U.S. Geological Survey Cooperative Agreement Award Number
Award #G19AP00009

Final Technical Report

Nevada Quaternary fault database: A new publicly accessible web-based resource

Rich D. Koehler (PI) and Jennifer Vlcan (co-PI)

Nevada Bureau of Mines and Geology
University of Nevada, Reno
1664 N. Virginia St., MS 178
Reno, NV 89557
(775) 682-8763, fax: (775) 784-1709
http://www.nbmg.unr.edu/
rkoehler@unr.edu
mauldin@unr.edu

December 28, 2020

Research supported by the U.S. Geological Survey (USGS), Department of Interior, under USGS award number G19AP00009. The views and conclusions contained in this document are those of the authors and should not be interpreted as representing the opinions or policies of the U.S. Geological Survey. Mention of trade names or commercial products does not constitute their endorsement by the U.S. Geological Survey.

Table of Contents

Abstract……...…….…..… 3
Introduction and Background……...…… 3
Methods and Technical Workflow…….....……..…….....4
Infrastructure.....4
Master Database.....5
Integrating New Mapping.....5
Preparation for Scientific Interpretation.....7
Layer Symbology.....7
Tracking Technical Information and GIS Edits.....7
Web GIS Development.....8

Results and Summary…….....……..……..…..8

Future Work…….…….....…….9
Reports Published…….....…….....…..9
Data Availability…….....……...9
Acknowledgments…….....……...….…..9
References…….....…….……10
Figures……...……..……....13

Abstract

The Nevada Bureau of Mines and Geology (NBMG) developed a new Quaternary fault database platform for Nevada, the third most seismically active state in the nation. Previous fault compilations for the state used in the USGS Quaternary fault and fold database are no longer being updated, thus there is a need for Nevada to maintain and update its fault database to reduce uncertainties in fault location and rupture parameters. To address this need, NBMG designed and built cyber infrastructure to host a new web-based Quaternary fault database for the state and began to populate the database within three pilot 1:250,000-scale quadrangles including the Reno, Walker Lake, and Las Vegas quadrangles. New information compiled for the database includes Quaternary fault traces from 42 geologic maps published through NBMG's STATEMAP program, updates to fault parameters from published research, and references. NBMG is currently merging the new information with the cyber infrastructure and anticipates releasing a web interface and downloadable GIS and KML files to earthquake scientists and the general public in 2021. The new database provides a model for expanding the database across the entire state in the future.

Introduction and Background

Nevada is the third most seismically active state in the United States (figure 1), behind Alaska and California (e.g. Anderson and Miyata, 2006). Much of this activity is associated with the Walker Lane (Oldow et al., 1994; Wesnousky et al., 2005; Faulds et al., 2005), which is a complicated and distinctive tectonic province, accommodating about 20–25% of the total slip between the North American and Pacific plates on the eastern side of the Sierra Nevada (Bennett et al., 2003; Hammond et al., 2011). The majority of the state of Nevada is in the Basin and Range Province, dominated by continental extension and normal faulting (e.g. Bennett et al., 2003) including the Central Nevada Seismic Belt, which hosted the Fairview Peak/Dixie Valley earthquakes in 1954 and the Pleasant Valley earthquake in 1915. Based on this seismic activity and the potential for future large earthquakes it is important to maintain a database of Quaternary active faults for the State that contains accurate information on fault trace locations and rupture parameters. The availability of the database on a web-based platform is useful to researchers, engineers, planners, and the general public and serves an important role in future earthquake research, seismic hazard assessments, earthquake risk reduction planning, and updates to the National Seismic Hazard Map.

Quaternary fault databases have been compiled and constructed for individual states for the USGS Quaternary Fault and Fold Database for the Nation (U.S Geological Survey, 2004) generally based on guidelines outlined in Haller et al (1993). Examples of these database compilations include those for California (Bryant, 2005), Oregon (Personius, 2002), Washington (Lidke et al., 2003), Montana (Stickney et al., 2000), Utah (Bowman, 2019), and Alaska (Koehler et al., 2012), among others. The USGS updated the online interface of the national Quaternary fault and fold database in 2017, but decided to only maintain select fault parameter metadata fields and are no longer updating fault trace data. This places the responsibility on individual states to maintain and update their respective Quaternary fault databases.

