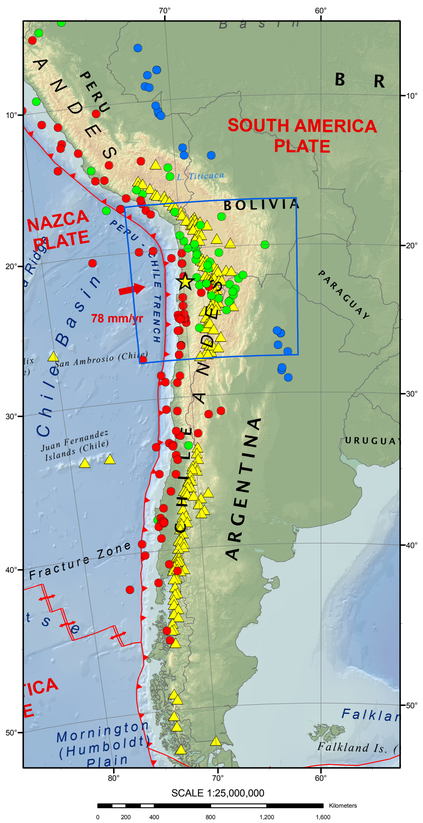
GSN

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 Setting



RELATIVE PLATE MOTIONS

The large red vectors indicate the relative motions of the Nazca and South America Plate. The motion of the Nazca Plate is generally eastward with respect to South America and produces large subduction earthquakes, volcanoes, and tsunamis.

EXPLANATION

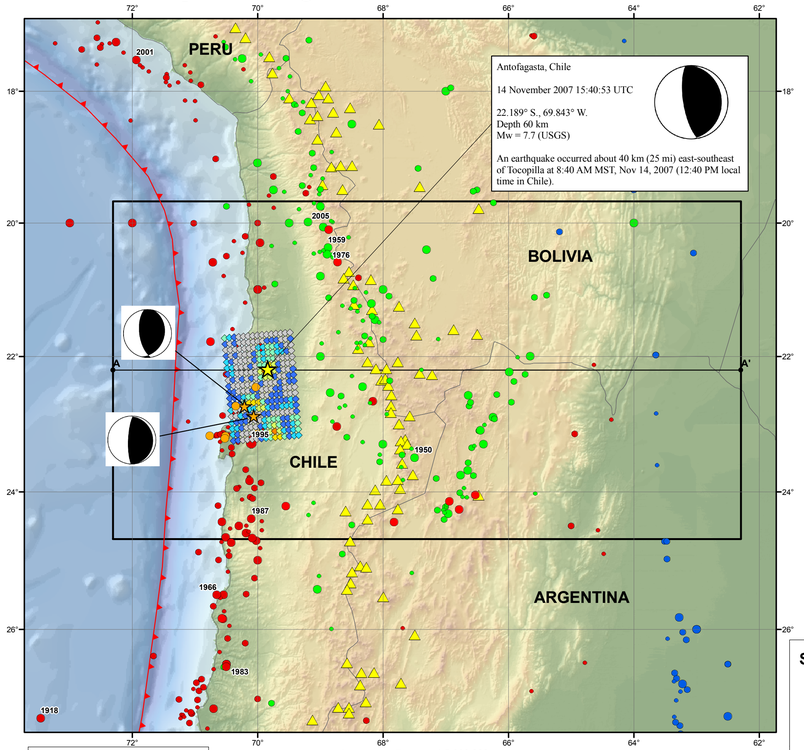
Mag >= 7.0

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

Plate Boundary

- Subduction
- Transform
- Divergent
- Convergent

Epicentral Region



EXPLANATION

- Main Shock

Aftershocks

- M 5 - 5.9
- M 6 - 6.8

Earthquake Magnitude

- 4.0 - 5.9
- 6.0 - 6.9
- 7.0 - 7.9
- 8.0 - 8.9
- 9.0 - 9.9

Earthquake Depth

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

Slip (cm)

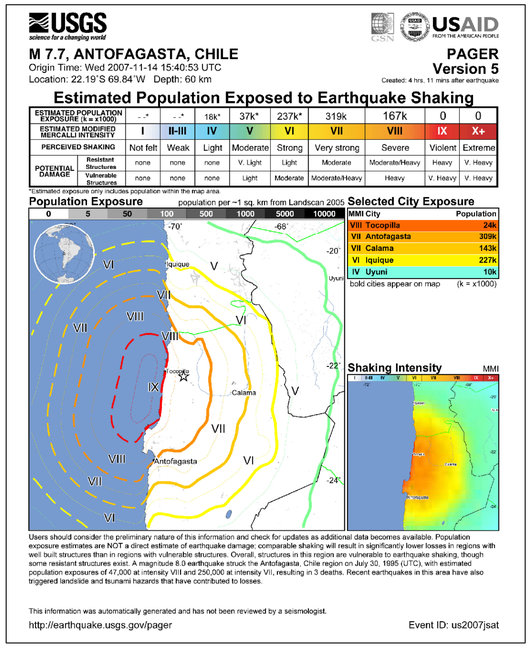
- 50
- 100
- 150
- 200
- 250
- 300
- 350
- 400

DISCUSSION

This earthquake resulted from the release of stresses that were generated by the subduction of the oceanic Nazca plate beneath the South American plate. In this region, known as the Peru-Chile subduction zone, ongoing subduction occurs at a rate of about 7.8 cm/year in an east-north-east direction. The subduction process generates numerous earthquakes and volcanism, and actively builds the Andes mountains. Subduction zones produce the biggest earthquakes on the planet. The largest earthquake of the past 100 years, the magnitude 9.5 1960 Chilean earthquake, occurred in the Peru-Chile subduction zone. The 1960 Chilean earthquake ruptured a 900-km long swath along the Chilean coast about 2000 km to south of the 13 June 2005 earthquake.

