

DRAFT - MEETING NOTES
COLORADO EARTHQUAKE HAZARD MITIGATION COUNCIL
September 15, 2022

1. **Attendees** Rob Jackson, Matt Morgan, Bob Kirkham, Vince Matthews, Ivan Wong, Allison Shumway, Emily Palmer, Robin McGuire, Steve Boand, Will Levandowski, Kyren Bogolub, Sean McGowan, Michael Haughey
2. **Additions to agenda**
 - a. TetraTech is trenching a paleoseismic site
 - i. people are invited to the trench review, tentatively Oct 6 or 7, if you want more info email Will!
 - ii. 31 Mile Buffalo Gulch Fault – in a Laramide fault zone.
 - iii. Maybe 1000 feet of throw in the tertiary
3. **Approval of minutes from the July 21, 2022, meeting**
 - a. Matt motion to Approve
 - b. Rob seconds
 - c. Approved!
4. **Matthew Morgan has been named as the new Director of the Colorado Geological Survey and the Colorado State Geologist.**
 - a. <https://coloradogeologicalsurvey.org/2022/65028-introducing-our-new-director/>
 - b. Nice job Matt!
5. **Will Levandowski, PhD, Tetra Tech, will present on the current status of the WUS/CEUS attenuation boundary determination.**
 - a. Collaboration between Levandowski, Dan McNamara, and USGS folks
 - b. Will and Dan’s boundary between CEUS and WUS looks very similar to the current USGS boundary but moved about 200 km north in Colorado, and the Colorado Plateau area (CEUS) gets a bit wider
 - c. Small effect on hazard, ~10% reduction in hazard for cities near the boundary
 - i. Mostly where the hazard is already low
 - d. Attenuation scales with lithosphere temperature
 - e. Sharp boundaries between thermochemical structure are between Proterozoic terranes
 - f. How are CEUS and WUS treated differently in the USGS National Seismic Hazard Model?
 - i. “Background seismicity” source – how EQ occurrence history is used to predict future earthquakes
 1. B values, 1.0 in CEUS and 0.8 in WUS
 2. Details of b-value might be one thing that will be improved in the updates of the map

- ii. How magnitude scales are converted to moment magnitudes
- g. Lg Attenuation Tomography
 - i. Measure ground displacement as a function of distance in different frequency bands – non overlapping frequency bands equates to unique data sets
 - ii. Linear inversion for quality factor (Q – inverse of attenuation)
 - iii. Decay of ground motion amplitude is also dependent on:
 - 1. source (EQ size)
 - 2. “Site effects” which is local geology near seismic receiver
 - iv. Measuring attenuation structure integrated through the entire crust
 - 1. Applies to events with epicenter distances up to ~2000km
 - v. To look across different frequency bands, examine Q_0 in $Q(f) = Q_0 * f^n$ to compare all the different frequency bands
 - vi. We see in the tomograms, SHARP boundary! Between CEUS and WUS
- h. Patterns in the Q maps
 - i. WUS
 - 1. Wasatch
 - 2. Yellowstone
 - 3. Southern Rockies
 - ii. CEUS – Proterozoic scars
 - 1. Suture zones on western Plains
 - 2. Midcontinent rift
- i. How do you turn a map into a line boundary between CEUS and WUS?
 - i. Ignore the Q map!
 - ii. Instead, examine on an event-by-event basis and look at all the stations along a single azimuth
 - 1. Plot up all the amplitudes on those stations
 - 2. Look for places where the slope of amplitude / distance changes, changes in the slope mean changes in Q
 - 3. That’s neat!
 - iii. Look at enough azimuths on enough individual events and you will get a bunch of scattered points you can trace a line through
- j. There’s an elephant in the room
- k. Sensitivity analysis shows that the hazard doesn’t change very much
 - i. Mostly related to how EQs move from one catalog to the other and how magnitudes are converted
- l. The elephant trunk is seen in a few different data sets
 - i. Temperature at 10km depth
 - ii. Seismic velocity in lower crust
 - iii. Average Vs in 70-125 km
 - iv. Again, indicates this is a thermochemical attenuation
 - 1. Not scattering, which is from physical things like crustal thickness and fractures

- v. Can even see it in a stress direction map!!! Boundaries are pretty profound, wow
- vi. So, it's interesting that since stress isn't transmitted across these strong attenuation (thermo related) boundaries!
- vii. 3 types of stress
 - 1. Edge, base, and body
 - a. Edge and base not happening here, not active plate boundaries
 - 2. Body comes from gravity, which acts on density variations within the material!
 - 3. So maybe the different thermochemical states change the density structure and thus the body stress! Ta-da
- m. Ok, 2nd order features in attenuation map – caused by scattering (probably?)
 - i. If we look back at this $Q(f) = Q_0 * f^n$ that n term (which is a Greek letter eta btw) is related to scattering attenuation!
 - ii. So, if we account for intrinsic scattering (from our Q_0 term) than what's left should be related to n (eta) and therefor related to scattering component of attenuation!
 - iii. What causes scattering?
 - 1. In Wasatch, probably lateral variation crustal thickness
 - 2. In Southern Rockies, Melt-filled dikes (rift related?) are the preferred explanation
- n. Elephant is not seen in some other geophysics that are less related to thermochemical structure, so once again, evidence its mostly thermo in origin

6. The 2020 Building Resilient Infrastructure and Communities (BRIC) program and the Mitigation Project Proposal entitled "Colorado Earthquake Resilience Investigation – Code Review & Rapid Visual Screening Pilot Study."

- a. There are two elements to the project.
 - i. Element 1 is a statewide examination of building codes applied to all K-12 public schools.
 - ii. Element 2 encompasses a pilot study of up to six critical infrastructure buildings using FEMA 154.
 - 1. The Las Animas County / City of Trinidad seismic area is to be examined as an Element 2 study site.
- b. Working group met May 24, June 21 and August 16. Code review meetings have occurred on July 25 and August 22. SEAC may provide volunteer evaluators for the field screenings
 - i. Working group meets the 20th , code group meets the 26th
 - ii. Keith Porter and Jim Harris will give their thoughts at the next code meeting
- c. There are arbitrary ground motion boundaries that result from the determination of Seismic Design Category as a function of site class and the step-function breakpoints in the building code.

- d. Lots of uncertainty goes into the decision-making process on building codes
- e. Summer 2023 will probably be when we do assessments on the buildings

7. CUSEC Apps: Apps & Field Data Collection (cusec.org)

- a. Similar to Rover app – an update
- b. Record field data of buildings
- c. Would be good to be able to put it into a database the state could get access to?

8. ShakeOut October 20, 2022.

- a. CEHMC is signed up. SEAC Seismic will have post in LinkedIn.
- b. Progress, slowly but surely!
- c. Would be good to get more K-12 schools

9. Kyren Bogolub recently had an updated Outcrop article published in the 100-anniversary issue of The Mountain Geologist. See “A brief history of notable Colorado seismicity and seismic stations,” pg. 251.

10. Discuss any new relevant seismic hazard updates for the state; new/ongoing projects, research, or any other topics of interest.

- a. Crickets chirp

11. Possible future speakers.