2019 BASIN AND RANGE PROVINCE EARTHQUAKE WORKING GROUP MEETING SUMMARY

Wednesday, February 6, 2019
Utah Department of Natural Resources Building, Auditorium (1st Floor)
1594 West North Temple, Salt Lake City, Utah

WELCOME AND INTRODUCTION

The Basin and Range Province Earthquake Working Group (BRPEWG) aims to bridge the gap between Basin and Range Province (BRP) and Intermountain West (IMW) state geologic survey earthquake research programs to address the need for effective communication and collaboration in applied earthquake-hazard research in the region. BRPEWG was previously convened at the Utah Department of Natural Resources building in 2006, 2011, and 2018. The 2019 meeting of BRPEWG was not funded by the U.S. Geological Survey (USGS) external grants program, but the meeting was still held due to the need to build on a successful meeting in 2018. Due to weather, the 2019 meeting had a delayed start of 10:00 am to allow attendees to safely commute to the DNR building. After welcoming Working Group members and guests, Emily Kleber (Utah Geological Survey [UGS]) summarized the BRPEWG's past activities and outlined the Working Group's purpose and goals for the future.

BRPEWG Purpose and Goals

- Establish and coordinate earthquake-hazard research agenda in the BRP, especially collaborative work across state lines.
- Provide a space and resource for Basin and Range states to determine and discuss technical issues related to fault behavior in the Basin and Range Province.
- Share best practices and reports of ongoing work in research programs in the Basin and Range.
- Identify and prioritize BRP cross-border Quaternary faults and future paleoseismic investigations in order to attribute fault characteristics in Basin and Range state fault databases and the USGS *Quaternary Fault and Fold Database of the United States.*

TECHNICAL PRESENTATIONS

- USGS Earthquake Geology Intermountain West (IMW) update: Ryan Gold, U.S. Geological Survey Intermountain West
- Idaho Earthquakes and Active Faults: Zach Lifton, Idaho Geological Survey
- Building a Montana Q Faults Database: Petr Yakovlev and Mike Stickney, Montana Bureau of Mines and Geology
- Earthquake Program at NBMG: Rich Koehler and Seth Dee, Nevada Bureau of Mines and Geology
- Updates and Highlights from Wyoming (remote): Seth Wittke, Wyoming Geological Survey

- Soil, Fluid, and Rock Properties Derived from Seismic Data: Hazard and Resource Assessments: Lee Liberty, Boise State University

- Basin and Range Province Earthquake Working Group Utah Update: Emily Kleber, Utah Geological Survey

DISCUSSION ITEMS

This group previously convened in 2018 via a USGS external research support grant to bring in earthquake and geologic hazards specialists from Basin and Range states. In 2019, the USGS did not provide external funding for the Utah Earthquake Working Groups, but several state representatives were able to attend the meeting with support of their organizations. The working group members present represented Idaho, Montana, Nevada, and Utah. Wyoming made a remote presentation, and Arizona and New Mexico sent summaries that were read out loud at the meeting. The summaries are at the end of this document.

Prior to the meeting, a survey was sent to working group members to decide on a discussion topic. The chosen topic was Quaternary fault databases. Existing state databases include:

- Arizona
  - Internal (recent updates at end of this document, fed into USGS national database)
- California
  - California Geological Survey Data Viewer – Quaternary Faults Layer (ESRI web map)
  - California Geological Survey – EQ Zapp: Earthquake Zones of Required Investigation (ESRI web map)
- Idaho
  - Idaho Miocene – Quaternary Fault Map (KMZ)
- Montana
  - Internal (update in P.Yakovlev presentation from 2019 BRPEWG meeting)
- New Mexico
  - New Mexico Bureau of Geology and Mineral Resources (NMBGMR) Interactive Map: Quaternary Fault layer (ESRI Web Map)
- Nevada
  - Quaternary Faults in Nevada (ESRI web map)
- Oregon
  - Oregon HazVu: Statewide Geohazards Viewer (ESRI web map)
- Utah
  - Utah Quaternary Fault and Fold Database (ESRI web map)
- Wyoming
  - Quaternary Fault and Folds in Wyoming Compilation (PDF)

The discussion was led by Rich Koehler (NBMG) and Emily Kleber (UGS), and occurred after presentations wrapped up from the Basin and Range states present. From the morning's presentations, it is clear that Basin and Range state geological surveys have varying levels of financial and technical support, as well as availability to focus on earthquake-related hazards studies, and thus fault databases are at differing levels. The group discussed the importance of having fault databases with the best available data available via state survey websites, and also via the USGS Quaternary Fault and Fold Database of the United States and the USGS U.S. Quaternary Faults map. The group discussed the recent changes (January 2017) to how the USGS will update a limited number of metadata fields in its database, and no

longer update “detailed reports” for faults.

The group discussed the different attributes that must be included in updates to the USGS database, but also discussed some attributes which may not be useful for each geologic survey. There was agreement on this for certain attributes (e.g., fault class), but disagreement for others (e.g., mapping certainty). The group discussed the importance of updating these attributes in the USGS database for upcoming updates to the USGS seismic hazard maps, including a minor update completed in 2018 and a major update coming up in 2020.

