

# Earthquakes Causing Damage in Arizona

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Nearly two years ago (9/78), the Bureau began researching historical seismicity in Arizona. The purpose of current efforts is to produce a revised epicenter map and earthquake catalog for the period of historical record.

In Arizona, written records date back to Spanish exploration.

The earliest event documented so far is one experienced by members of the Coronado expedition in 1540. The first seismograph was installed in 1909 in Tucson. However, earthquake chronology has been grossly incomplete until very recently, perhaps in the last 20 years. Arizona still lacks adequate seismic instrumentation to recognize and accurately locate minor earthquakes throughout the state.

FIGURE 1: SUMMARY OF 20 DAMAGING HISTORICAL SEISMIC EVENTS

Date	Time (GMT)	Epicenter Location N-Lat. W-Long.	Place Name Near Epicenter	Max. Int.	Mag.	Felt Area (km <sup>2</sup> )	Comments	Refs.
<sup>1</sup> Nov. 30, 1852	08:20	32.45°, 115.25°	Ft. Yuma, CA	IX–XI	•	•	—In the epicentral area, Major Heintzelman and his party, in a trip made after Dec. 15, found over 100 mud volcanoes. The volcanoes were still emitting steam and gasses, the major one erupting every 10–15 min. and throwing mud 60–70 ft. in the air. The shock was violent at Ft. Yuma. Much fissuring occurred in the Yuma area, and rockfalls were observed at Chimney Peak and at other mountains. In some places, Colorado River sank 2 ft. and banks caved in at many locations.	4, 11
<sup>2</sup> May 3, 1872	00:45	32.8°, 115.2°	Yuma, AZ	VI	5.9	•	—In Yuma, people rushed out into the streets. Two buildings were cracked.	21, 27
<sup>3</sup> May 3, 1887	23:12	31.0°, 109.1°	Pitaicachi, MX	XII	7.2	1,600,000	—This major quake caused 51 deaths in northern Sonora, and major destruction to property in Mexico and SW Arizona. A fault scarp 50 km long and 3 m high formed just south of the Arizona-Mexico border. It was felt in nearly fifty towns in Arizona, including Bisbee, Clifton, Globe, Phoenix, Tucson, and Yuma.	9
<sup>4</sup> Jul. 30, 1891	13:05	32.11°, 114.96°	Lerdo, MX	IX–X	•	•	—Large fissures opened up along the Colorado River in Mexico. Homes in Lerdo were badly cracked, and several were destroyed. In Yuma, people rushed into the streets, some walls were cracked, and small objects were moved about.	18, 27
<sup>5</sup> Oct. 7, 1899	06:30	31.71°, 110.070°	Tombstone, AZ	V	•	•	—Windows rattled, hanging objects swung, clocks stopped, and a few people rushed for the street.	13
<sup>6</sup> Jan. 25, 1906	08:32:30	35.2°, 111.7°	San Francisco Mtns, AZ	VII–VIII?	•	223,100	—At Flagstaff, several chimneys were thrown down, walls cracked, and glassware was broken. The shock was felt in Angell, Bellemont, Phoenix, Seligman, Williams, Winslow, and towns in New Mexico and Utah.	7, 10, 17
<sup>7</sup> May 26, 1907	10:00	29.48°, 110.23°	Morales, MX	VIII–IX	•	•	—In the epicentral region, severe damage was done to adobe and stone buildings. The shock was of sufficient force to awaken people in Benson, Bisbee, San Bernardino Ranch, Tombstone, and Tucson.	1, 8
<sup>8</sup> Sept. 24, 1910	04:05	36°, 111.1°	Coconino Forest, AZ	VII	•	116,550	—In the Coconino Forest, a series of shocks caused boulders to roll into the camp of a construction crew. The shocks were felt throughout northern AZ, southern UT, and NW NM. Fifty-two were felt in Flagstaff from Sept. 10 through Sept. 24.	7, 12, 20
<sup>9</sup> Aug. 18, 1912	21:10:40	36.5°, 111.5°	N. of San Francisco Mtns., AZ	VII–VIII(?)	•	142,420	—People fled to streets in Winslow, Flagstaff, Tuba and Williams. Windows and crockery were broken in Williams. Damage to houses was also reported in Williams. Navajo Indians reported earthcrack 30 mi long N of San Francisco Peaks, where rockslides were also reported.	2, 7, 17
<sup>10</sup> Nov. 21, 1915	00:13:27	32.4166°, 115.2500°	Calexico, CA	VII–VIII	7.1	310,800	—In Yuma, buildings trembled, dishes and books fell off shelves, and water in pitchers splashed out. People rushed into the streets.	7, 17, 22
<sup>11</sup> Dec. 31, 1934	18:45	32°, 114.75°	Baja California, MX	VII–X	7.1	207,200	—Crevices opened and roads buckled in the epicentral region. A swaying motion was felt in Phoenix and Yuma. The quake was also noticed in Casa Grande, Coolidge, Eloy, Florence, Nogales, Prescott, and Tucson.	6, 7, 15, 22, 24
<sup>12</sup> Jan. 10, 1935	08:10	36.1°, 112.2°	Grand Canyon, AZ	VI–VII	•	•	—Minor rock slides occurred. Windows broke and plaster cracked in the town of Grand Canyon. A subterranean rumble awakened sleepers.	7, 12, 24
<sup>13</sup> Apr. 8, 1937	12:00	35.7°, 109.5°	Ganado, AZ	VI–VII	•	•	—The shock caused slight damage at Sage Memorial Hospital.	12, 23

