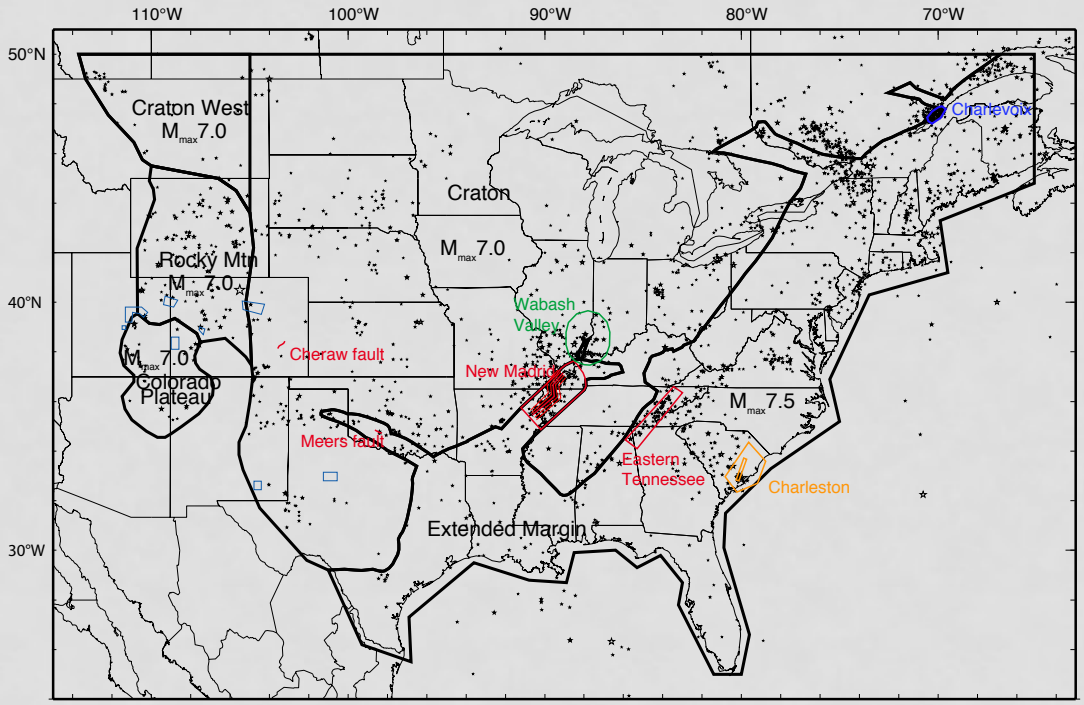
CEUS SOURCE UPDATE –OTHER SOURCES–

CEUS WORKSHOP
2014 NATIONAL SEISMIC HAZARD MAPS
FEBRUARY 22–23, 2012
MEMPHIS, TENN.

INTRODUCTION



- Road map
  - geologic context
  - contributions from new published science
  - CEUS-SSC comparison sensitivity studies
- Fault sources
- Aerial sources
- Special zones

USGS science for a changing world

CHERAW SOURCE, COLO.

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MOST RECENT CHERAW PUBLICATIONS

- **1990s**
- Crone, A.J., Machette, M.N., Bradley, L.A., and Mahan, S.A., 1997, Late Quaternary surface faulting on the Cheraw fault, southeastern Colorado: U.S. Geological Survey Miscellaneous Geologic Investigations I-2591, 7 p. pamphlet, 1 pl.
- Jack Benjamin & Associates and Geomatrix Consultants, 1996, Probabilistic seismic hazard assessment for the U.S. Army chemical disposal facility, Pueblo Depot Activity, Colorado: Technical report to Science Applications International Corporation, Maryland, under Contract JBA 148-130-PU-002.
- Crone, A.J., and Machette, M.N., 1995, Holocene movement on the Cheraw fault, SE Colorado--Another hazardous late Quaternary fault in the stable continental interior: Eos, Transactions of the American Geophysical Union, v. 76, no. 46, November 7, 1995, supplement, p. F362.
- Unruh, J.R., Wong, I.G., Hitchcock, C.S., Bott, J.D.J., Silva, W.J., and Lettis, W.R., 1994, Seismotectonic evaluation, Pueblo Dam, Fryingpan-Arkansas Project, south-central Colorado: U.S. Bureau of Reclamation, 134 p.
- **1980s**
- Kirkham, R.M., and Rogers, W.P., 1981, Earthquake potential in Colorado: Colorado Geological Survey Bulletin 43, 171 p., 3 pls.
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- Scott, G.R., Taylor, R.B., Epis, R.C., and Wobus, R.A., 1978, Geologic map of the Pueblo 1° x 2° quadrangle, south-central Colorado: U.S. Geological Survey Miscellaneous Geologic Investigations I-1022.
- Sharps, J.A., 1976, Geologic map of the Lamar quadrangle, Colorado and Kansas: U.S. Geological Survey Miscellaneous Geologic Investigations I-944, scale 1:250,000.
- Scott, G.R., 1970, Quaternary faulting and potential earthquakes in east-central Colorado: U.S. Geological Survey Professional Paper 700-C, C11-C18 p.

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CHERAW FAULT SOURCE, COLO. USGS AND CEUS SSC COMPARISON

	2008 USGS	CEUS SSC
Source length	45 km	46 km (0.8) 62 km (0.2)
Characteristic M	M7.0±0.2	M6.8 (0.3) M7.0 (0.3) M7.2 (0.3) M7.4 (0.1)
Rupture bottom	15 km	13 km (0.4) 17 km (0.4) 22 km (0.2)
Dip of source	60° NW	50° NW (0.6) 65° NW (0.4)
Slip rate	0.15 mm/yr	0.14 mm/yr (0.185)* 0.16 mm/yr (0.63)* 0.19 mm/yr (0.185)*
Recurrence	8,700 yr	20,000 yr (0.4)* 10,700 yr (0.6)*
Earthquake occurrence model	Poisson	*In-cluster branch Poisson Out-of-cluster branch Poisson

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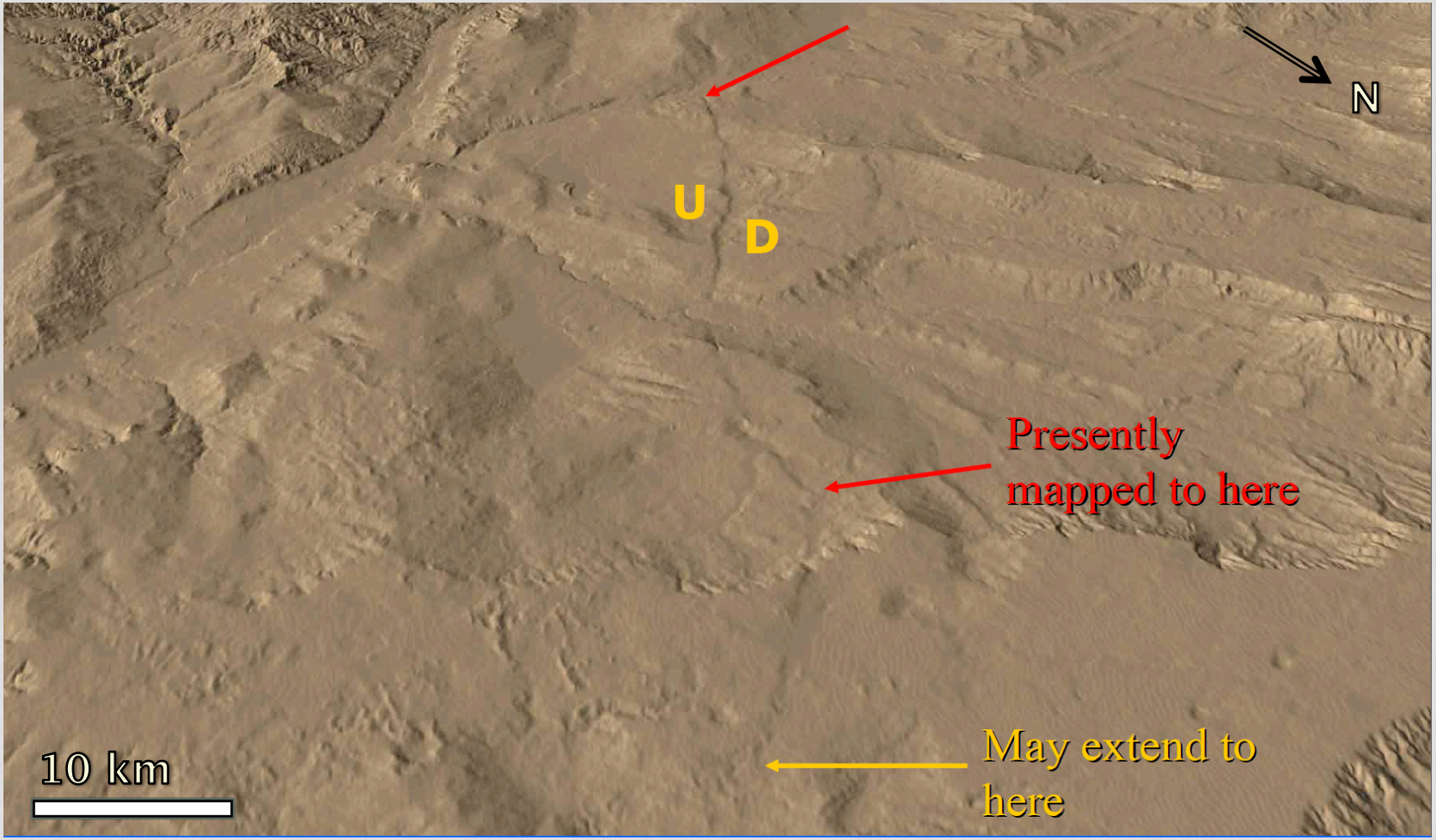
CHERAW SOURCE LENGTH