The group also discussed the future of the BRPEWG and what future topics should be discussed. Members were interested in having more opportunities to develop collaborative proposals, as well as share knowledge and “best practices” for things like geochronology, applying high resolution topographic data to earthquake hazards, and using software to create surface models with stereo-paired aerial photos. The group agrees that it is important to continue meeting annually in order to share knowledge and continue with earthquake studies in the Basin and Range Province.

WORKING GROUP PRODUCTS AND RELATED DATA

The final agenda, speaker presentations, and this summary document are available on the BRPEWG web page at https://geology.utah.gov/hazards/earthquakes-faults/utah-earthquake-working-groups/basin-and-range-province-earthquake-working-group/.

MEETING ATTENDANCE

Working Group Members (* Speaker)

Steve Bowman	Utah Geological Survey
Seth Dee*	Nevada Bureau of Mines and Geology
Chris DuRoss	U.S. Geological Survey, Earthquake Hazards Program
Colleen Elliott	Montana Bureau of Mines and Geology
Ryan Gold*	U.S. Geological Survey, Earthquake Hazards Program, IMW Coordinator
Emily Kleber*	Utah Geological Survey (BRPEWG Co-Chair)
Rich Koehler*	Nevada Bureau of Mines and Geology (BRPEWG Co-Chair)
Zach Lifton	Idaho Geological Survey
William Lund	Utah Geological Survey, Emeritus
Lucille Piety	U.S. Bureau of Reclamation
Petr Yakovlev*	Montana Bureau of Mines and Geology

Guests

Sofia Agopian	GeoStrata, Inc.
Gordon Douglass	Utah Geological Survey
Rich Giraud	Utah Geological Survey
Michael Hylland	Utah Geological Survey
Susan Lutz	Public
Bill Keach	Utah Geological Survey
Greg McDonald	Utah Geological Survey
Adam McKean	Utah Geological Survey
Jim Pechmann	University of Utah Seismograph Stations

UPDATES FROM WORKING GROUP STATES NOT PRESENT

Arizona Geological Survey – Earthquake Program Activities 2017-2018

Jeri Y. Ben-Horin and Phil Pearthree

Summary

The Arizona Geological Survey has continue to add additional Quaternary faults to our faults database using field mapping and aerial photographic interpretations. AZGS is currently mapping the Mead Slope fault, north of Hoover Dam, and preparing to date faulted and unfaulted landforms in order to better constrain displacement history and slip rate, as well as locate potential paleoseismic sites. AZGS submitted a proposal to NEHRP map the Lake Mary fault, in the Flagstaff area with the goal of determining long-term slip rates, and to locate paleoseismic sites. Neither the Mead Slope nor the Lake Mary faults have been excavated for earthquake histories and slip rate determinations. AZGS has informally updated the internal AZGS faults database, but the additions need further analyses in order to be added to the official database. The Arizona Broadband Seismic Network is in its 11th year of operation, and has expanded to 15 broadband stations. The AZGS earthquake catalog is updated, and includes earthquakes that are below the detection threshold reported by the NEIC for Arizona. AZGS has continued outreach efforts that include the Great Arizona ShakeOut, social media announcements regarding local quakes, and fielded many calls from citizens interested in earthquakes.

Fault Mapping and Analyses

Ongoing -

The Arizona Geological Survey has continued to add additional Quaternary faults to our database using our StateMap efforts, as well as general reconnaissance mapping efforts across the state. Previously mapped faults in and adjacent to the city of Flagstaff were mapped in greater detail this past summer using newly available LiDAR data. AZGS added 3km of additional length to the northern strand of the Oak Creek fault where it cut Quaternary basalt flows, as well as multiple smaller fault traces paralleling the main strand within the Flagstaff city limits.

AZGS obtained a NEHRP grant to better constrain the displacement history, slip rate and evaluate potential trench sites along the Mead Slope fault, just north of Hoover Dam. Work along the Mead Slope began in earnest this past fall, after a lengthy permit process to fly a drone within

land administered by the National Park Service (Lake Mead Recreation Area in this case) was finally obtained. Aerial photos taken with the drone, along with ground control points were used to generate high-resolution DEMs using the AgiSoft Software. Using the DEMs generated with AgiSoft, the fault zone is being mapped in detail (1:6,000 in some places) and it appears that movement has occurred along two main parallel strands, with the westernmost strand showing more clear evidence for a younger rupture compared to the last rupture on the eastern strand. In addition, we are evaluating faulted and unfaulted deposits for potential cosmogenic and OSL dating. There is abundant evidence of greater deformation of older Pliocene-Quaternary deposits along the fault, which we are working to better define through our detailed mapping efforts.

Planned –

The AZGS submitted a proposal to the National Earthquake Hazards Reduction Program for detailed mapping using drone photography and DEM generation, with the goal of locating potential paleoseismic sites along the Lake Mary Fault Zone, just south of the city of Flagstaff. This fault has evidence of Quaternary faulting, but a paleoseismic investigation has never been completed.