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<sup>14</sup> Sept. 17, 1938	17:20:18	33.25°, 108.75°	Duncan, AZ	V-VII	5.5	20,720	—In Duncan, bottles fell from shelves and plaster was cracked. Some cracks occurred in walls. In Clifton, a deep rumble was heard and trees and bushes shook. The shock was also felt in Morenci, Safford, San Simon, and Thatcher.	12, 24
<sup>15</sup> May 19, 1940	15:36:40	32.7°, 115.5°	Imperial Valley, CA	X	6.7-7.1	155,400 (in the U.S.)	—Nine people were killed and 5-\$6 million damage was done in the epicentral region. In the Yuma district, damage was estimated at \$50,000. Four water service lines were broken and the irrigation system was badly damaged. Large crevices were formed. In Somerton, roads were buckled and bridges were dislodged. Also felt in Phoenix and Tucson.	3, 7, 13, 19, 24, 28
<sup>16</sup> Jan. 17, 1950	00:53	35.5°, 109.5°	Ganado, AZ	VI-VII	.	.	—Ground cracks ½ in. wide to 12 ft. long were found south of Ganado Trading Post.	7, 12
<sup>17</sup> Dec. 25, 1969	12:49:10.1	33.4°, 110.6°	Gila Co., AZ	VI-VII	4.4-5.1	.	—Dishes and windows were broken at Globe. Some buildings were cracked at San Carlos Reservation. It was felt at Coolidge Dam, Miami, Roosevelt Lake, Tucson, and Winkelman.	12, 14, 22, 23, 24
<sup>18</sup> Feb. 4, 1976	00:04:58.1	34.66°, 112.50°	Chino Valley, AZ	VI	5.1	80,290	—The shock caused slight damage in the Prescott area. Mirrors, bottles and glasses broke. It was felt in many towns in Arizona, including Flagstaff, Phoenix, Tucson, and Yuma.	12, 16, 24
<sup>19</sup> Oct. 15, 1979	23:16:52.4	32.633°, 115.333°	Imperial Valley, CA	IX	6.5-6.8	.	—The quake caused minor damage in Yuma. It was felt in Phoenix and Tucson. Damage near the epicenter towns of Brawley, Calexico, Imperial and El Centro was estimated to be \$30 million; 91 people were injured. Strike slip offset 57 cm measured on Imperial Fault, CA.	5, 14, 25
<sup>20</sup> Jun. 9, 1980	04:28	32.269°, 114.947°	S. of Mexicali, MX	IX	6.2-6.3	.	—Two people were killed and about 100 injured in MX. The quake knocked groceries off of the shelves of stores in Yuma. It was felt in Phoenix and in Tucson.	14, 26

\*These numbers correspond to those on the map of Figure 2.

REFERENCES FOR FIGURE 1

- 1.\* Bisbee Daily Review
2. Bulletin of the Seismological Society of America, Seismic Notes section, v. II, p. 209-210
3. Bulletin of the Seismological Society of America, Seismic Notes section, v. XXX, p. 304-306
4. Bureau of Reclamation, U.S. Dept. of Interior, Record of Earthquakes in the Yuma Area, 1776-1976, July 1976
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7. Coffman, J. L., and Von Hake, C. A., editors, 1973, Earthquake History of the U.S., U.S. Dept. of Commerce, and National Oceanic and Atmospheric Administration
8. Douglas Daily Dispatch
9. DuBois, S. M., and Smith, A. W., in press, The 1887 earthquake in San Bernardino Valley, Sonora: historical accounts and intensity patterns in Arizona: Special Paper No. 3, Arizona Bureau of Geology and Mineral Technology
10. Flagstaff Coconino Sun
11. Ft. Yuma Meteorological Report, 1852, Copy from the National Archives, record group no. 27, Center for the Polar Archives
12. National Oceanic and Atmospheric Administration, Computer listing of Arizona earthquakes
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14. Phoenix Arizona Republic
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16. Prescott Courier
17. Reid, H. F., unpublished, Microfilmed records of worldwide earthquakes, personal clippings and index file
18. San Francisco Examiner
19. Somerton Star
20. Sturgal, J. R. and Irwin, T. D., 1971, Earthquake History of Arizona, 1850-1966: Arizona Geological Society Digest, v. IX
21. Topozada, 1980, Excerpts from Semi-Annual Report to USGS, re: California Earthquakes, 1800-1899, California Division of Mines and Geology, January
22. Tucson Citizen
23. Tucson Daily Star
24. U.S. Coast and Geodetic Survey, annual volume series, U.S. Earthquakes
25. U.S. Geological Survey, 1980, Earthquake information bulletin, v. 12, n. 2, p. 76
26. U.S.G.S., 1980, Preliminary determination of epicenters, n. 23-80
27. Yuma Arizona Sentinel
28. Yuma Daily Sun