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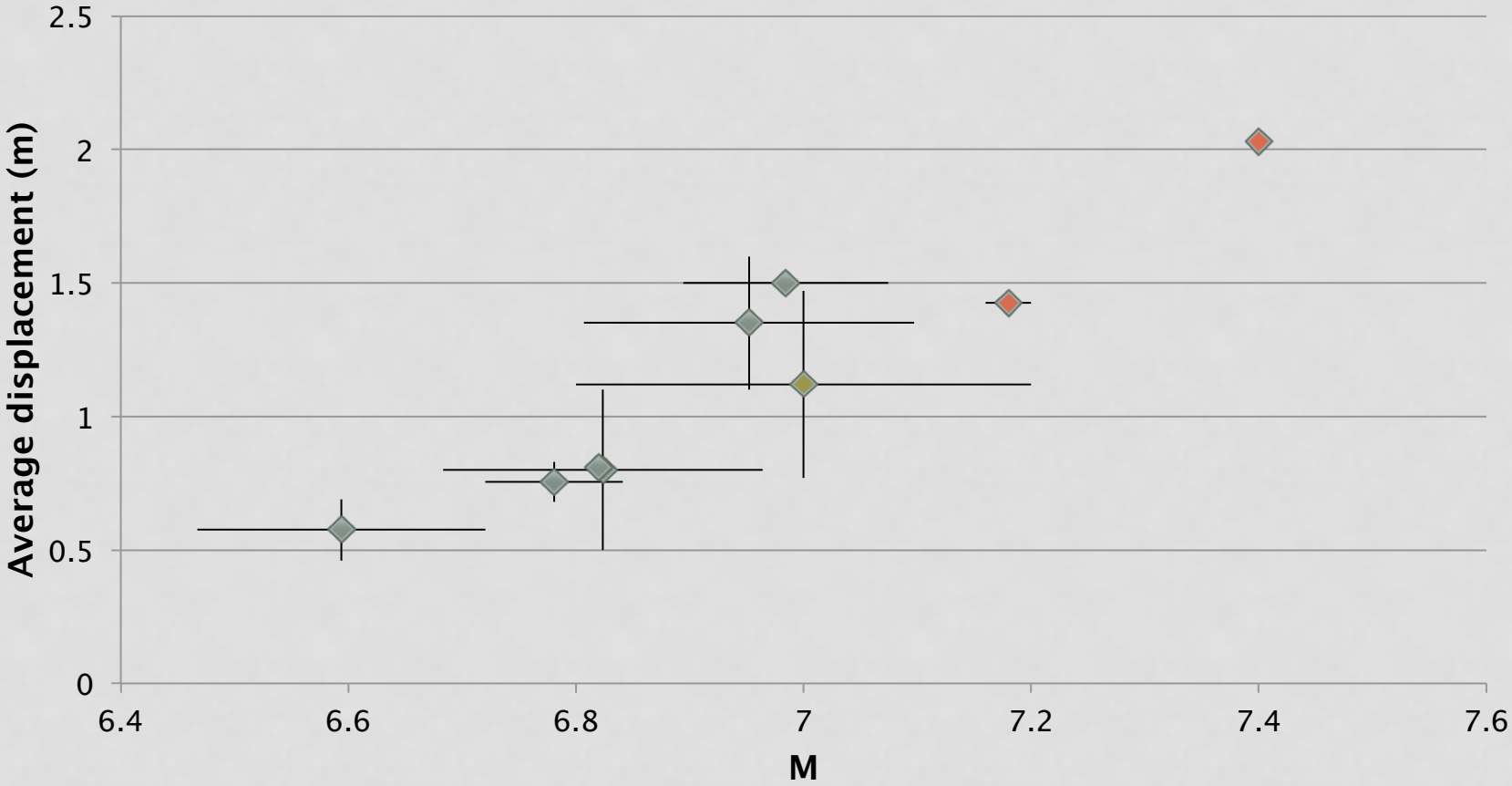
CHERAW FAULT, COLO.
M



displacement data from Crone and others 1997

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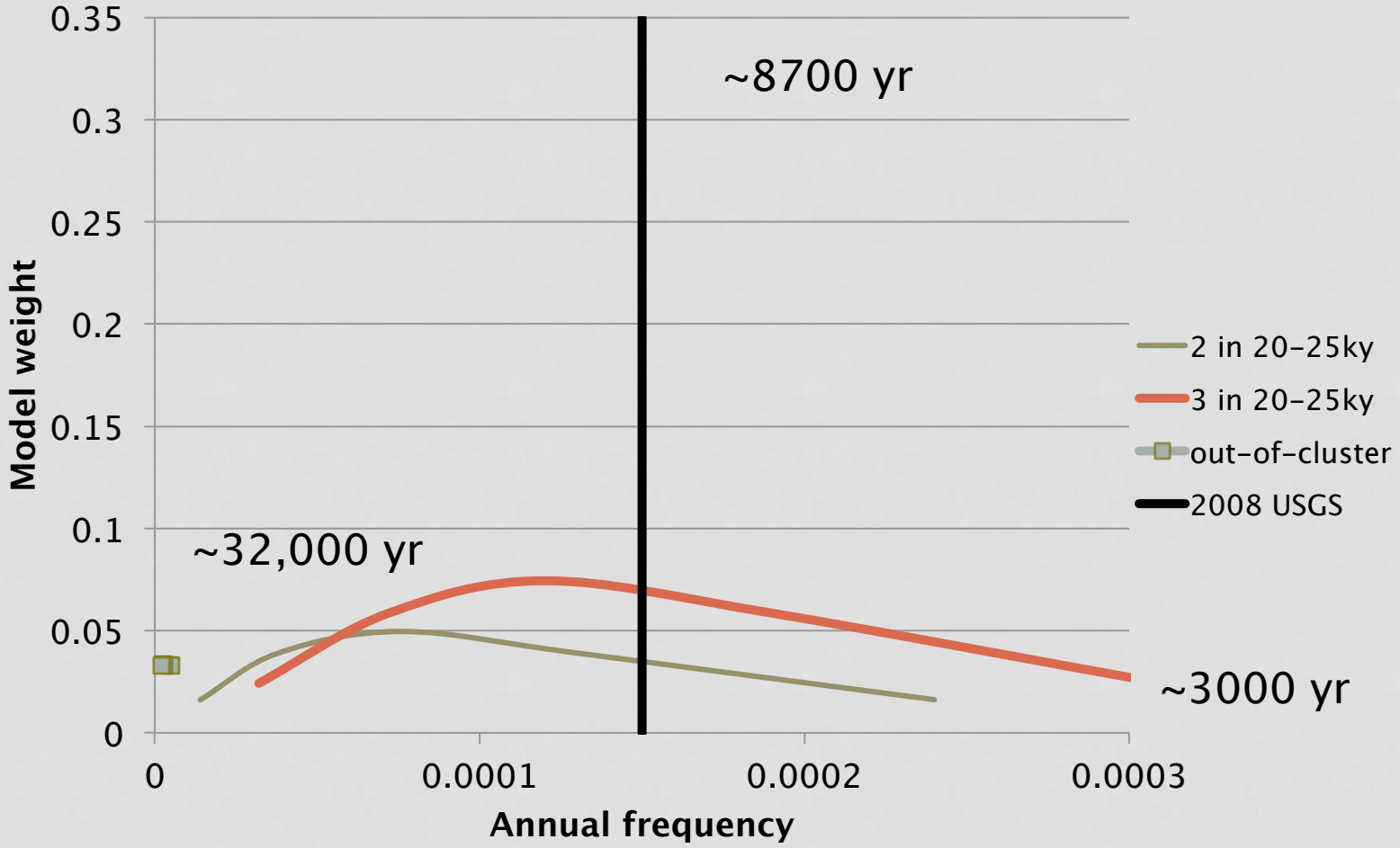
ANNUAL FREQUENCY OF EARTHQUAKES CHERAW SOURCE



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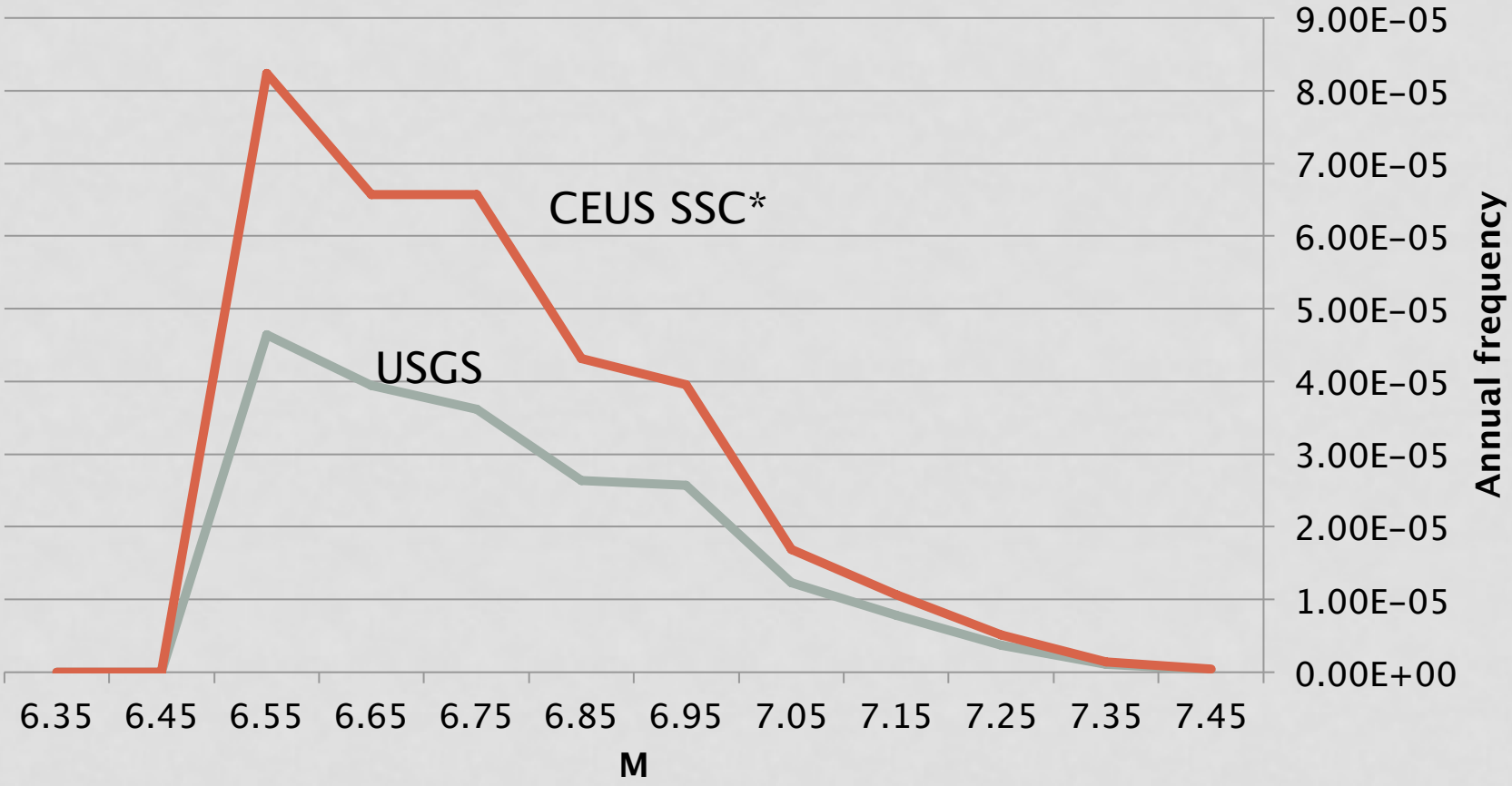
CHERAW SOURCE MAGNITUDE-FREQUENCY DISTRIBUTION



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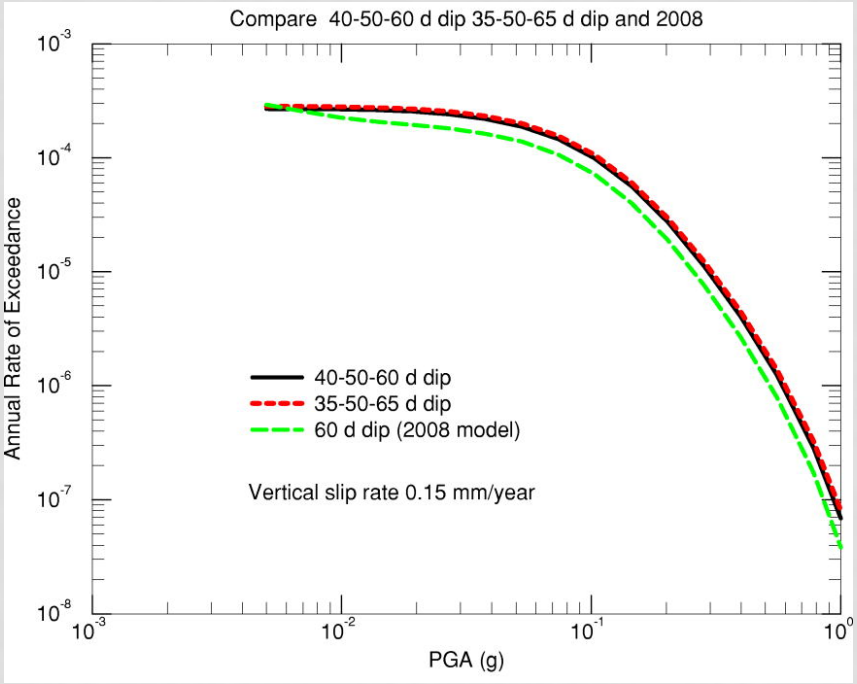
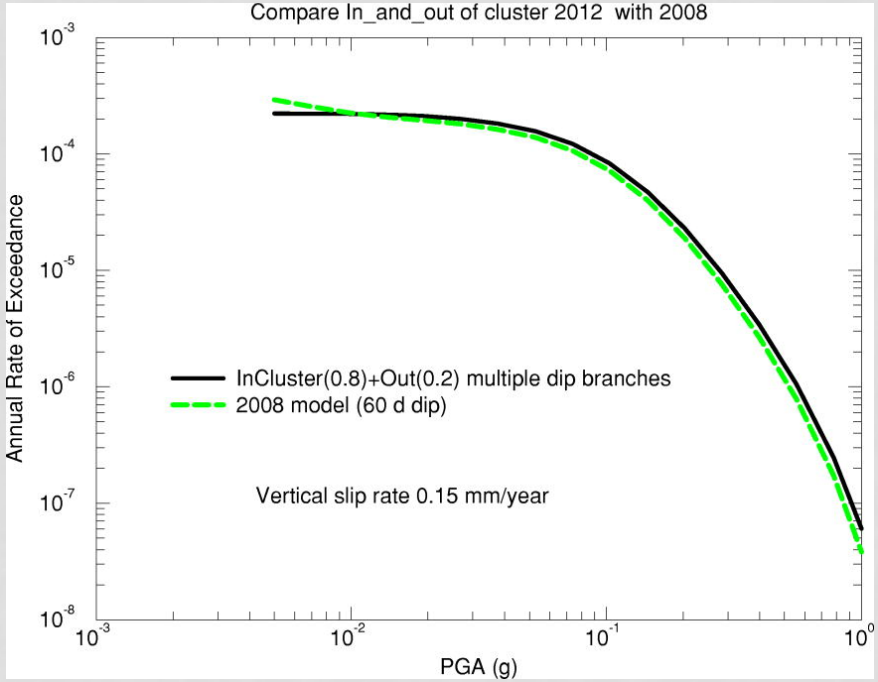
HAZARD IN PUEBLO, COLO., FROM CHERAW SOURCE