Faults and Folds Database Updates

The AZGS has informally updated the Quaternary fault database for Arizona and we use the updated version for internal purposejjs. When we have time to perform quality control and complete new data forms, we would like to add these to the national fault and fold database. While this would not require a lot of time or resources, we have not been able to complete the process – but hope to do so in the next 2 years or less.

Seismic Network –

The Arizona Geological Survey has owned and operated a broadband seismic network since 2008. Originally consisting of 7 legacy TA stations, the AZGS added 6 additional broadband stations, and recently adopted two additional TA stations (214A in Organ Pipe CNM, and W18A in Petrified Forest NP) this past fall. AZGS has maintained stations in the field, data flow to our servers, and archived data at the DMC. The NEIC incorporates AZGS station data in regional and local earthquake locations; however, AZGS maintains a separate earthquake catalog because the NEIC only locates events in the M 3.0 or greater range for many parts of the state. Only the very northernmost section of Arizona is monitored for quakes below M 3.0 as the Utah University Seismograph Stations and the Nevada Seismic Lab overlap AZGS in their monitoring efforts, and are recognized as a contributing regional network by the NEIC.

AZGS is currently upgrading its data acquisition system with Earthworm 8.0 and will determine if the expanded broadband station coverage will be dense enough to utilize Earthworm's auto-detection modules. AZGS' goal is to improve catalog completeness, and provide more accurate seismicity rates for the state.

Outreach –

The biggest outreach effort by AZGS was in the form of the Great Arizona ShakeOut that was funded by NEHRP and matching funds from AZGS and included logistical support from the Arizona Dept. Emergency and Military Affairs. The Great Arizona ShakeOut of Oct. 2018 engaged 113,824 people practicing, 'Drop, Cover, & Hold On', to prepare for the ground shaking that accompanies moderate to severe earthquakes. Enrollment in 2018 increased 3% from 2017; in 2016 and 2015, enrollment was ~66k and ~74k, respectively. Our primary audience of K-12 and college students and staff comprised 49,412 (46,707 in 2017) and 29,575 (29,090 in 2017), respectively.

New Mexico Bureau of Geology & Mineral Resources

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BRPEWG 2019 February 6, 2019

Re: New Mexico Earthquake Program Update

1. The Bureau of Geology/New Mexico Tech hired a new seismologist in February 2018. Dr. Mairi Litherland joins us from Stanford University where her dissertation was on the crustal structure of the Ruby Mountains metamorphic core complex, NV, using passive seismic imaging.

Mairi is the manager of the New Mexico Tech Seismological Observatory

(www.ees.nmt.edu/outside/NMTSO/), where she is maintaining ~20 seismic stations in the Socorro area and southeast NM (Permian Basin). She's also working to expand network coverage throughout the state.

2. Trenching investigations of the Pajarito fault continue at Los Alamos National Labs (literally in their backyard!). The Pajarito fault is one of the most active in the state and definitely the most trenched. General consensus so far is that the most recent surface rupture event occurred 1.3-7.3 ka.

Three trenches were dug in 2018 but only two hit major fault strands. Strata interpretation and pedogenic and geochronological analyses are ongoing. Dan Koning and Shari Kelley from the Bureau are participating in this project along with paleoseismologists from Los Alamos and Lettis Consultants International.

3. The NM Dept. of Homeland Security & Emergency Management has asked the Bureau to consider hosting a post-earthquake clearinghouse. We are hoping to observe Idaho's clearinghouse exercise in March and are in discussions with Matthew Wall and Patti

Sutch at WSSPC to iron out the details. This would be a 2020 effort if we decide to pursue it.

4. A QuakeSmart conference geared at local businesses was held in Albuquerque on October
18 in conjunction with Great ShakeOut. The event was hosted by the City of Albuquerque Office of Emergency Management. Cynthia Connolly, Dan Koning, and Mairi Litherland attended from the Bureau.

Unfortunately, ShakeOut numbers in NM were once again the lowest in the Intermountain West at <4,000. I've encouraged our outreach coordinator, Cynthia Connolly, to confer with Mark Benthien at SCEC on strategies to improve participation.

5. The Bureau now hosts the state's Quaternary faults and folds database on our web map application at https://maps.nmt.edu/. I'm the point-of-contact for updating the database (though I need to advertise this better) and we have a GIS team who can readily update the web map. The faults are downloadable and currently shown at 1:500,000—I'd like to make our 1:24,000 dataset available as well.

6. New Mexico continues to acquire LiDAR data for large swaths of the state. The attached image shows data available from the Earth Data Analysis Center at the University of New Mexico. I believe this is all QL1 and QL2, and portions of it can be downloaded online at https://rgis-data.unm.edu/rgisportal/. There are also QL2 datasets for the Rio Grande corridor in southern NM extending south into Texas; the Bureau has these but I don't know about their wider availability.

More data for central and eastern NM is set for a spring 2019 delivery thanks to funding by NRCS, FEMA, and USGS. Contacts for NM LiDAR data are Mike Timmons at the Bureau of Geology (mike.timmons@nmt.edu) and Paul Neville at EDAC (pneville@edac.unm.edu).

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Attached image: