Earthquakes: From New Mexico and Beyond

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Before and After January 12, 2010 Earthquake
Presidential Palace in Port-au-Prince, Haiti

Earthquake damage – 2010 Chile earthquake
Why did these happen?

• Earthquakes happen everyday all over the world

• Specifics of the size and location of this earthquake are driven by large scale processes impacting entire planet

• PLATE TECTONICS
Plate Tectonics

- Earth’s surface composed of rigid plates
- Move over time due to slow convection of Earth’s interior
- Edges of plates grind past each other - causing earthquakes
- Also important for volcanic eruptions, atmosphere composition
Types of Earthquakes

Earthquakes occur at plate boundaries.
The motion of plates dictates the type of earthquake motion.
Where do earthquakes occur?
Magnitude 7.0 Haiti Earthquake
January 12, 2010

Occurred on plate boundary between North American and Caribbean plates, strike slip motion
At subduction zone, Nazca Plate dives beneath South American Plate, producing reverse faulting and majority of world’s earthquakes.
Earthquakes in New Mexico?

• Yes, there are some, mostly small magnitude

• But…..

• Strong earthquakes in the Socorro area were noted as early as 1869.

• A relatively well-documented history of 20th century earthquakes in Socorro begins in January of 1904, and 3 large events in 1906 (largest magnitude 5.8).
Features of the New Mexico region

• Key features: Rio Grande Rift, Jemez Lineament

• Eruptive centers along Jemez lineament, Albuquerque volcanoes, vents for Carrizozo flows
• Have some earthquakes associated with faults along/within the Rio Grande Rift

• Socorro Seismic Anomaly (SSA)
  – in region of the mid-crustal Socorro Magma Body
Finding the Socorro Magma Body

Seismogram (left) and corresponding ray paths (right) from a characteristic Socorro region microearthquake.
SMB at Depth

- Model for the SMB - sill-like feature of \( \sim 3000 \text{ km}^2 \) at 19 km depth

- Relatively flat and thin (\( \sim 150 \text{ m} \))

- Seismicity above it due to crustal extension as the body inflates

Courtesy New Mexico Tech Geophysics program
... practically two thirds of the town of Socorro is falling down. The Court House is in ruins and the people of the town are in terror. The railroad service has been crippled... 

NY Times, July 18, 1906

Socorro Mayor Bursum responded with a prepared statement:

The reports regarding the earthquake at Socorro have been exaggerated, the damage to date being limited to the falling and toppling over of loose chimneys and shaking of some of the walls of buildings not of a substantial character.

H.F. Reid, fresh from his seminal study of the San Francisco earthquake, researched the Socorro earthquakes and published a paper (Reid, 1911) in the first issue of the Bulletin of the Seismological Society of America. He estimated the strongest shaking to be in the immediate Socorro area and to correspond to an acceleration of approximately 15% of gravity.
New Mexico Seismicity - Statistics

- ~1500 earthquakes $M \geq 2$ in NMT catalog from 1962

- A few areas tend to be hotspots for activity
  - Socorro area (central New Mexico) -- SSA
  - *Raton (NE New Mexico, coalbed methane fields)
  - *SE New Mexico (near water dispersal wells in DD oil field)

* High activity in last 10 years
Socorro Seismic Anomaly

- Region of < 1% of the area, makes up ~30% of statewide seismicity
NM Earthquakes 2010
(Jan – June)

289 events total

Majority SE of Carlsbad, Socorro area
Swarm activity in Socorro

- Fairly common in Socorro region
- 2 sequences in 1983 centered west of Socorro, occurred again in Oct-Nov 2005
  - Over 1600 events detected within 1 month
  - Largest magnitude 2.4
- 2009 swarm activity
  - 500+ earthquakes located in Lemitar region, largest magnitude 2.5

2009 swarm events
• 2005 and 2009 sequences
Useful Earthquake Resources

- http://www.iris.edu/hq/programs/education_and_outreach
Useful Earthquake Resources

Useful Earthquake Resources

• http://www.ees.nmt.edu/Geop/NM_Seismology.html

New Mexico Earthquakes

• List of Recent New Mexico Earthquakes
• Press Releases on Recent New Mexico Earthquakes
• Did you feel a possible earthquake? Contact the NMT Geophysics Program and report your observations at the US Geological Survey Did you feel it? site.
• Near Real-Time Seismograph Plots for New Mexico and Surrounding States
• Poster (11 by 7 inches) Earthquakes in New Mexico and the Socorro Magma Body (full sized posters available on request).
• Seismic Activity and Risks in the Socorro Region of Central New Mexico
• General information on Earthquakes in New Mexico and Elsewhere e/o NM Bureau of Geology and Mineral Resources
• Socorro’s Mid-Crustal Magma Body
• New Mexico Tech Seismological Observatory
New Mexico Tech Seismological Observatory

Latest Earthquakes in New Mexico

This list will be updated once a week with felt earthquakes being added within 24 hours. Felt earthquakes are in **boldface** type.

**Most recent events are at the top of the list**

<table>
<thead>
<tr>
<th>UTC Day</th>
<th>UTC Time</th>
<th>Lat (deg)</th>
<th>Lon (deg)</th>
<th>Depth (km)</th>
<th>Magnitude</th>
<th>RMS</th>
<th>STD epicenter (km)</th>
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<td>-106.889</td>
<td>5.06</td>
<td>0.31</td>
<td>0.20</td>
<td>0.49</td>
<td>N of San Aculin</td>
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**Event Archives**

- June 2010
- May 2010
- April 2010
- March 2010
- February 2010
- January 2010