Original fault compilations in Nevada prepared for the national Quaternary fault and fold database (Sawyer et al., 1999) relied extensively on the quadrangle-scale Quaternary fault mapping across the state conducted for Department of Defense MX missile siting studies (e.g. Dohrenwend et al., 1996) and in the Reno/Carson City area, fault compilations by Bell (1981; 1984) and Dohrenwend (1982). These initial fault compilations were supplemented by fault trace data from consulting reports, published geologic maps, and journal articles. The Sawyer et al. (1999) compilation was adopted by the USGS national Quaternary fault and fold database and included detailed information on Quaternary faults such as most recent prehistoric deformation, geomorphic expression, paleoseismic studies, length, average strike, recurrence interval, and slip rate among other parameters. These parameters have only been variably

updated over the last 20 years and are not necessarily representative of the current understanding of the Quaternary behavior along each fault.

A more recent effort to compile Quaternary fault traces for Nevada was conducted by dePolo (2008), who added fault location data from fault compilations performed for county governments (dePolo and Dee, 2015a; 2015b; 2015c; 2015d; 2015e, and 2015f). This fault map, the "Quaternary faults in Nevada", NBMG Map 167 is displayed on NBMG's "MyHazards-Nevada" web application (https://gisweb.unr.edu/MyHAZARDS/) and is publicly available as a paper map (figure 2). However, GIS shapefiles and KML files of the database are difficult for the public to access. Despite being an improvement of earlier compilations, this map was never integrated into the USGS national Quaternary fault and fold database due to differences in schemas as well as limited fault parameter attributes for newly added faults. Additionally, this map does not contain Quaternary active faults shown on NBMG's geologic map products funded through the USGS STATEMAP program published over the last decade.

Comparison of the Sawyer et al. (1999) and dePolo (2008) compilations to the current USGS Quaternary fault database indicates fault trace location discrepancies, the presence of additional faults in the Nevada database that are not contained on the national map, and differing fault parameter information. This is partly a reflection of the addition of more recent information in later compilations, but also reflects map registration issues over the years related to multiple transformations of the data.

To address these discrepancies and update Nevada's Quaternary fault database to reflect recent research NBMG designed this pilot project to develop a master Quaternary fault database for three 1:250,000-scale quadrangles (Reno, Walker Lake, and Las Vegas) to ensure integration into the national database (figure 3). Efforts were focused on performing quality control over existing data and incorporating specific missing data and fault parameter attributes into the master database. The specific objectives of this project were to

- Design and build cyber infrastructure to host a new Quaternary fault database for Nevada including attribute tables of fault parameters and complete reference sources for each fault.
- Update, populate, and complete Nevada's existing database within the three pilot quadrangles (Reno, Walker Lake, and Las Vegas) with information published over the last 20 years including references and new geologic maps showing active fault traces published by NBMG through the USGS STATEMAP program; and
- Make the database publicly available through a web interface and downloadable GIS and KML files.

Methods and Technical Workflow

Infrastructure

A managed, enterprise database system was in development for NBMG when this project began, and it was considered for production. However, limited users editing the database, time constraints, and a steeper learning curve for this more robust system were all factors that led to the decision of using an ESRI file geodatabase for the master database. This kept the infrastructure basic for the pilot project to allow the focus to remain on updating specific data and determining a workflow to integrate faults from existing mapping. Ultimately, the final dataset from the pilot quadrangles can be integrated into the enterprise system to allow future updates of the statewide dataset to occur in a managed database in the future.

Master database

Early in the project development NBMG considered using NBMG's Map 167 (dePolo, 2008) as the master Quaternary fault database, as it represents the most recent compilation of active faults in Nevada. However, because this map was created with schema that differ from the USGS Quaternary fault and fold database and has limited fault parameter attributes, it was determined that it would be better to adopt the existing USGS database in order to seamlessly integrate Nevada updates into the national database in the future.

A copy of the USGS Quaternary faults and folds database was downloaded from the USGS website as an ESRI file geodatabase and served as the master database for this pilot project. All original fields and existing data in the USGS database were retained, and several fields were added to keep track of edits to the database during production (table 1).

Table 1. Fields added to master database to keep records of edits.

Field Name	Description
IncludeIn2020	Indicated whether the line should be included in the 2020 update
2020FaultCategory	Indicated whether the line is a Quaternary fault or a bedrock fault
Source2020	Stored the source of the line
Reference2020	Captured the scientific reference for the line
Notes2020	Captured any other important notes about the line

The USGS master database was compared to NBMG's Map 167 and several 1:250,000-scale Quaternary fault maps (Bell, 1984; Dohrenwend et al., 1982) to evaluate compatibility between these datasets. Differences between these datasets were rectified by inspecting GoogleEarth imagery to evaluate the quality of evidence supporting Quaternary activity. Faults that do not appear in the USGS national database but were determined to be Quaternary active were added to our master database. Additionally, discrepancies in fault location for faults shown on both Map 167 and the national database were rectified by inspecting the original map sources to determine the best representation. Examples of these discrepancies are shown in figures 4 and 5.

