

Non-tectonic Earthquakes

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We currently exclude non-tectonic events if...

- The seismogenic process is ongoing but significant hazard is not expected (e.g., most mining blasts, coal bumps, rock bursts, fluid injection)
- The seismogenic process has ceased (e.g., Rocky Mountain Arsenal)

Identification

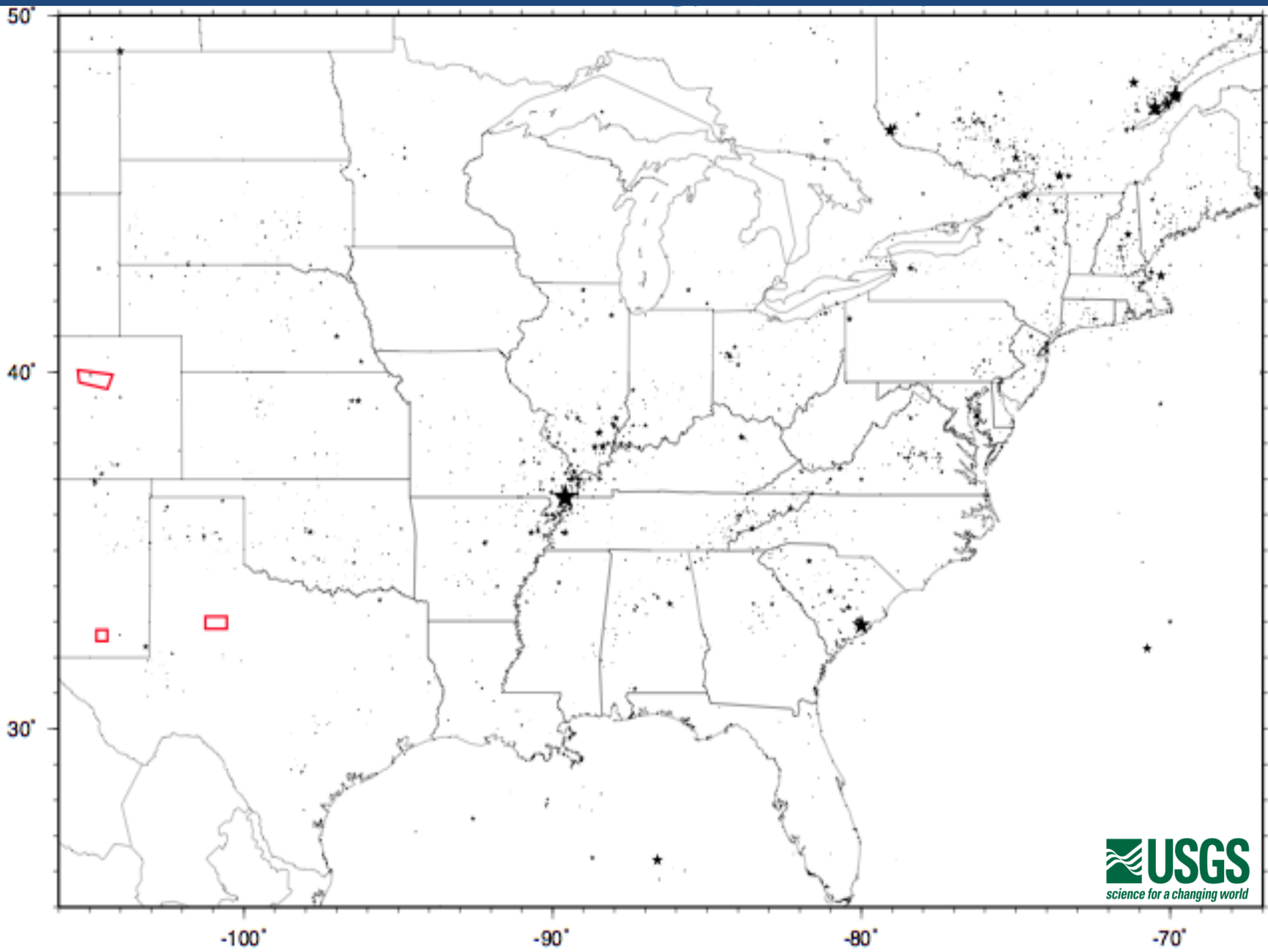
- ✓ Special studies & published listings. Examples:
 - Mining-related seismicity in Kentucky (Street, Bollinger & Woolery, SRL, 2002)
 - Mining-related seismicity in Colorado (Kirkham & Rogers, ColoradoGS Bulletin, 2000)
 - US Nuclear Tests July 1945 through September 1992 (DOE/NV-209-REV15, 2000)
- ✓ *Ad hoc* inquiries about specific events
- ✓ Explosion flag in PDE

Implementation

- ✓ “Exclusion zones” (preferably with begin & end dates)
- ✓ “Special Case” listings (trump all other sources during catalog assembly process)

Zones

- Central Utah: coal mining, 1900-?
- Rangely, CO: fluid injection, 1957-?
- Rocky Mountain Arsenal, CO: fluid injection, 1962-1975
- Cogdell, TX: oil 1974-?
- Paradox Valley, CO: fluid injection, 1985-?
- Dagger Draw, NM: oil, 1998-?
- Paonia, CO: coal mining, 2001-?



ENA Special Cases

| Since 2010:
 | Mar2011-Jan2012 Youngstown OH. Injection?
 | Oklahoma, Arkansas, TrinidadCO, DallasTX - induced?

| New Mexico along CEUS/WUS boundary (fix Nov10)
 | Force this eqk into wmm.c so it doesn't get lost.
 4.8 -106.95 36.96 0 1966 01 23 01 56 39.3 *SNM

| West of Chicago, quarry blast? (Boyd email, Sep10)
 2.7 -87.85 41.80 0 2010 08 31 18 00 30. *?

| 1534 Canada, bogus DNAG? (Wheeler email, Aug10)
 6.3 -70.10 47.70 0 1534 1 1 0 0 0. -Wheeler

| 1964 Saskatchewan, bogus DNAG? (Atkinson email, Jul09)
 4.0 -109.70 50.00 33 1964 09 19 20 51 05. -Atkinson

| 1910 Arizona, new magnitude (Pancho BSSA, Apr08)
 5.0 -111.10 36.00 0 1910 09 24 04 05 0. +Pancho, BSSA

| Ohio, mine-related (Mike Hansen email, Aug06)
 3.4 -81.61 39.75 0 1988 05 28 16 18 28.1 *MOH

| Kentucky mine-related (Street, Bollinger & Woolery-SRL, 2002)
 2.5 -87.49 37.17 0 1984 09 20 20 42 31.0 *MKYb
 1.1 -87.31 37.49 0 1985 03 11 23 46 54.4 *MKYb
 1.9 -88.39 37.69 0 1986 07 15 07 07 48.2 *MKYb
 2.6 -85.92 37.95 0 1986 12 05 18 45 03.8 *MKYb
 2.5 -88.46 37.35 0 1987 02 18 23 36 37.5 *MKYb
 2.2 -86.63 37.31 0 1987 03 12 18 05 55.9 *MKYb
 3.1 -85.80 37.94 0 1987 06 04 17 19 23.4 *MKYb
 2.5 -86.11 37.18 0 1987 06 13 19 25 57.7 *MKYb
 2.2 -83.73 38.12 0 1989 04 07 03 55 05.9 *MKYb
 4.3 -82.07 37.14 0 1989 04 10 18 12 16.0 *MKYb
 2.0 -83.65 36.68 0 1989 06 13 02 32 29.3 *MKYb
 2.4 -83.93 36.61 0 1989 12 02 18 02 27.7 *MKYb
 2.2 -86.99 37.23 0 1990 01 25 22 06 49.2 *MKYb
 2.2 -86.78 37.34 0 1990 02 20 19 51 05.4 *MKYb
 2.5 -86.79 37.32 0 1990 03 08 17 32 57.2 *MKYb
 1.9 -86.73 37.16 0 1990 03 12 21 31 36.2 *MKYb
 2.1 -86.86 37.31 0 1990 03 15 22 27 02.4 *MKYb
 2.6 -86.79 37.20 0 1990 03 22 17 29 00.0 *MKYb
 2.0 -86.90 37.39 0 1990 04 08 19 52 22.9 *MKYb
 2.7 -83.05 36.95 0 1990 11 08 10 02 10.9 *MKYrf
 ... 13 more MKYb thru Nov1998 ...