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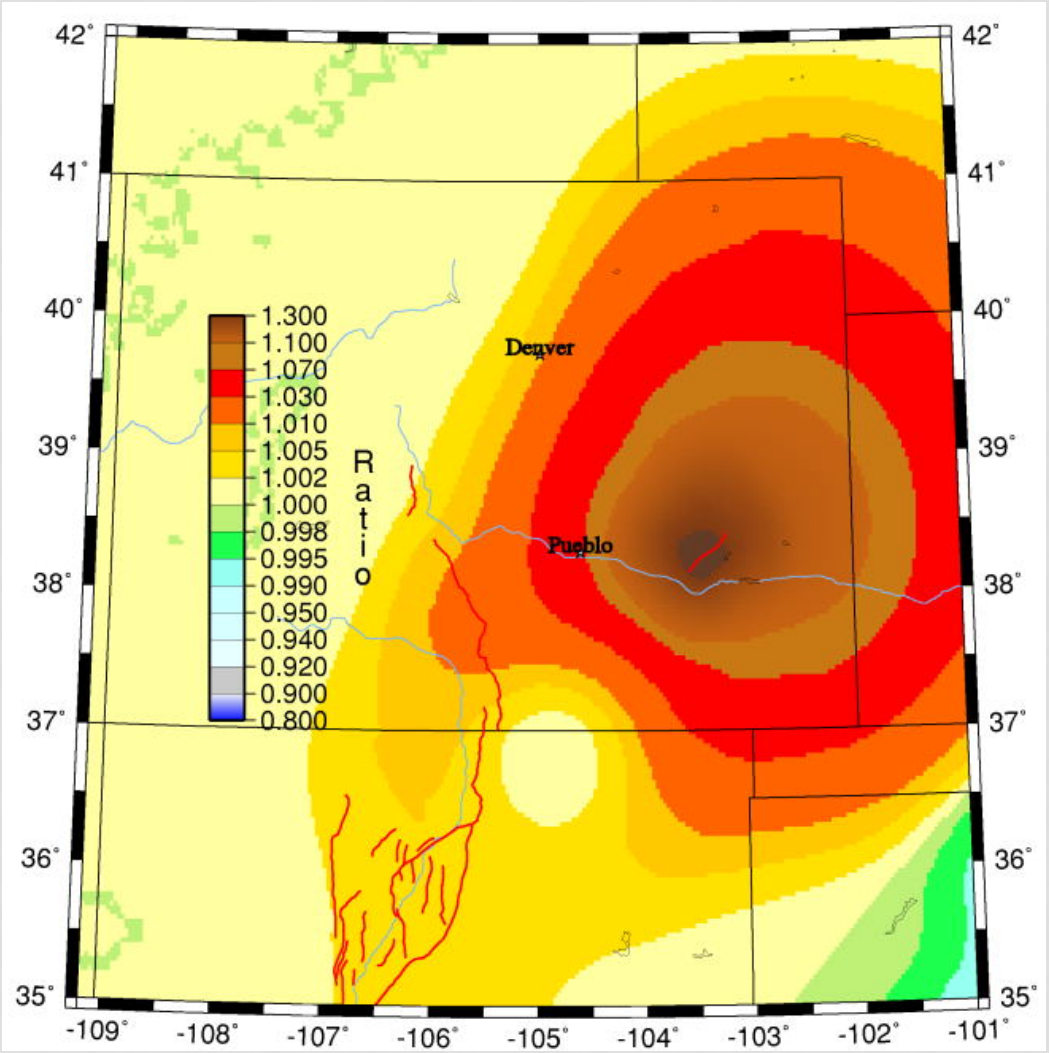
35/50/65°-DIP ALTERNATIVE MODEL



PGA
2% PE in 50 yr
Vs30 760 m/s

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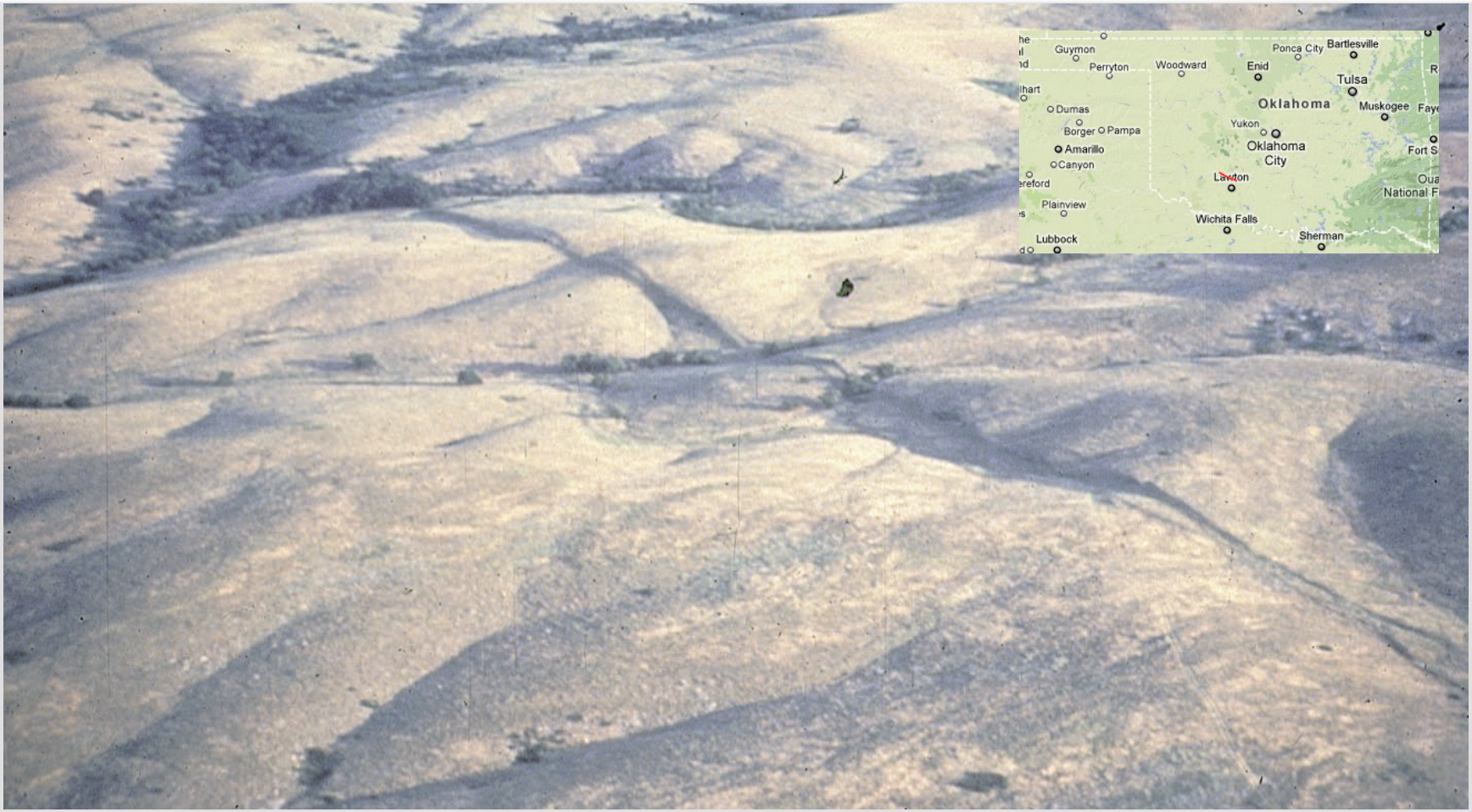
MEERS SOURCE, OKLA.