The new master database was constructed to be publishable as a streaming GIS layer to be displayed in the web application designed for this project (described below).

Integrating New Mapping

Quaternary faults mapped during NBMG's STATEMAP geologic mapping projects were integrated into the project mxd. NBMG's GIS layer of STATEMAP geologic map frames was queried to include only the 1:24,000-scale projects with new geologic mapping. These map frames were then clipped to the three pilot quadrangle boundaries, resulting in a total of 42 maps that coincided with the project area (table 2).

GIS packages for each of the resulting 1:24,000-scale maps were available in multiple formats from past GIS conversion projects. These individual data packages were gathered and organized into a common folder structure. Many of the geodatabases used common schemas, but many did not. Slight variations between the databases with common schemas were also discovered. Thus, it was decided to not migrate these data into a common database structure or the master database, and they were instead left in their original formats, which consisted of geodatabases (both file and personal) and shapefiles.

Based on inspection of the geologic mapping, NBMG identified faults that displace Quaternary deposits and tagged these faults in their own varied formats. For this tagging, a "Keep2020" field was added to each of the existing datasets and a "Y" was populated in the field for any fault trace that was to be

migrated into the master database. Lines from each of these datasets with a "Y" attribute in the Keep2020 field were later exported to temporary shapefiles and then imported into the master geodatabase. Prior to transferring the data into the master database, the fields and attributes in the exports were evaluated to determine which original fields corresponded to fields in the master.

Table 2. List of STATEMAP 1:24,000-scale published geologic maps from which fault traces were extracted for the master database. Maps are organized by 1:250,000-scale quadrangle.

1:250,000 scale quadrangle name	1:24,000-scale geologic maps added to the fault database
Reno	
	Bell Canyon
	Bell Mountain
	Fraser Flat
	West half of Moses Rock
	Dogskin Mountain
	Nixon Area
	Wadsworth
	Olinghouse
	Seven Lakes Mountain
	Virginia City
	Lahontan Mountains
	Grimes Point
	Flowery Peak
	McTarnahan Hill
	Tule Peak
	Sutcliffe
	Fernley East
	Stockton Flat Well
	Fernley West
	Griffith Canyon
	Lower Walker River Area North half
	Reno Area compilation
	Hazen
	Bunejug Mountains
	Desert Peak
	Wabuska
	West Gate
	Mount Rose
	Mt Rose NW
	Washoe City
	Granite Peak
Walker Lake	
	Minden
	Gardnerville
	Yerington
	Lower Walker River South Half
	Lower Walker River North Half
Las Vegas	
	Tule Springs Park
	Corn Creek Springs
	Frenchman Mountain
	Iceberg Canyon
	Pahrump
	Horse Springs

Preparation for Scientific Interpretation

An ArcMap document (.mxd) was prepared with various layers sourced to basemaps, quadrangle boundaries, the master database, the Map 167 database, and all GIS line layers for existing 1:24,000-scale STATEMAP products that were identified to be included in the project. Similarly, georeferenced images of 1:24,000- and 1:250,000-scale published geologic maps were also included as layers for reference. A screen shot of the ArcMap (.mxd) showing the various layers in the Table of Contents panel is shown in figure 6.

Group layers were developed to organize the numerous datasets. Brief notes were also added to layer names to make it clear which layers should be edited, and which were simply for reference and therefore not to be edited. In addition, brief notes to indicate the projection of each dataset were included in layer names since some layers were projected on-the-fly in the mxd and others were projected to a common coordinate system. The 1:24,000-scale quadrangle index was used as a reference layer and grid for tracking progress across the regional dataset during interpretation and GIS editing.

Layer Symbology

During interpretation, it was important to see which fault traces were marked for integration into the master database as Quaternary faults versus those that were not incorporated (i.e. bedrock faults). Thus, specific symbology was set on each existing map layer to visually track editing progress. All layers with existing mapping were set to show green lines for features with a "Y" attribute in the Keep2020 field, and a red color was used to indicate null values. Multiple layers with similar symbology were also used for tracking progress in the fields that were added to the master database.

