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Seismicity of the Earth 1900–2010
Mexico and vicinity

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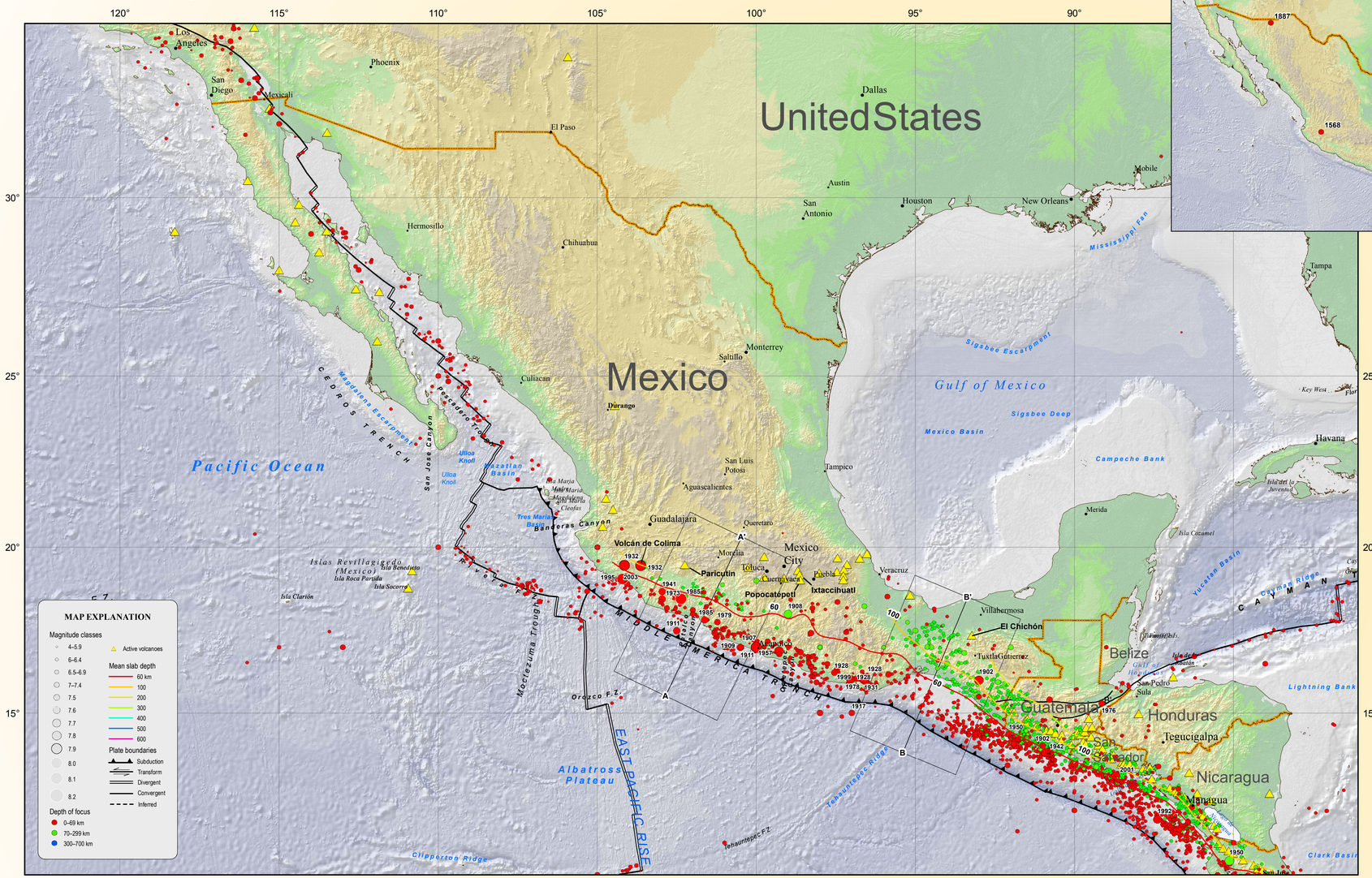


PRE-INSTRUMENTAL SEISMICITY 1500–1899
Events causing deaths

MAP EXPLANATION

Magnitude classes
4–5.9
6–6.4
6.5–6.9
7–7.4
7.5
7.6
7.7
7.8
7.9
8.0
8.1
8.2

Active volcanoes

Mean slab depth
60 km
100
200
300
400
500
600

Plate boundaries
Subduction
Transform
Divergent
Convergent
Inferred

Depth of focus
0–69 km
70–299 km
300–700 km

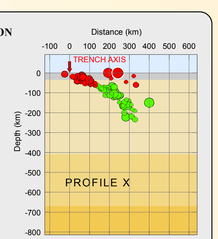
Universal Transverse Mercator Projection

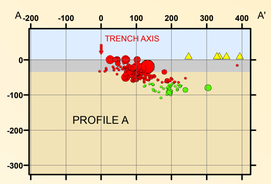
Scale 1:8 000 000
0 100 200 300 400 500 600 700 800 Kilometers

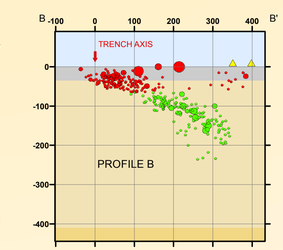
Digital map database and cartography by Susan Rhea and Art Tarr
Manuscript approved for publication Month Day, 2011

DEPTH PROFILE EXPLANATION

Profiles of earthquake and volcano locations are constructed from the mapped data. Locations of the profile intersection with the surface are drawn in the map and labeled to coincide with the profile label. Box defines extent of earthquakes included in the profile. Length of the profile graphic is the same as in the map. Distance in kilometers from the trench axis is indicated in the X direction, depth in kilometers is indicated in the Y direction. There is no vertical exaggeration. See Explanation at side for color key. Not all earth layers, earthquake depths or magnitude, are visible on every profile.







