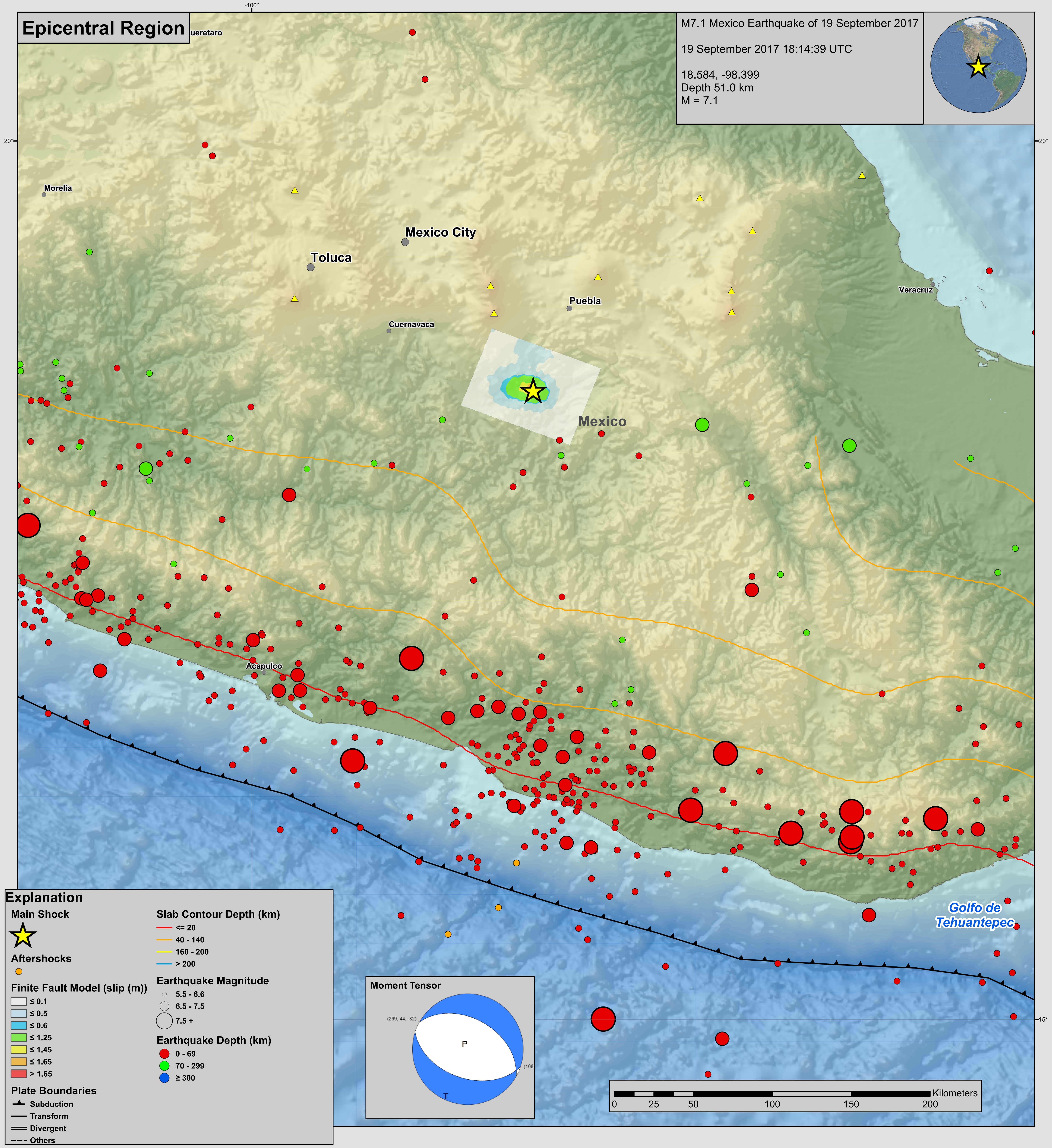
USGS science for a changing world
U.S. Department of the Interior
U.S. Geological Survey