Tracking Technical Information and GIS Edits

Tracking of technical details and GIS edits was important since so many datasets were being analyzed and incorporated into the master database. During project setup, a notes document was maintained to keep track of important details including folder paths, projections of layers, which datasets were projecting on the fly, what fields were added along with their intent, symbology meaning, and other reasoning during the setup process. This was critical to understand what exactly was done given the manual approach to the workflow and will be helpful for future phases of updates to the database.

Tracking of GIS edits was handled in the database using the editor tracking feature. Editor tracking was enabled in the master geodatabase settings of line feature class. This automatically added several fields to the attribute table of the lines feature class (table 3), and the system automatically populated the fields as GIS edits were made.

Table 3. Fields added to the master database to track personnel and date for all digitizing and editing.

Field Name	Description
CreateID	Automatically tracks who digitizes a new feature. Pulls this information from computer login.
CreateDate	Automatically tracks the date that a new feature has been digitized.
EditID	Automatically tracks who edits an existing feature. Pulls this information from the computer login.
EditDate	Automatically tracks the date that an existing feature was edited.

Web GIS Development

A web application was developed to host the new master database (figure 7). This application included the development of the interface, symbology, popups, and other components and was built based on the most current version of the master geodatabase which was being developed concurrently.

A REST map service was published using the current version of the master database and added to an ArcGIS Hub web map so popups could be configured on the service/streaming layer. The web map was then added to Web App Builder (WAB) for ArcGIS, which is the web application platform that NBMG had previously adopted for all web applications. Further development and configuration of layers within WAB was necessary to ensure a user-friendly interface and to enable download functionality. A search feature is currently under development.

The web application includes several additional background layers. The master fault database produced for this pilot project only encompasses the Reno, Walker Lake, and Las Vegas 1:250,000-scale quadrangles. Thus, fault traces from NBMG's Map 167 and the USGS Quaternary fault and fold database were included to show the distribution of Quaternary faults across the state. For areas outside the pilot project boundary, NBMG's Map 167 includes additional faults that are not included in the national database. It is anticipated that the location and rupture parameters of these faults will be evaluated in subsequent projects but are included in the web application for completeness.

Vector shapefiles for faults mapped in NBMG STATEMAP projects are also included as a background layer. Although the Quaternary faults were incorporated in the master fault database, many of the bedrock faults are along projection of Quaternary faults and may be determined to be Quaternary faults based on future research. Additionally, these faults could rupture as secondary faults in future earthquakes. Thus, these faults are included as a background layer for user reference and potential future characterization.

The web application is designed to be user-friendly and publicly available and can seamlessly incorporate any updates to the master fault geodatabase. It is anticipated that the master fault geodatabase will continually be published as a streaming service and replaced in the live web application as updates for the rest of the State are completed in subsequent projects. GIS and KML files of the master fault geodatabase, as well as background layers will be available for download pending NBMG internal review.

Results and Summary

A primary objective of this pilot project was to design and build cyber infrastructure to host a new Quaternary fault database for Nevada including attribute tables of fault parameters and complete reference sources for each fault. The cyber infrastructure design and construction was completed as described in the Methods and Technical Workflow sections above and provides a backbone format that can be migrated to a more robust managed, enterprise database system once the database is expanded beyond the pilot quadrangles updated in this project (described below).

NBMG compiled base maps, new 1:24,000 scale geologic mapping (STATEMAP), and existing Quaternary fault databases (USGS; NBMG) within three 1:250,000-scale pilot quadrangles (Reno, Walker Lake, and Las Vegas) (figure 6). The compiled database was compared to original source maps and discrepancies in fault trace location were evaluated to determine the most accurate line work to include in the new master database (figures 4 and 5). Fault parameters and references were migrated from the USGS Quaternary fault and fold database into the new master database. Fault trace mapping from published geologic maps related to NBMG's STATEMAP program including bedrock and Quaternary faults were also added to the master database (table 2). Evaluation of these maps resulted in the addition of numerous Quaternary faults not previously accounted for in the USGS or NBMG fault databases. Additionally,

NBMG conducted a review of literature published since the USGS database was released and identified faults in which new research and fault parameter information was available.