ENA Special Cases - continued

| Colorado mine-related (Kirkham & Rogers-CGS Bull 152, 2000)
 0.0 -106.17 39.37 0 1964 05 23 21 44 59.1 *MCO Climax
 4.7 -106.46 39.36 0 1966 04 03 16 21 34.0 *MCO SouthPark
 3.0 -107.39 39.14 0 1984 06 12 04 48 54.1 *MCO Redstone
 3.1 -107.48 38.93 0 1994 09 26 01 21 45.6 *MCO Somerset
 2.8 -107.49 38.90 0 1994 11 02 02 05 44.4 *MCO Somerset
 3.0 -107.45 38.87 0 1995 01 01 12 43 19.3 *MCO Somerset
 2.9 -107.48 38.88 0 1995 03 14 22 13 47.7 *MCO Somerset

| Nukes (DOE/NV--209-REV 15, Dec2000)
 | Gnome (near Carlsbad NM, 3kt, Plowshare)
 0.0 -103.87 32.26 0 1961 12 10 19 00 00.0 *AECGnome
 | Salmon (near Hattiesburg MS, 5.3kt, VelaUniform)
 0.0 -89.57 31.14 0 1964 10 22 16 00 00.0 *AECSalmon
 | Sterling (near Hattiesburg MS, 0.38kt, VelaUniform)
 0.0 -89.57 31.14 0 1966 12 03 12 15 00.1 *AECSterling
 | Gasbuggy (near Farmington NM, 29kt, Plowshare)
 5.1 -107.21 36.68 0 1967 12 10 19 30 00.1 *AECGasbuggy
 | Rulison (Grand Valley CO, 40kt, Plowshare)
 5.3 -107.95 39.36 0 1969 09 10 21 00 00.0 *AECRulison
 | Rio Blanco (near Rifle, CO / 33kt*3 / Plowshare)
 5.4 -108.37 39.79 0 1973 05 17 16 00 00.1 *AECRioBlanco

| 1916 Skyland, relocate (Chapman, pc)
 5.2 -83.55 35.62 0 1916 02 21 22 39 0. +Chapman

| 1909 Illinois, USHIS loc more consistent with felt rpts
 5.0 -88.1 41.6 0 1909 05 26 14 42 0. +USHIS

| 1882 Colorado, Mw=6.6 (~mb) from felt area (Spence BSSA, 96)
 6.6 -105.5 40.5 0 1882 11 08 01 30 0. +Spence, USHIS

| 08 Jan 1817 CEUS. NCEER event added in 2008 update. Youngs:
 | 04:00 local and 09:00 GMT the same? Armbruster: offshore
 | based on intensity. EPRI is near lat 36! Munsey will check.

| pre-1700 (Ebel SRL, May1996)
 6.5 -71.8 44.4 0 1638 06 11 19 0 0. +Ebel
 7.0 -70.1 47.6 0 1663 02 05 22 30 0. +Ebel
 3.5 -71.5 42.5 0 1668 12 19 0 0 0. +Ebel
 3.5 -70.8 42.8 0 1685 02 18 21 0 0. +Ebel
 3.0 -70.8 42.0 0 1697 02 20 11 15 0. +Ebel

CEUS-SSC

- They started with NSHMP information, then did an extensive analysis.
- New catalog of non-tectonic seismicity.
- NSHM updates: we can build on CEUS-SSC non-tectonic list (whether we adopt their overall catalog or not).

Issues

- ✓ Name: non-tectonic?, man-made?, induced?
- ✓ How large can they be?
- ✓ Should we consider more complex models with alternative recurrence or m_{max} ?
- ✓ These earthquakes are controlled by processes that can start or stop “arbitrarily”. How do we accommodate this in a PSHA?