M7.1 Mexico Earthquake of September 19, 2017

Earthquake Summary Map prepared in cooperation with the Global Seismographic Network
GSN

Epicentral Region



Tectonic Summary

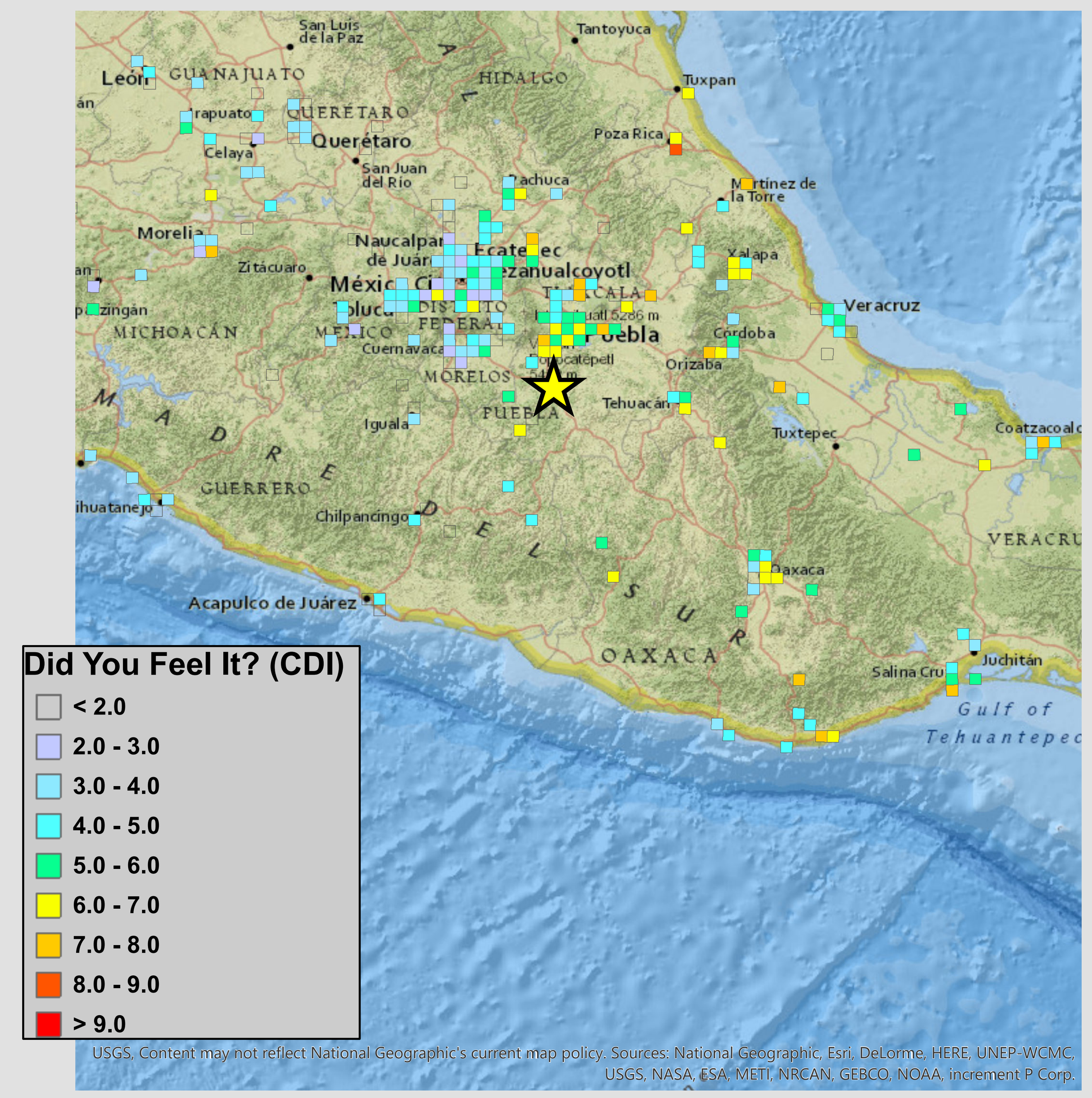
The September 19, 2017, M 7.1 earthquake in Central Mexico occurred as the result of normal faulting at a depth of approximately 50 km. Focal mechanism solutions indicate that the earthquake occurred on a moderately dipping fault, striking either to the southeast, or to the northwest. The event is near, but not directly on, the plate boundary between the Cocos and North America plates. In the region of this event, the Cocos plate converges with North America at a rate of approximately 76 mm/yr, in a northeast direction. The Cocos plate begins its subduction beneath Central America at the Middle America Trench, about 300 km to the southwest of this earthquake. The location, depth, and normal-faulting mechanism of this earthquake indicate that it is likely an intraplate event, within the subducting Cocos slab, rather than on the shallower megathrust plate boundary interface.