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MOST RECENT MEERS PUBLICATIONS

- **1990s**
- Jones-Cecil, M., 1995, Total-field aeromagnetic and derivative maps of the Lawton area, southwestern Oklahoma: U.S. Geological Survey Geophysical Investigations Series Map GP-998-A, 2 sheets, scale 1:100,000.
- Swan, F.H., Wesling, J.R., Hanson, K.A., Kelson, K.I., and Perman, R.C., 1993 written commun., Draft report--Investigation of the Quaternary structural and tectonic character of the Meers fault (southwestern Oklahoma): Technical report to U.S. Nuclear Regulatory Commission, Washington, D.C., under Contract NRC-04-87-007, July 1993, 104 p., 3 pls.
- Cetin, H., 1992, The northwest extension of the Meers fault in southwestern Oklahoma, in Sharma, S., ed., Proceedings of the 28th symposium on engineering geology and geotechnical engineering:, 28th Symposium on Engineering Geology and Geotechnical Engineering, Boise, Idaho, April 1-3, 1992, Proceedings, p. 43-58.
- Cetin, H., 1990, The northwest continuation of the Meers fault and its tectonic activity in southwestern Oklahoma: Geological Society of America Abstracts with Programs, v. 22, p. 3.
- Crone, A.J., and Luza, K.V., 1990, Style and timing of Holocene surface faulting on the Meers fault, southwestern Oklahoma: Geological Society of America Bulletin, v. 102, p. 1-17.
- Kelson, K.I., and Swan, F.H., 1990, Paleoseismic history of the Meers fault, southwestern Oklahoma, and implications for evaluations of earthquake hazards in the Central and Eastern United States, in Weiss, A.J., ed., Seventeenth water reactor safety information meeting: Proceedings of the U.S. Nuclear Regulatory Commission NUREG/CP-0105, v. 2, p. 341-365.
- Miller, R.D., Steeples, D.W., and Myers, P.B., 1990, Shallow seismic reflection survey across the Meers fault, Oklahoma: Geological Society of America Bulletin, v. 102, p. 18-25.
- Ramelli, A.R., and Slemmons, D.B., 1990, Implications of the Meers fault on seismic potential in the Central United States, in Krinitzsky, E.L., and Slemmons, D.B., eds., Neotectonics in earthquake evaluation: Geological Society of America Reviews in Engineering Geology, v. 8, p. 59-75.
- **1980s**
- Jones-Cecil, M., and Crone, A.J., 1989, Constraints on the Anadarko basin-Wichita uplift boundary interpreted from aeromagnetic data, in Johnson, K.S., ed., Anadarko basin symposium, 1988: Oklahoma Geological Survey Circular 90, p. 228-232.
  McConnell, D.A., 1989, Determination of offset across the northern margin of the Wichita uplift, southwest Oklahoma: Geological Society of America Bulletin, v. 101, p. 1317-1332.
- Madole, R.F., 1988, Stratigraphic evidence of Holocene faulting in the mid-continent--The Meers fault, southwestern Oklahoma: Geological Society of America Bulletin, v. 100, p. 392-401.
- Luza, K.V., Madole, R.F., and Crone, A.J., 1987, Investigation of the Meers fault in southwestern Oklahoma: U.S. Nuclear Regulatory Commission NUREG/CR-4937, 53 p., 2 pls.
  Luza, K.V., Madole, R.F., and Crone, A.J., 1987, Investigation of the Meers fault, southwestern Oklahoma: Oklahoma Geological Survey Special Publication 87-1, 75 p., 2 pls.
- Ramelli, A.R., Slemmons, D.B., and Brocoum, S.J., 1987, The Meers fault--Tectonic activity in southwestern Oklahoma: U.S. Nuclear Regulatory Commission NUREG/CR-4852, 25 p.

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MEERS FAULT SOURCE, OKLA. USGS AND CEUS SSC COMPARISON

	2008 USGS	CEUS SSC
Source length	35 km	37 km (0.9) 67 km (0.1)
Characteristic M	M7.0±0.2	M6.6 (0.1) M6.7 (0.45) M6.9 (0.3) M7.3 (0.1) M7.4 (0.05)
Rupture bottom	15 km	15 km (0.5) 20 km (0.5)
Dip of source	vertical	vertical (0.5) 40° SW (0.5)
Recurrence	4,550 yr	2,300 yr *
Earthquake occurrence model	Poisson	*In-cluster branch Poisson Out-of-cluster branch Poisson

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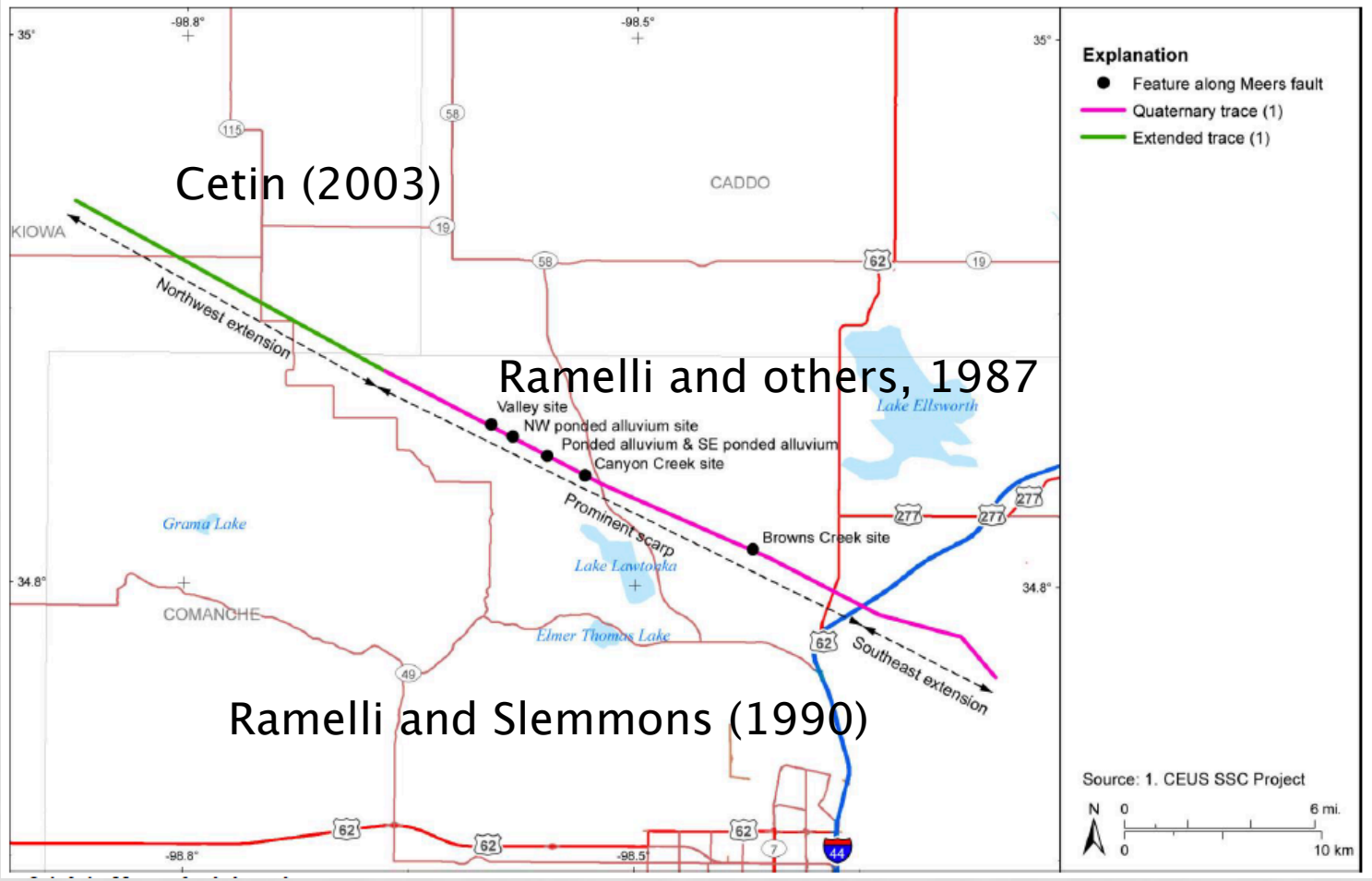
MEERS SOURCE LENGTH



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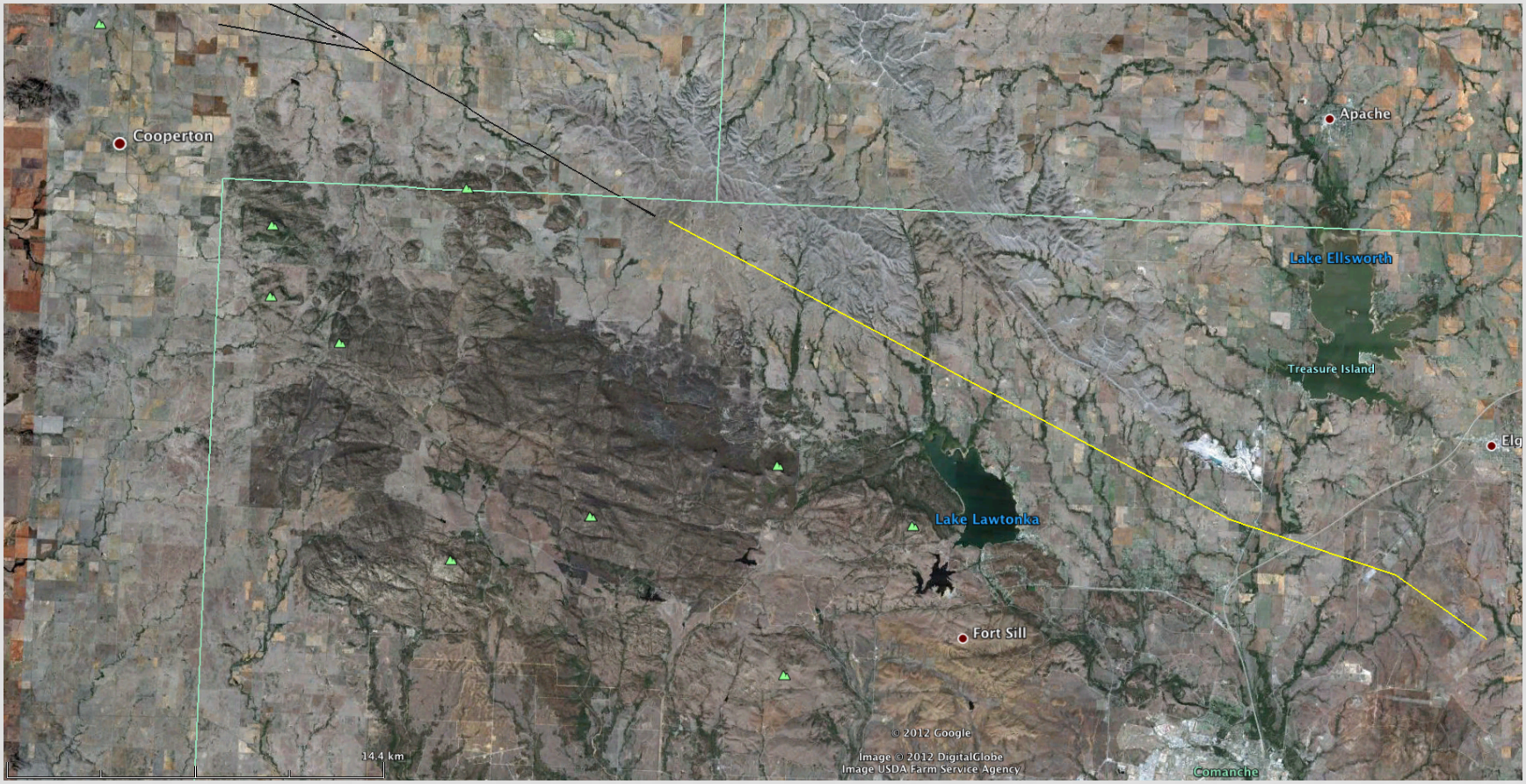
EXTENT OF QUATERNARY MEERS FAULT



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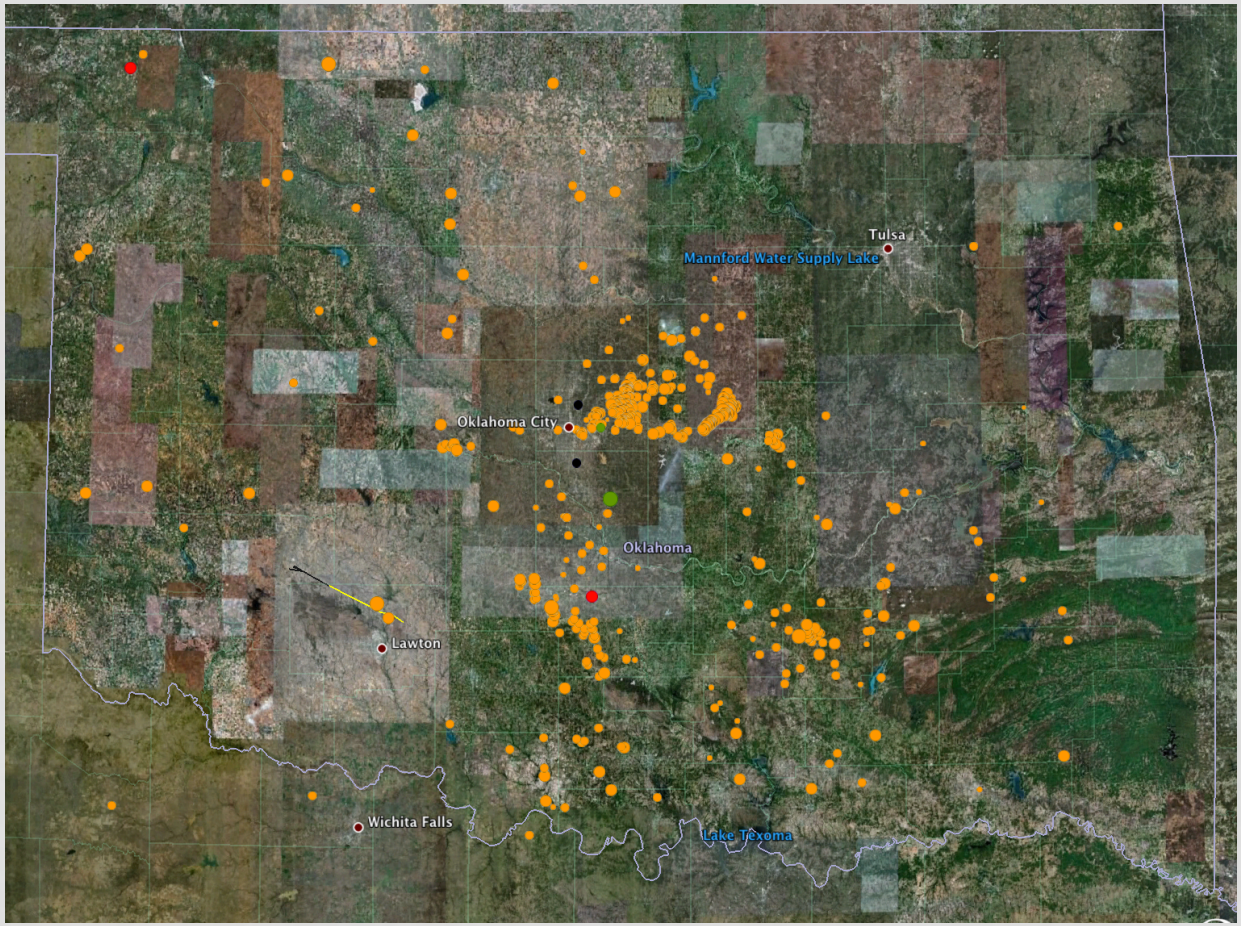
OKLAHOMA SEISMICITY



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MEERS SOURCE DIP

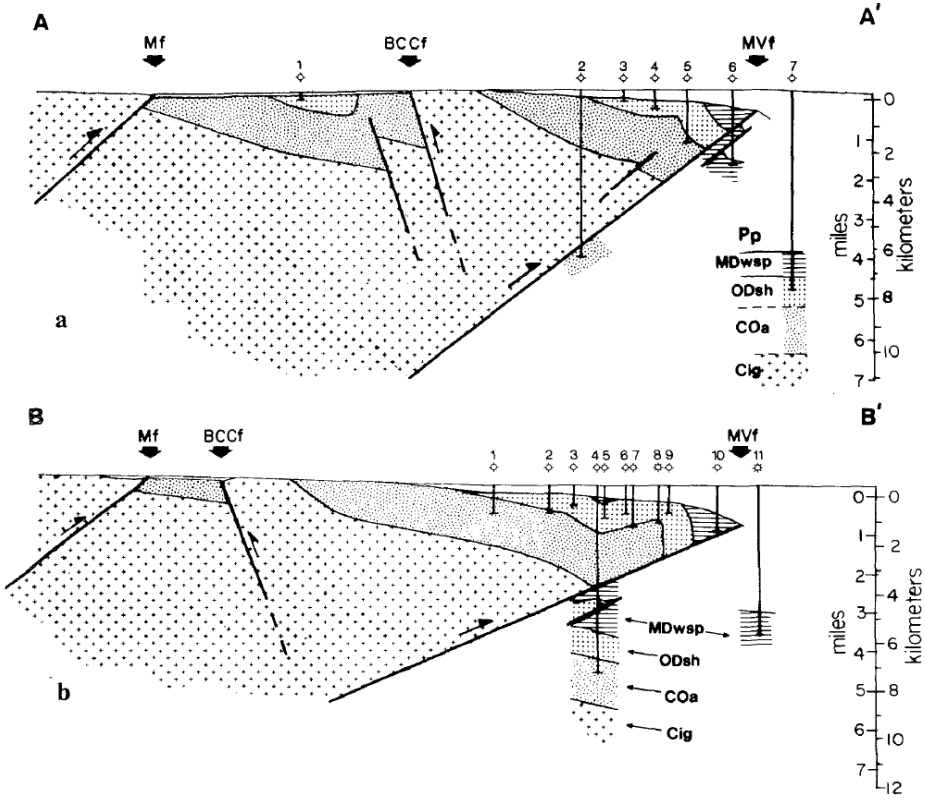

Figure 4. Cross sections through Lawton segment of Frontal fault zone; lines of sections shown in Figure 3. MVf, Mountain View fault system; BCCf, Blue Creek Canyon fault; Mf, Meers fault (dip unknown). Cig, undifferentiated basement rocks; Pp, post-Mississippian rocks; other stratigraphic abbreviations as in Figure 3. No vertical exaggeration. a. Cross section A–A′; b. cross section B–B′. Wells used to construct cross sections listed in Table 1.

from McConnell, 1989

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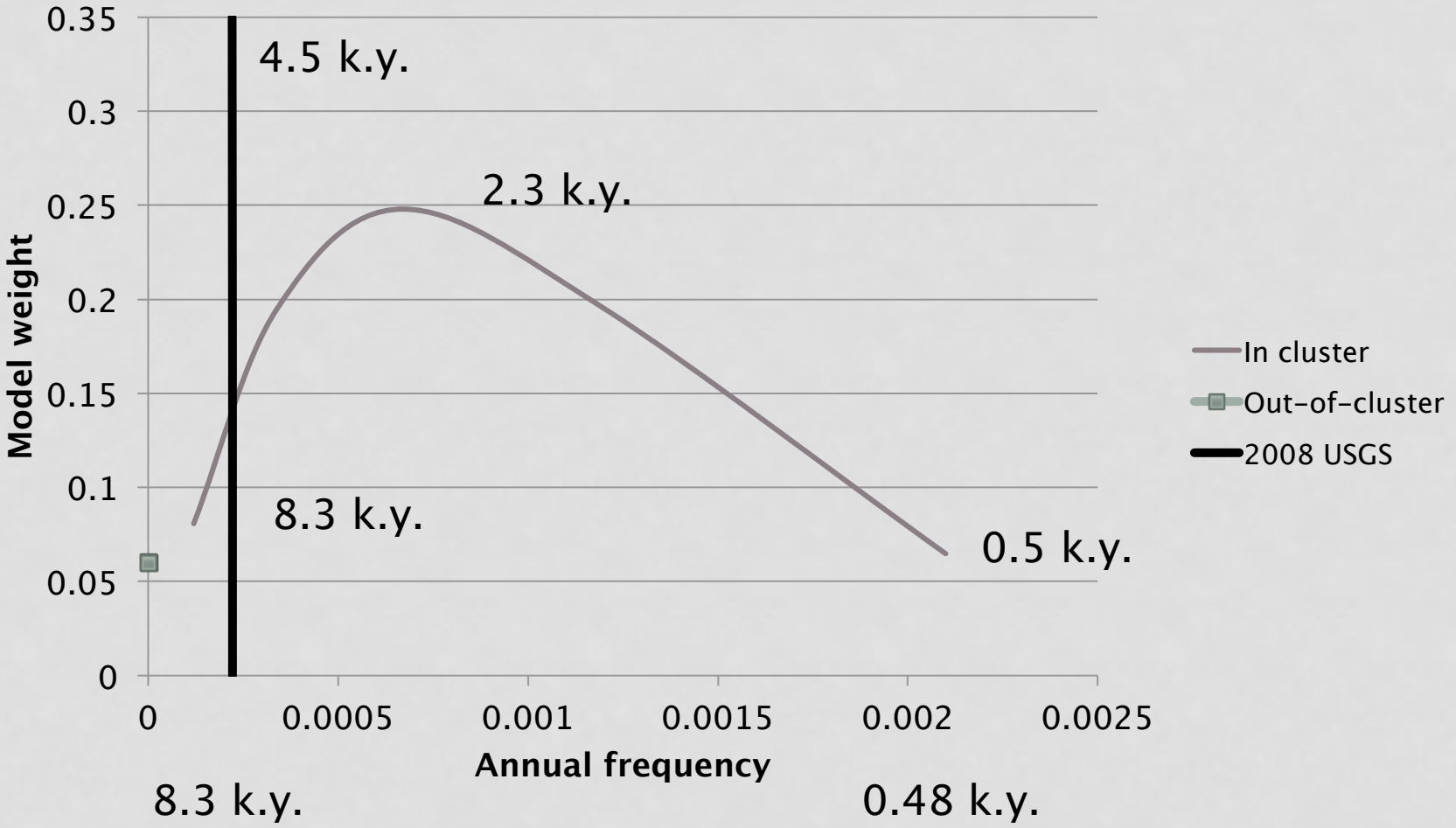
ANNUAL FREQUENCY OF EARTHQUAKES MEERS SOURCE



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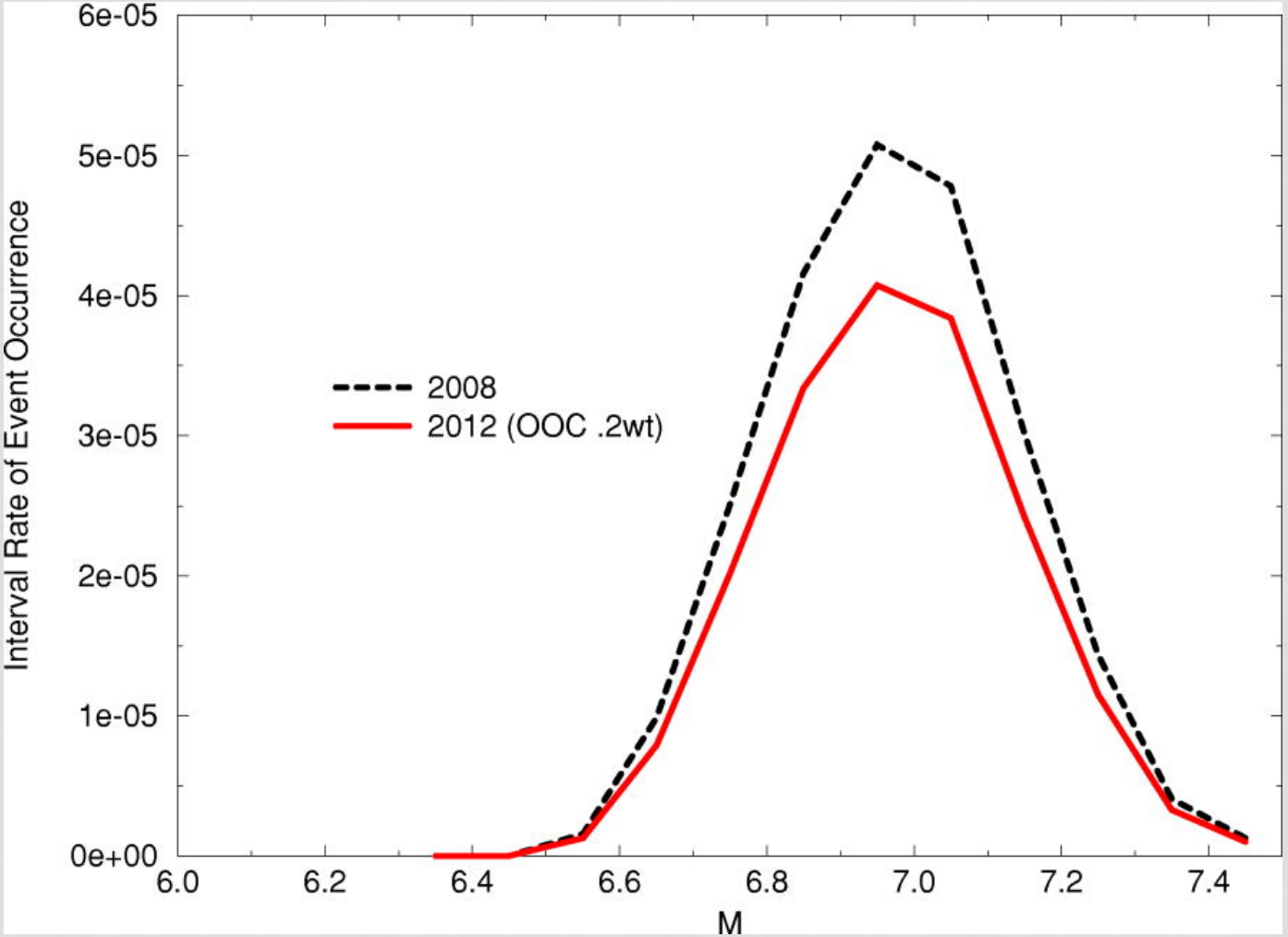
MAGNITUDE-FREQUENCY DISTRIDUTION, MEERS SOURCE