\*The numbers preceding the above sources match the numbers in the last column of Figure 1

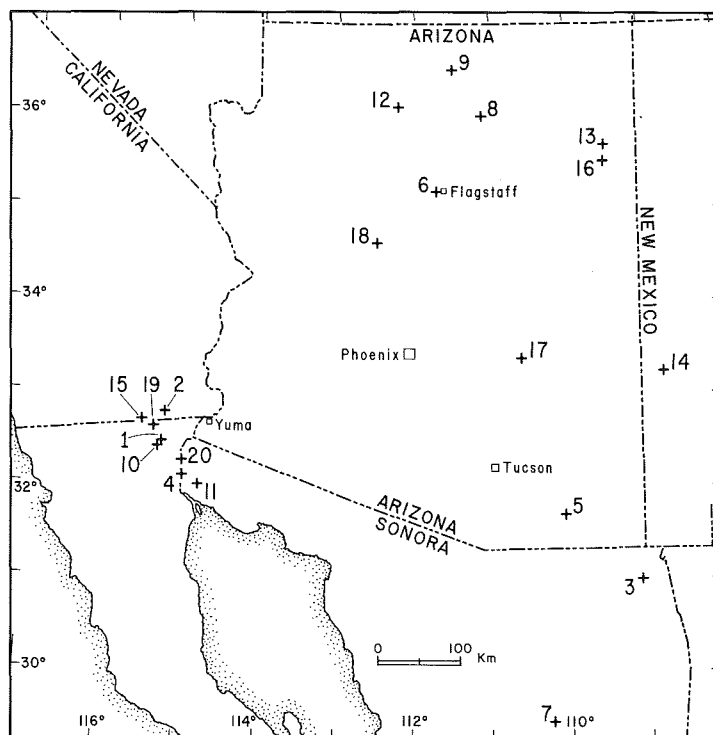


Figure 2: Epicenter locations corresponding to earthquakes in Figure 1.

Information on earthquakes felt or recorded in Arizona was sought from many institutions, references and personal contacts. Library research has been conducted at the University of Arizona, State Capitol Archives (Phoenix), local historical societies and museums, as well as in several departments of the U.S. National Archives and the Library of Congress (Washington, D.C.). Microfilm, bound newspaper volumes and special collections of early correspondence, diaries and documents have been searched. A