While commonly plotted as points on maps, earthquakes of this size are more appropriately described as slip over a larger fault area. Normal-faulting events of the size of the September 19th, 2017 earthquake are typically about 50x20 km (length x width).

Over the preceding century, the region within 250 km of the hypocenter of the September 19th, 2017 earthquake has experienced 19 other M 6.5+ earthquakes. Most occurred near the subduction zone interface at the Pacific coast, to the south of the September 19 event. The largest was a M 7.6 earthquake in July 1957, in the Guerrero region, which caused between to 50-160 fatalities, and many more injuries. In June 1999, a M 7.0 at 70 km depth, just to the southeast of the September 19, 2017 earthquake, caused 14 fatalities, around 200 injuries, and considerable damage in the city of Puebla (MMI VIII).

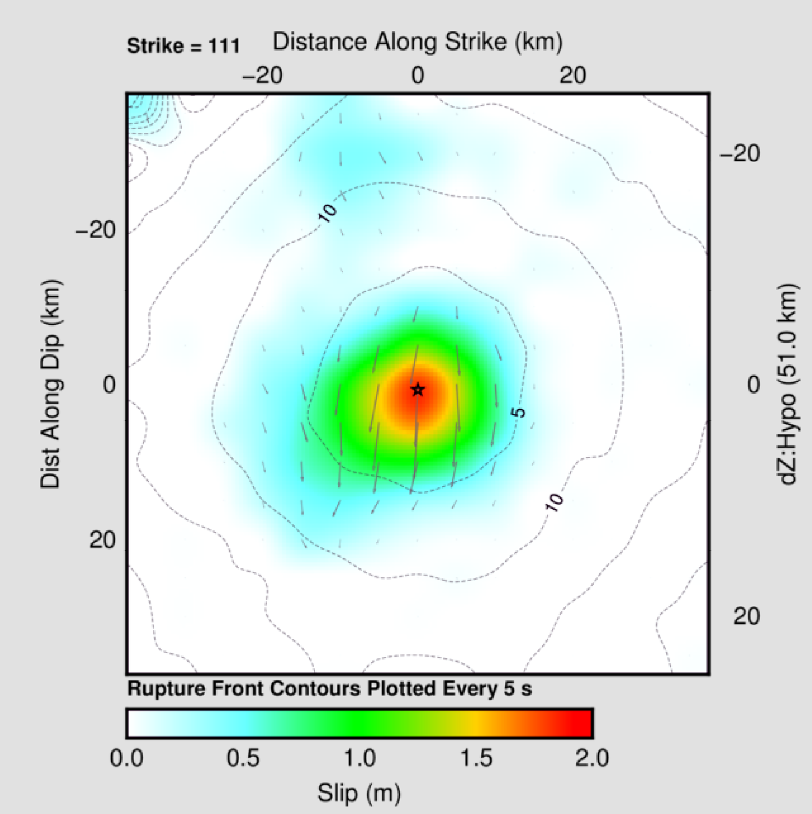
Today is the anniversary of the devastating 1985 M 8.0 Michoacan earthquake, which caused extensive damage to Mexico City and the surrounding region. That event occurred as the result of thrust faulting on the plate interface between the Cocos and North America plates, about 450 km to the west of the September 19, 2017 earthquake. Today's earthquake also occurs 12 days after a M 8.1 earthquake offshore of Chiapas, in southern Mexico. The epicenter of the M 8.1 event is located about 650 km to the southeast of today's quake. That earthquake also occurred as the result of normal faulting within the subducting Cocos Plate, at a depth of 50-70 km.