Significant Earthquakes Mag ≥ 7.5

Year	Mon	Day	Time	Lat	Long	Dep	Mag
1913	08	06	2214	-17.000	-74.000	0	7.8
1918	12	04	1147	-27.275	-73.464	25	7.5
1922	10	11	1450	-16.125	-72.385	160	7.6
1922	11	11	0432	-28.553	-70.755	35	8.7
1950	12	09	2138	-23.500	-67.500	100	7.7
1959	06	14	0012	-20.369	-68.881	111	7.5
1960	01	13	1540	-15.814	-72.788	95.4	7.5
1966	12	28	0818	-25.502	-70.655	30	7.7
1976	11	30	0041	-20.472	-68.893	133	7.6
1983	10	04	1852	-26.539	-70.503	24.6	7.7
1987	03	05	0917	-24.395	-70.102	45.3	7.6
1995	07	30	0511	-23.285	-70.103	46	8.0
2001	06	23	2033	-16.305	-73.550	29.8	8.4
2001	07	07	0938	-17.522	-71.938	17.4	7.6
2005	06	13	2244	-19.987	-69.197	115	7.8



USGS science for a changing world — USAID FROM THE AMERICAN PEOPLE

M 7.7, ANTOFAGASTA, CHILE
Origin Time: Wed 2007-11-14 15:40:53 UTC
Location: 22.19°S 69.84°W Depth: 60 km

PAGER
Version 5
Created: 4 hrs, 11 mins after earthquake

Estimated Population Exposed to Earthquake Shaking

ESTIMATED POPULATION EXPOSURE (k = x1000)		-.-*	-.-*	18k*	37k*	237k*	319k	167k	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 2005

Selected City Exposure

MMI	City	Population
VIII	Tocopilla	24k
VII	Antofagasta	309k
VII	Calama	143k
VI	Iquique	227k
IV	Uyuni	10k

bold cities appear on map (k = x1000)

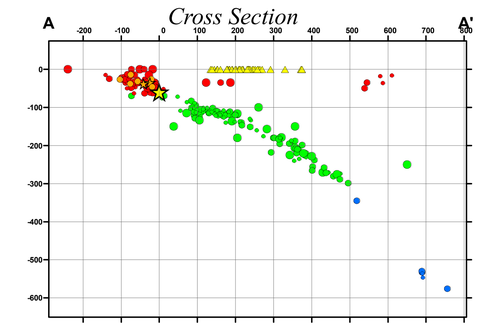
Shaking Intensity MMI

Users should consider the preliminary nature of this information and check for updates as additional data becomes available. Population exposure estimates are NOT a direct estimate of earthquake damage; comparable shaking will result in significantly lower losses in regions with well built structures than in regions with vulnerable structures. Overall, structures in this region are vulnerable to earthquake shaking, though some resistant structures exist. A magnitude 8.0 earthquake struck the Antofagasta, Chile region on July 30, 1995 (UTC), with estimated population exposures of 47,000 at intensity VIII and 250,000 at intensity VII, resulting in 3 deaths. Recent earthquakes in this area have also triggered landslide and tsunami hazards that have contributed to losses.

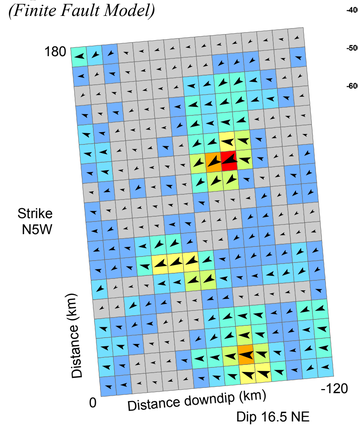
This information was automatically generated and has not been reviewed by a seismologist.

http://earthquake.usgs.gov/pager Event ID: us2007jsat

Cross Section



Slip Distribution
(Finite Fault Model)



FINITE FAULT MODEL
Contributed by
Yuehua Zeng and Gavin Hayes (NEIC), and Chen Ji (UCSB)

Distribution of the amplitude and direction of slip for subfault elements (small rectangles) of the fault rupture model are determined from the inversion of teleseismic body waveforms. Arrows indicate the amplitude and direction of slip (of the hanging wall with respect to the foot wall); the slip amount is also color-coded as shown. The view of the rupture plane is from above.

The strike of the fault rupture plane is N5W and the dip is 16 NE. The dimensions of the subfault elements are 10 km in the strike direction and 8 km in the dip direction. The rupture surface is 180 km along strike, and 120 km downdip. The depth of the rupture surface is about 55 km.

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)
Finite Fault Model, Chen Ji, UC Santa Barbara (2007)

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
15 November 2007
Map not approved for release by Director USGS