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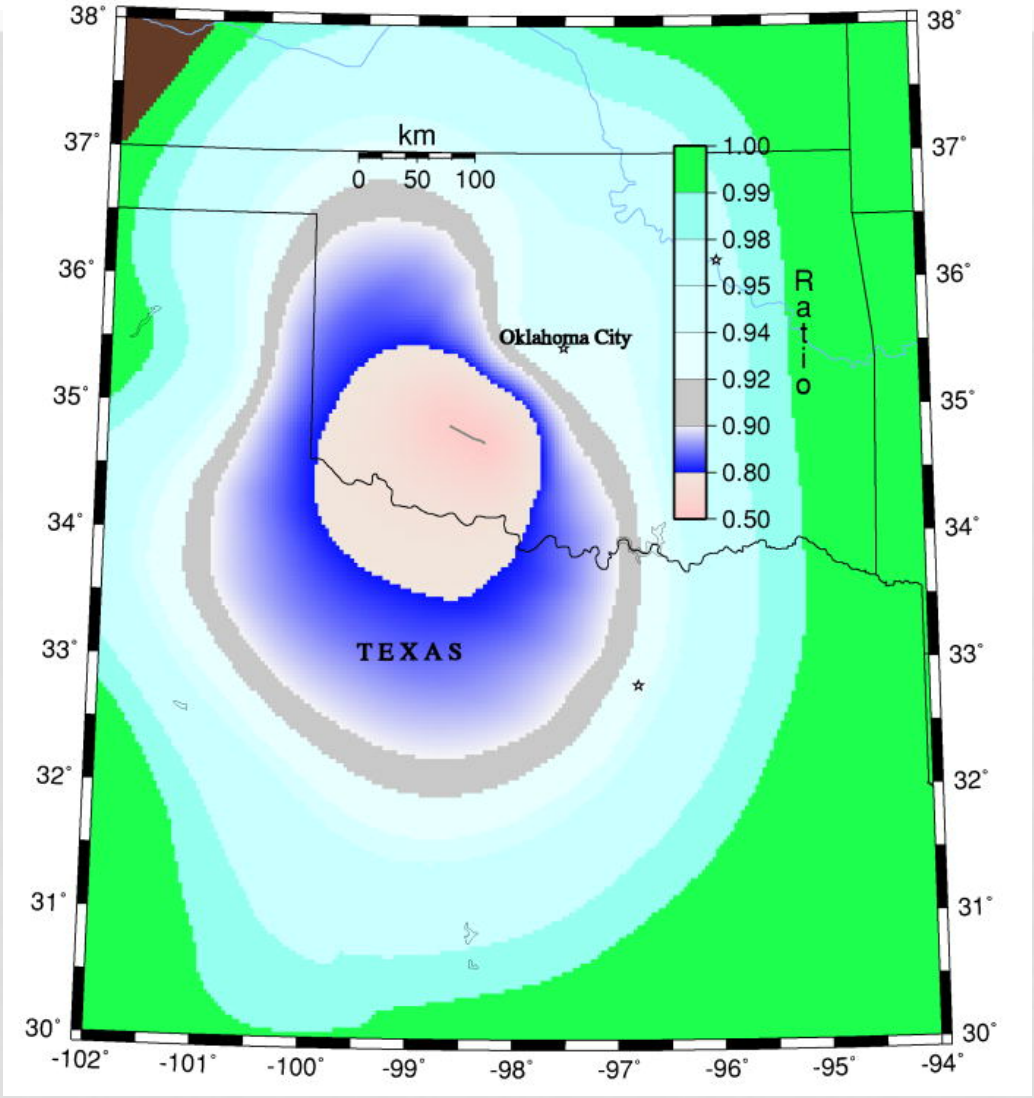
IMPLEMENT OUT-OF-CLUSTER BRANCH



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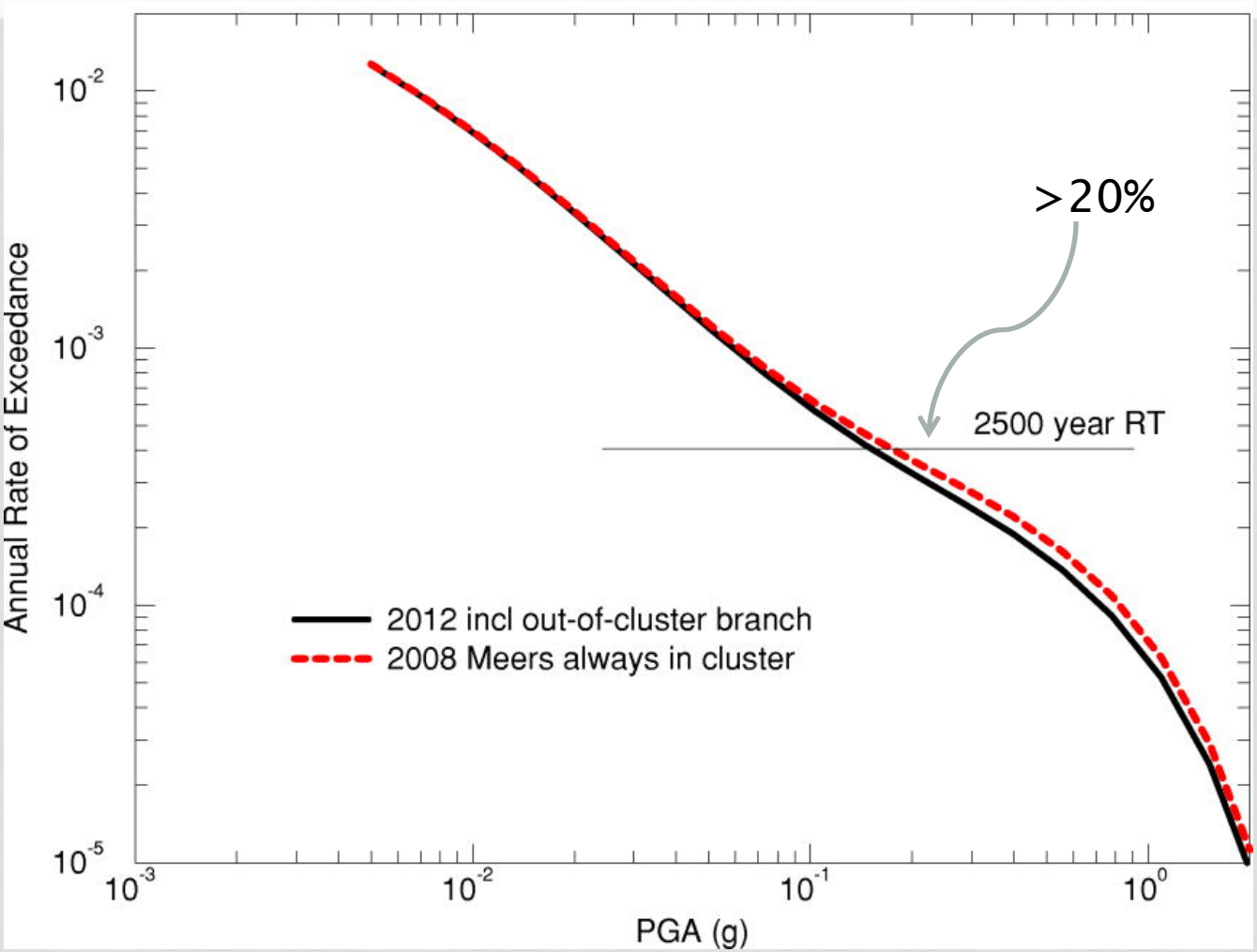
HAZARD AT LAWTON, OKLA.



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CRUSTAL FAULT QUESTIONS

- Should the USGS consider additional width alternatives?
- Should the USGS consider longer source alternatives?
- Should the USGS consider consider out-of-cluster branch?

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