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 fault rupture plane is from above. The strike of the fault rupture plane is 111° and the dip is 42°SSW. The dimensions of the subfault elements are 5 km in the strike direction and 5 km in the dip direction. The rupture surface is approximately 40 km along strike and 40 km along downdip. The seismic moment release based upon this plane is 5.7e+26 dyne.cm.



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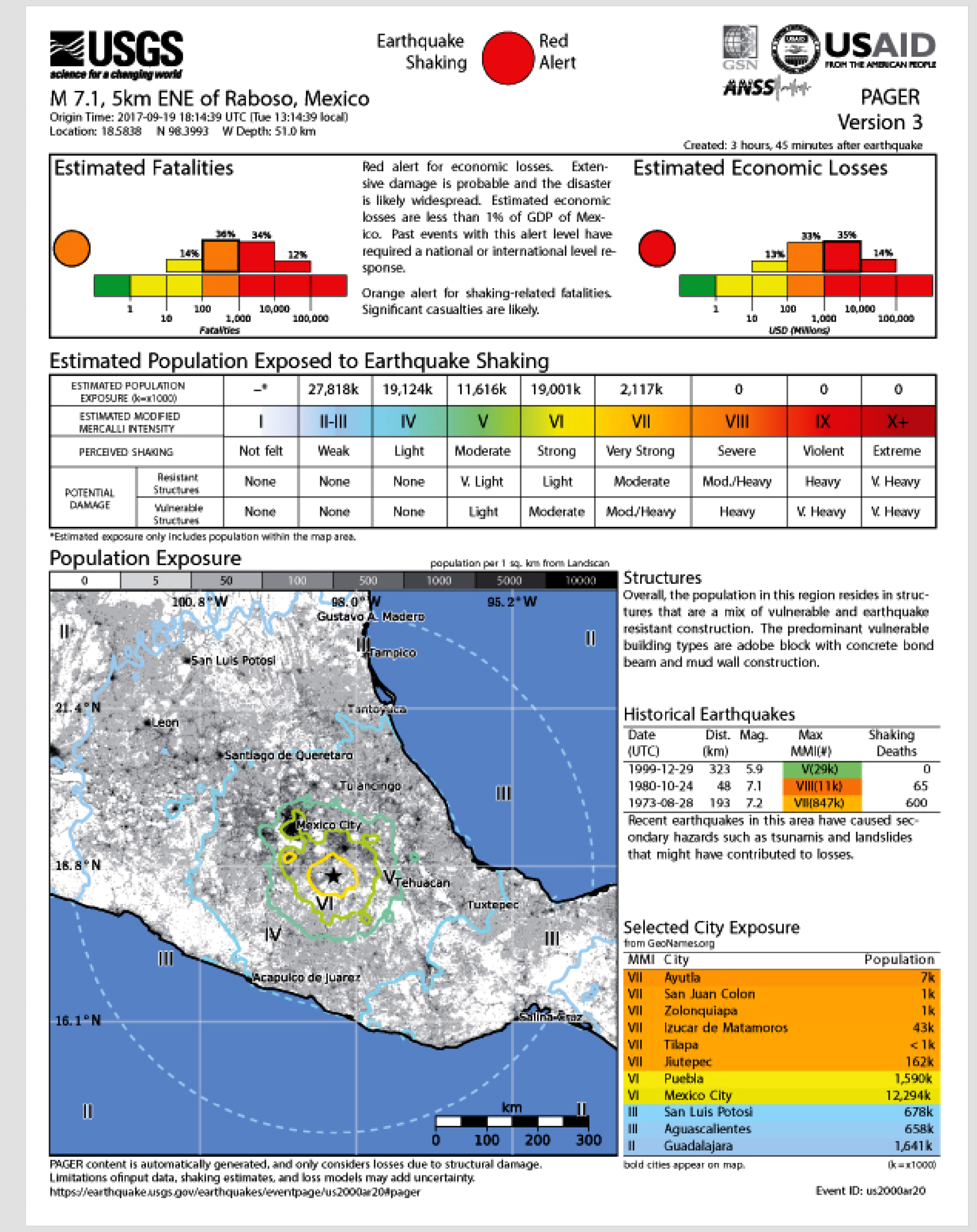