The new master database has been compiled and a web site to host the database has been created (figure 7). Our progress on populating attribute tables with new published information was compromised during 2020 due to the COVID-19 pandemic, which resulted in office closures and limited access to Arc-enabled computing facilities. Information from new research has been assembled, and NBMG is currently updating the attribute tables and references in the master database to reflect these advances. Once these items are finalized and NBMG's internal review is complete, the resulting database and web interface are expected to be released in 2021. The database will be updateable, publicly accessible, and serve as the master source for Nevada's Quaternary fault data in the three pilot quadrangles. The methods and data products described in this report provide a template to pursue future funding to expand the compilation to additional quadrangles in the state with the eventual goal of producing a statewide master database to ultimately serve as the primary data source for the national database.

Future Work

- NBMG is currently seeking funding to apply the methodology developed in this pilot project to other quadrangles with the ultimate goal of producing a Quaternary fault database for the entire state of Nevada.
- The new master database is designed to be easily updateable. As future research on Quaternary fault parameters is published, attribute tables and references for individual faults will be updated. Additionally, new faults identified through mapping programs can also be added to the database.

Reports Published

An Open-File Report is in preparation to be published by the Nevada Bureau of Mines and Geology. Additionally, the interactive web portal will be available online once NBMG internal review protocols have been completed. We anticipate release of this product in 2021.

Data Availability

Base GIS data including fault line shapefiles, fault parameter tables, and metadata are currently archived at the Nevada Bureau of Mines and Geology servers at University of Nevada, Reno and are available upon request. The web portal application will be publicly available for download once the web application is internally reviewed by NBMG staff and published.

Acknowledgments

This work was funded under USGS NEHRP Cooperative Agreement G19AP00009. The views and conclusions contained in this Final Technical Report are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the US Government.

References

Anderson, J.G., and Miyata, Y., 2006, Ranking states by seismic activity: Seismological Research Letters, 77, p. 672–677.

Bell, J.W., 1984, Quaternary fault map of Nevada-Reno sheet, Nevada Bureau of Mines and Geology Map 79, 1 sheet, scale 1:250,000.

Bell, J.W., 1981, Quaternary fault map of the Reno 1° by 2° quadrangle, Nevada-California: U.S. Geological Survey Open-File Report 81-982, scale 1:250,000, 62 p.

Bennett, R.A., Wernicke, B.A., Niemi, N.A., Friedrich, A.M., and Davis, J.L., 2003, Contemporary strain rates in the northern Basin and Range Province from GPS data, Tectonics, 22, NO. 2, 1008, doi:10.1029/2001TC001355

Bowman, S., 2019, 2018 Utah earthquake working groups, Final Technical Report, U.S. Geological Survey National Earthquake Hazards Reduction Program, award #G18AP00023.

Bryant, W.A. (compiler), 2005, Digital database of Quaternary and younger faults from the Fault Activity Map of California, version 2.0: California Geological Survey website, http://www.consrv.ca.gov/CGS/information/publications/QuaternaryFaults_ver2.htm

dePolo, C.M., 2008, Quaternary faults in Nevada, Nevada Bureau of Mines and Geology, Map 167, scale 1:1,000,000.

dePolo, C.M, and Dee, S.M., 2015a, Preliminary Quaternary fault and seismicity map of the Vya 1 x 2 degree quadrangle, Nevada, Nevada Bureau of Mines and Geology, Open-File Report 15-11A, scale 1:250,000.

dePolo, C.M, and Dee, S.M., 2015b, Preliminary Quaternary fault and seismicity map of the McDermitt 1 x 2 degree quadrangle, Nevada Bureau of Mines and Geology, Open-File Report 15-11B, scale 1:250,000.

dePolo, C.M, and Dee, S.M., 2015c, Preliminary Quaternary fault and seismicity map of the Wells 1 x 2 degree quadrangle, Nevada Bureau of Mines and Geology, Open-File Report 15-11C, scale 1:250,000.

dePolo, C.M, and Dee, S.M., 2015d, Preliminary Quaternary fault and seismicity map of the Lovelock 1 x 2 degree quadrangle, Nevada, Nevada Bureau of Mines and Geology, Open-File Report 15-11D, scale 1:250,000.

dePolo, C.M, and Dee, S.M., 2015e, Preliminary Quaternary fault and seismicity map of the Winnemucca 1 x 2 degree quadrangle, Nevada Bureau of Mines and Geology, Open-File Report 15-11E, scale 1:250,000.

dePolo, C.M, and Dee, S.M., 2015f, Preliminary Quaternary fault and seismicity map of the Elko 1 x 2 degree quadrangle, Nevada Bureau of Mines and Geology, Open-File Report 15-11F, scale 1:250,000.

dePolo, C.M., Ramelli, A.R., and Muntean, T., 2000, Preliminary geologic map of the Gardnerville quadrangle, Douglas County, Nevada, Nevada Bureau of Mines and Geology Open-File Report 2000-9, scale 1:24,000.

Dohrenwend, J.C., Schell, B.A., Menges, C.M., Moring, B.C., and McKittrick, M.A., 1996, Reconnaissance photogeologic map of young (Quaternary and late Tertiary) faults in Nevada, *in* Singer, D.A. (ed.), Analysis of Nevada's metal-bearing mineral resources: Nevada Bureau of Mines and Geology Open-File Report 96-2, 1 plate, scale 1:1,000,000.

Dohrenwend, J.C., 1982, Map showing late Cenozoic faults in the Walker Lake 1° by 2° quadrangle, Nevada-California: U.S. Geological Survey Miscellaneous Field Studies Map MF-1382-D, 1 sheet, scale 1:250,000.

Faulds, J. E., Henry, C. D., and Hinz, N. H., 2005, Kinematics of the northern Walker Lane: An incipient transform fault along the Pacific–North American plate boundary, Geology 33, p. 505–508.

Haller, K.M., Machette, M.N., and Dart, R.L., 1993, Maps of major active faults, Western Hemisphere, International Lithosphere Program (ILP) Project II-2—Guidelines for U.S. database and map: U.S. Geological Survey Open-file Report 93-338, 45 p.

Hammond, W.C., Blewitt, G., and Kreemer, C., 2011, Block modeling of crustal deformation of the northern Walker Lane and Basin and Range from GPS velocities, Journal of Geophysical Research, B Solid Earth Planets, 116, p. 1–28.

Koehler, R.D., Farrell, R-E, Burns, P., and Combellick, R., 2012, Quaternary faults and folds of Alaska: A digital database: Miscellaneous Publication MP 141, Alaska Division of Geological and Geophysical surveys.

Lidke, D.J., Johnson, S.Y., McCrory, P.A., Personius, S.F., Nelson, A.R., Dart, R.L., Bradley, Lee-Ann, Haller, K.M., and Machette, M.N., 2003, Map and data for Quaternary faults and folds in Washington State: U.S. Geological Survey Open-File Report 03-428, 1 plate, scale 1:750,000, 15 p. http://pubs.usgs.gov/of/2003/428/.

Oldow, J.S., Kohler, G., and Donelick, R.A., 1994, Late Cenozoic extensional transfer in the Walker Lane strike-slip belt, Nevada, Geology 22, 637-640.

Personius, S.F., compiler, 2002, Quaternary faults in Oregon, *in* Quaternary fault and fold database of the United States: U.S. Geological Survey website, http://earthquakes.usgs.gov/regional/qfaults

Sawyer, T.L., Adams, K.D., Oswald, J., and Haller, K.M., compilers, 1999, Quaternary fault database for Nevada, *in* Quaternary fault and fold database of the United States: U.S. Geological Survey website, http://earthquakes.usgs.gov/regional/qfaults

Stickney, M.C., Haller, K.M., and Machette, M.N., 2000, Quaternary faults and seismicity in western Montana: Montana Bureau of Mines and Geology Special Publication 114, 1 sheet, scale 1:750,000.

U.S. Geological Survey, 2004, Quaternary fault and fold database for the nation, Fact Sheet 2004-3033, https://pubs.usgs.gov/fs/2004/3033/fs-2004-3033.html.

Wesnousky, S.G., Barron, A.D., Briggs, R.W., Caskey, S.J., Kumar, S., and Owen, L., 2005, Paleoseismic transect across the northern Great Basin, USA, Journal of Geophysical Research, 110, B05408.

Figures

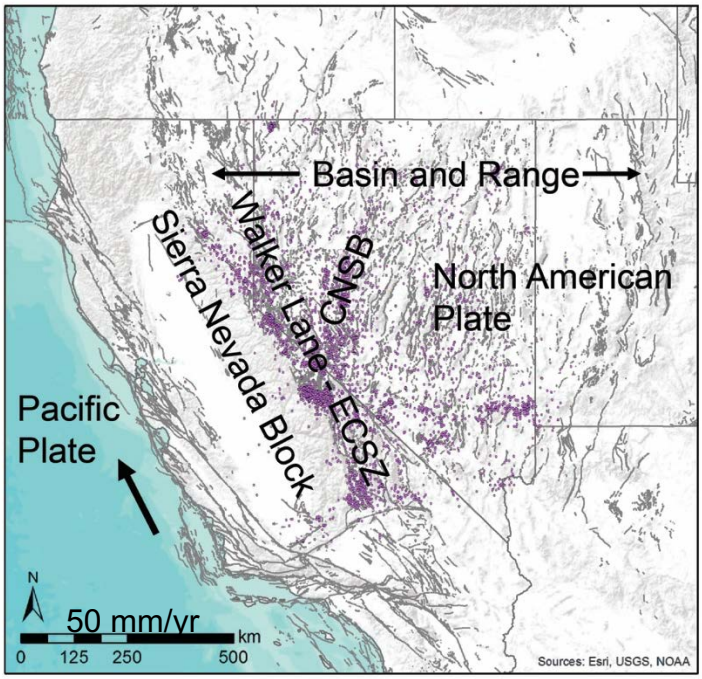


Figure 1. Map showing fault traces (grey lines) from the national Quaternary fault and fold database and major tectonic zones in Nevada including the Walker Lane, Central Nevada Seismic Belt (CNSB), Eastern California Shear Zone (ECSZ), and the Basin and Range Province. Purple dots are the locations of earthquakes in Nevada and adjacent California from the Nevada Seismological Laboratory.