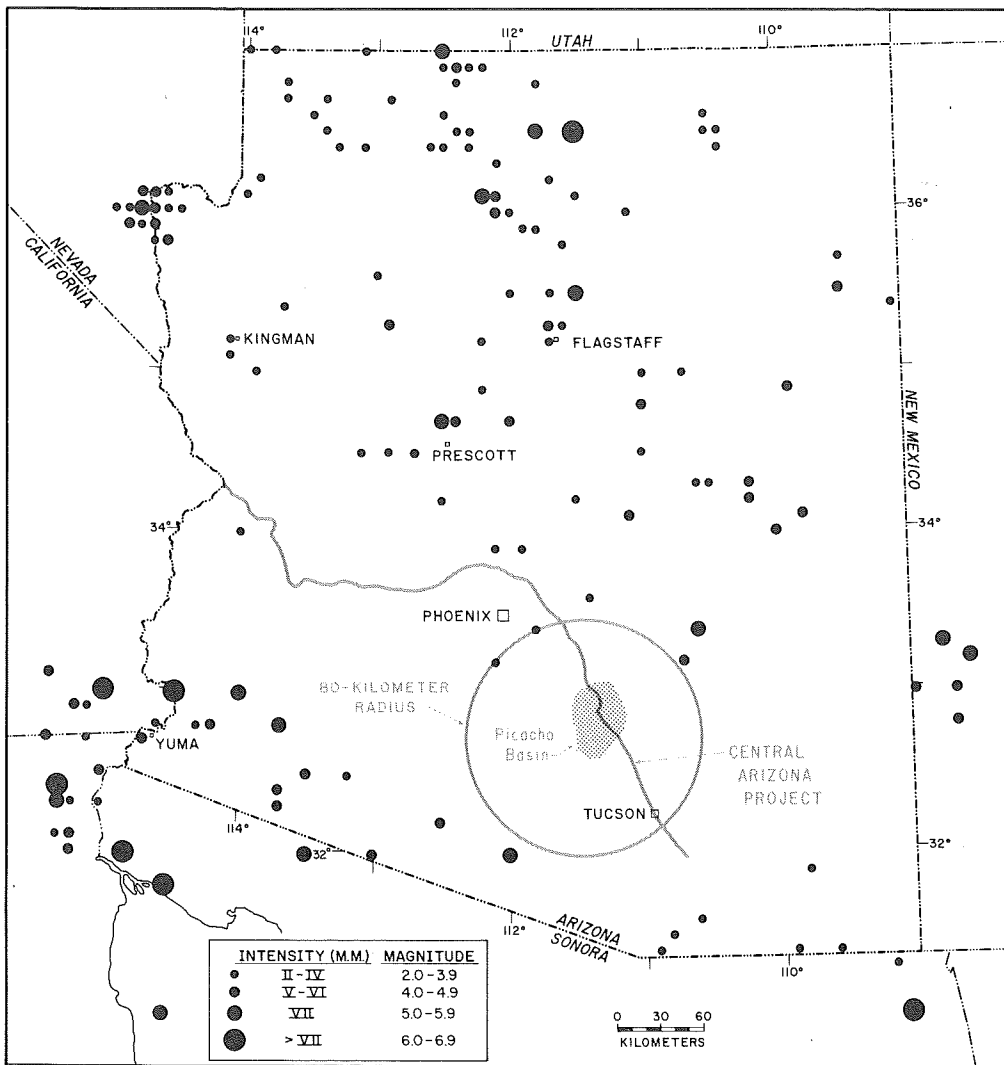


Figure 3: DuBois: Preliminary map of historical earthquake epicenters.

Raymond: Picacho Basin site, gray shaded area on map

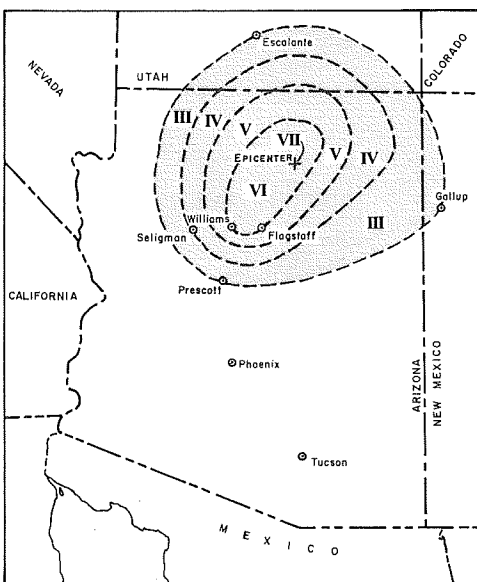
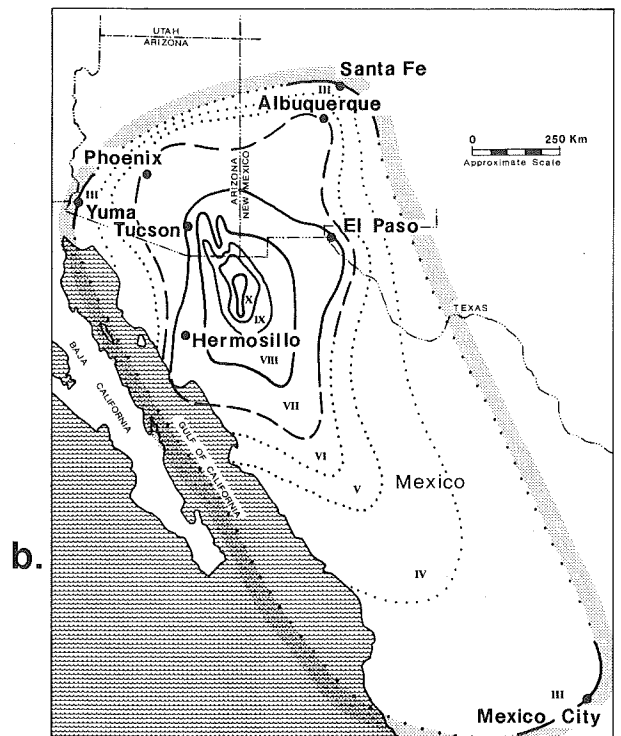


Figure 4: Isoseismal maps

a. August 18, 1912

b. May 3, 1887



few weather reports from early military posts and weather stations were obtained in the Polar and Scientific Archives (Washington, D.C.). However, most of the information on file consists of contemporary newspaper accounts of local and distant earthquakes.

Figure 1 summarizes many of the largest earthquakes in or near Arizona (epicenter locations in Figure 2).