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TECTONIC SUMMARY

Located atop three of the large tectonic plates, Mexico is one of the world's most seismologically active regions. The relative motion of these crustal plates causes frequent earthquakes and occasional volcanic eruptions

Most of the Mexican landmass is on the westward moving North American plate. The Pacific Ocean floor south of Mexico is being carried northeastward by the underlying Cocos plate. Because oceanic crust is relatively dense, when the Pacific Ocean floor encounters the lighter continental crust of the Mexican landmass, the ocean floor is subducted beneath the North American plate creating the deep Middle American trench along Mexico's southern coast. Also as a result of this convergence, the westward moving Mexico landmass is slowed and crumpled creating the mountain ranges of southern Mexico and earthquakes near Mexico's southern coast. As the oceanic crust is pulled downward, it melts; the molten material is then forced upward through weaknesses in the overlying continental crust. This process has created a region of volcanoes across south-central Mexico known as the Cordillera Neovolcánica.

The area west of the Gulf of California, including Mexico's Baja California Peninsula, is moving northwestward with the Pacific plate at about 95 mm per year. Here, the Pacific and North American plates grind past each other creating strike-slip faulting, the southern extension of California's San Andreas fault. In the past, this relative plate motion pulled Baja California away from the coast forming the Gulf of California and is the cause of earthquakes in the Gulf of California region today.

Mexico has a long history of destructive earthquakes and volcanic eruptions. In September 1985, a magnitude 8.1 earthquake killed more than 9,500 people in Mexico City. In southern Mexico, Volcán de Colima and El Chichón erupted in 2005 and 1982, respectively. Paricutin volcano, west of Mexico City, began venting smoke in a cornfield in 1943; a decade later this new volcano had grown to a height of 424 meters. Popocatépetl and Ixtaccihuatl volcanos ("smoking mountain" and "white lady," respectively), southeast of Mexico City, occasionally vent gas that can be clearly seen from the City, a reminder that volcanic activity is ongoing. In 1994 and 2000 Popocatépetl renewed its activity forcing the evacuation of nearby towns, causing seismologists and government officials to be concerned about the effect a large-scale eruption might have on the heavily populated region. Popocatépetl volcano last erupted in 2010.

DATA SOURCES AND MAP DISPLAY

The earthquake locations shown on the main map (left) and on the depth profiles (lower left) are taken from the global 1900–2007 Centennial catalog (Engdahl and Villaseñor, 2002) and a catalog of high-quality depth determinations for the period 1964–2002 (Engdahl, personal comm., 2003) .

Major earthquakes (7.5≤M≤8.2) are labeled with the year of occurrence, while earthquakes (8.0≤M≤8.2) are labeled with the year of occurrence and also denoted by a white outline.

The Seismic Hazard and Relative Plate Motion map (below) shows the generalized seismic hazard (Giardini and others, 1999) and relative plate motion vectors (open arrows with labels; DeMets and others, 1994).

The pre-instrumental seismicity map (upper left) shows approximate locations of events based on macro-seismic reports and field investigations (NOAA National Geophysical Data Center database of significant earthquakes, 2010). These are earthquakes for which deaths were reported.

Base map data sources include GEBCO 2008 shaded relief, Volcanoes of the World dataset (Siebert and Simkin, 2002), plate boundaries (Bird, 2003), and geographic information from Digital Chart of the World (ESRI, (2002). Subduction slab contours are colored and labeled as to depth (Hayes and Wald, 2010).

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Seismic Hazard and Relative Plate Motion

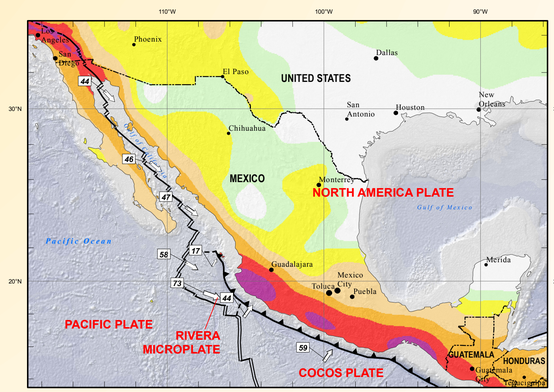

FIGURE EXPLANATION

Peak ground acceleration
0–0.2 m/s²
0.2–0.4
0.4–0.8
0.8–1.6
1.6–3.2
3.2–6.4
6.4–9.8

Relative plate motion
11.0–19.9 mm/yr
20.0–39.9
40.0–59.9
60.0–79.9
80.0–100.0

Plate boundaries
Subduction
Transform
Divergent
Convergent
Inferred