USGS science for a changing world — Earthquake Shaking Red Alert — GSN — USAID FROM THE AMERICAN PEOPLE — ANSS

M 7.1, 5km ENE of Raboso, Mexico
Origin Time: 2017-09-19 18:14:39 UTC (Tue 13:14:39 local)
Location: 18.5838 N 98.3993 W Depth: 51.0 km

PAGER Version 3
Created: 3 hours, 45 minutes after earthquake

Estimated Fatalities

14% 36% 34% 12%
1 10 100 1,000 10,000 100,000
Fatalities

Red alert for economic losses. Extensive damage is probable and the disaster is likely widespread. Estimated economic losses are less than 1% of GDP of Mexico. Past events with this alert level have required a national or international level response.

Orange alert for shaking-related fatalities. Significant casualties are likely.

Estimated Economic Losses

13% 33% 35% 14%
1 10 100 1,000 10,000 100,000
USD (Millions)

Estimated Population Exposed to Earthquake Shaking

ESTIMATED POPULATION EXPOSURE (k=x1000)		--*	27,818k	19,124k	11,616k	19,001k	2,117k	0	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	Mod./Heavy	Heavy	V. Heavy
	Vulnerable Structures	None	None	None	Light	Moderate	Mod./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

100.8°W 98.0°W 95.2°W 21.4°N 18.8°N 16.1°N Gustavo A. Madero, San Luis Potosi, Tampico, Tantoyuca, Leon, Santiago de Queretaro, Tulancingo, Mexico City, Tehuacan, Tuxtepec, Acapulco de Juarez, Salina Cruz; km 0 100 200 300

Structures

Overall, the population in this region resides in structures that are a mix of vulnerable and earthquake resistant construction. The predominant vulnerable building types are adobe block with concrete bond beam and mud wall construction.

Historical Earthquakes

Date (UTC)	Dist. (km)	Mag.	Max MMI(#)	Shaking Deaths
1999-12-29	323	5.9	V(29k)	0
1980-10-24	48	7.1	VIII(11k)	65
1973-08-28	193	7.2	VII(847k)	600

Recent earthquakes in this area have caused secondary hazards such as tsunamis and landslides that might have contributed to losses.

Selected City Exposure
from GeoNames.org

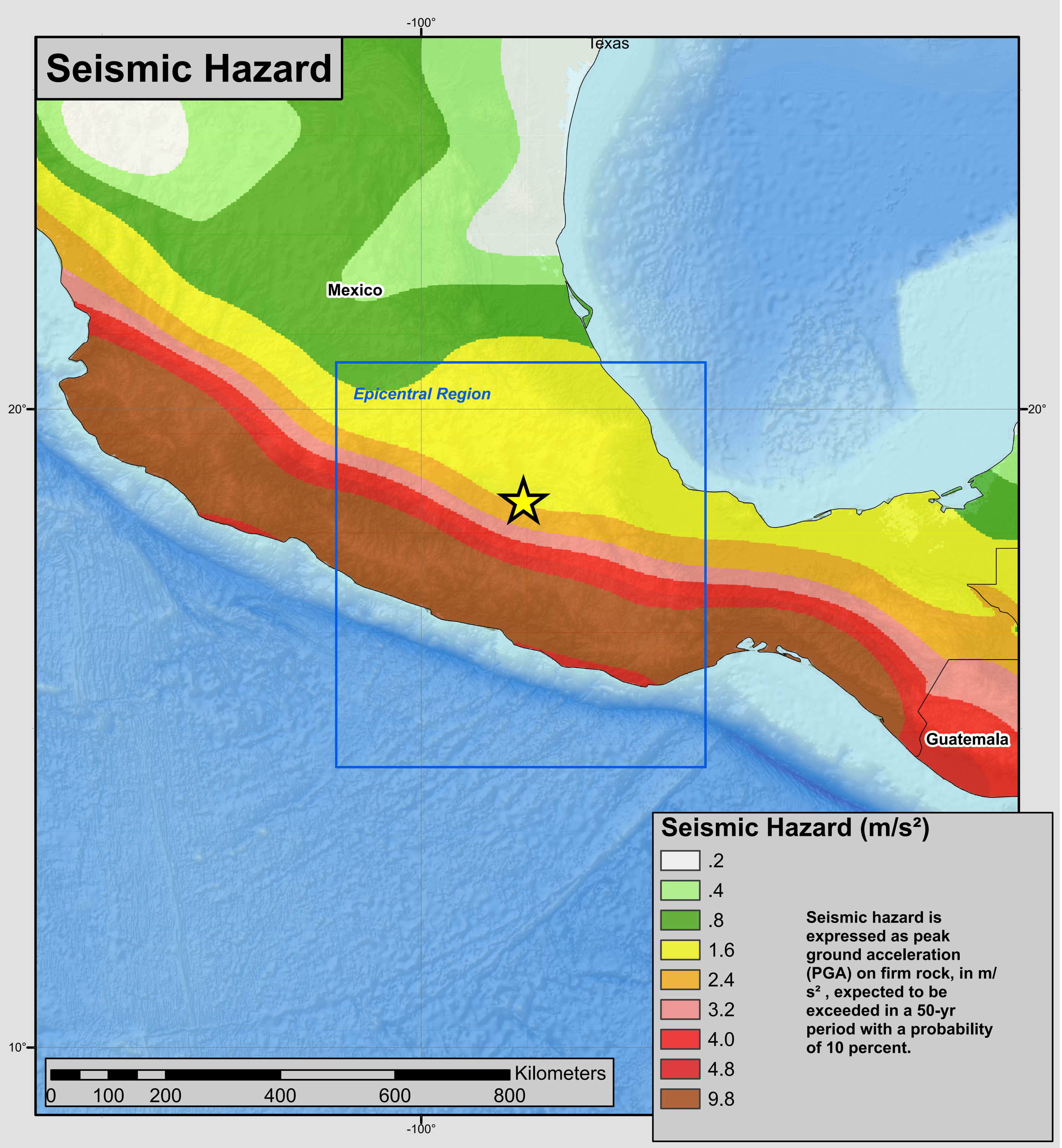
MMI	City	Population
VII	Ayutla	7k
VII	San Juan Colon	1k
VII	Zolonquiapa	1k
VII	Izucar de Matamoros	43k
VII	Tilapa	< 1k
VII	Jiutepec	162k
VI	Puebla	1,590k
VI	Mexico City	12,294k
III	San Luis Potosi	678k
III	Aguascalientes	658k
II	Guadalajara	1,641k

bold cities appear on map. (k = x1000)

PAGER content is automatically generated, and only considers losses due to structural damage. Limitations of input data, shaking estimates, and loss models may add uncertainty.
https://earthquake.usgs.gov/earthquakes/eventpage/us2000ar20#pager

Event ID: us2000ar20

Seismic Hazard



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
Volcanoes of the World (Siebert and Simkin, 2002)

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.

Map updated by U.S. Geological Survey National Earthquake Information Center
21 September 2017
http://earthquake.usgs.gov/
Map not approved for release by Director USGS