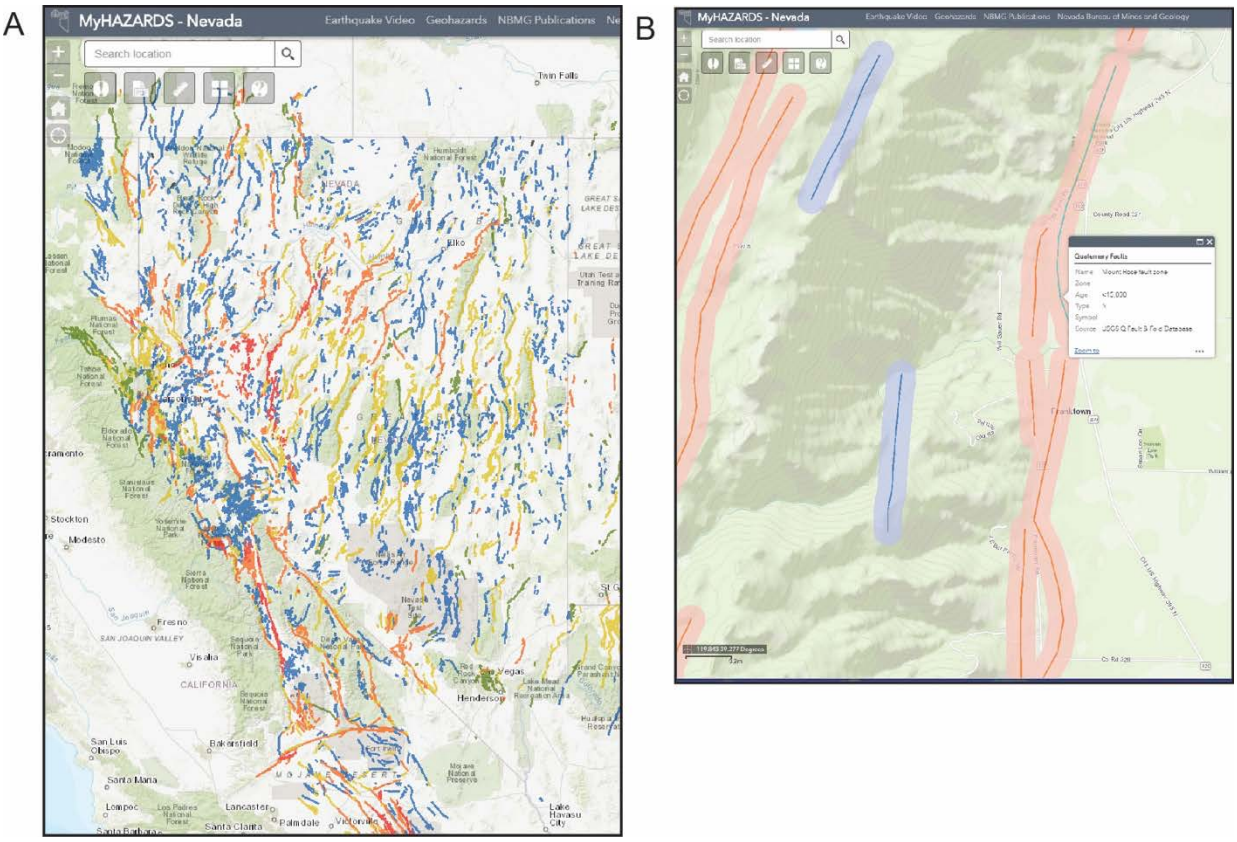


Figure 2. (A) Nevada Quaternary fault map from the Nevada Bureau of Mines and Geology "MyHazards-Nevada" web application (https://gisweb.unr.edu/MyHAZARDS/). (B) Zoomed in view of the southern Mount Rose fault zone and pop-up window with limited fault parameter information. At large viewing scales the faults show up as wide polygons, which has caused problems with user groups in the past. The "MyHazards-Nevada" web application does not provide references or downloadable fault shapefiles (GIS or KML) files to the public.

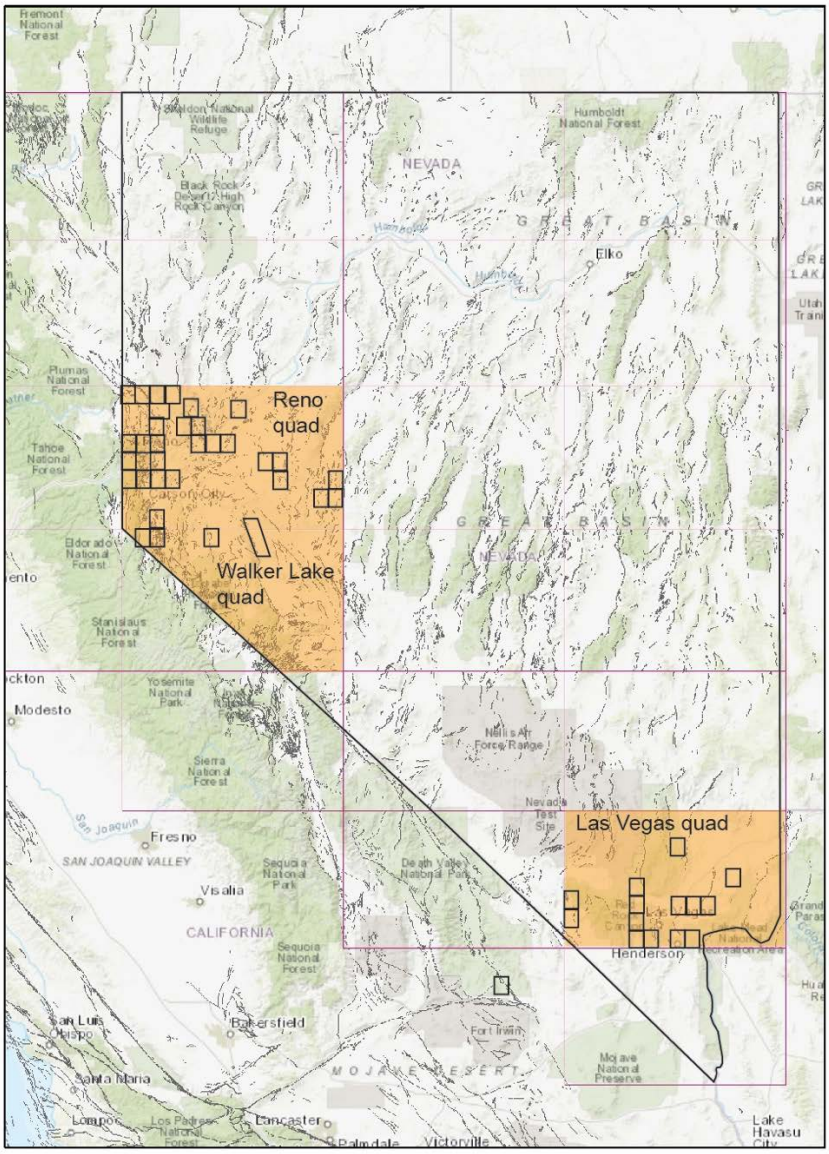


Figure 3. Map of the state of Nevada showing quadrangles compiled in this fault database (orange) including the Reno, Walker Lake, and Las Vegas quadrangles. Thin purple lines are 1:250,000-scale quadrangle boundaries. Squares outlined in black indicate 1:24,000-scale NBMG STATEMAP products that depict Quaternary fault traces incorporated in the fault database. These fault traces were not entirely previously contained in either the NBMG or USGS Quaternary fault and fold databases.

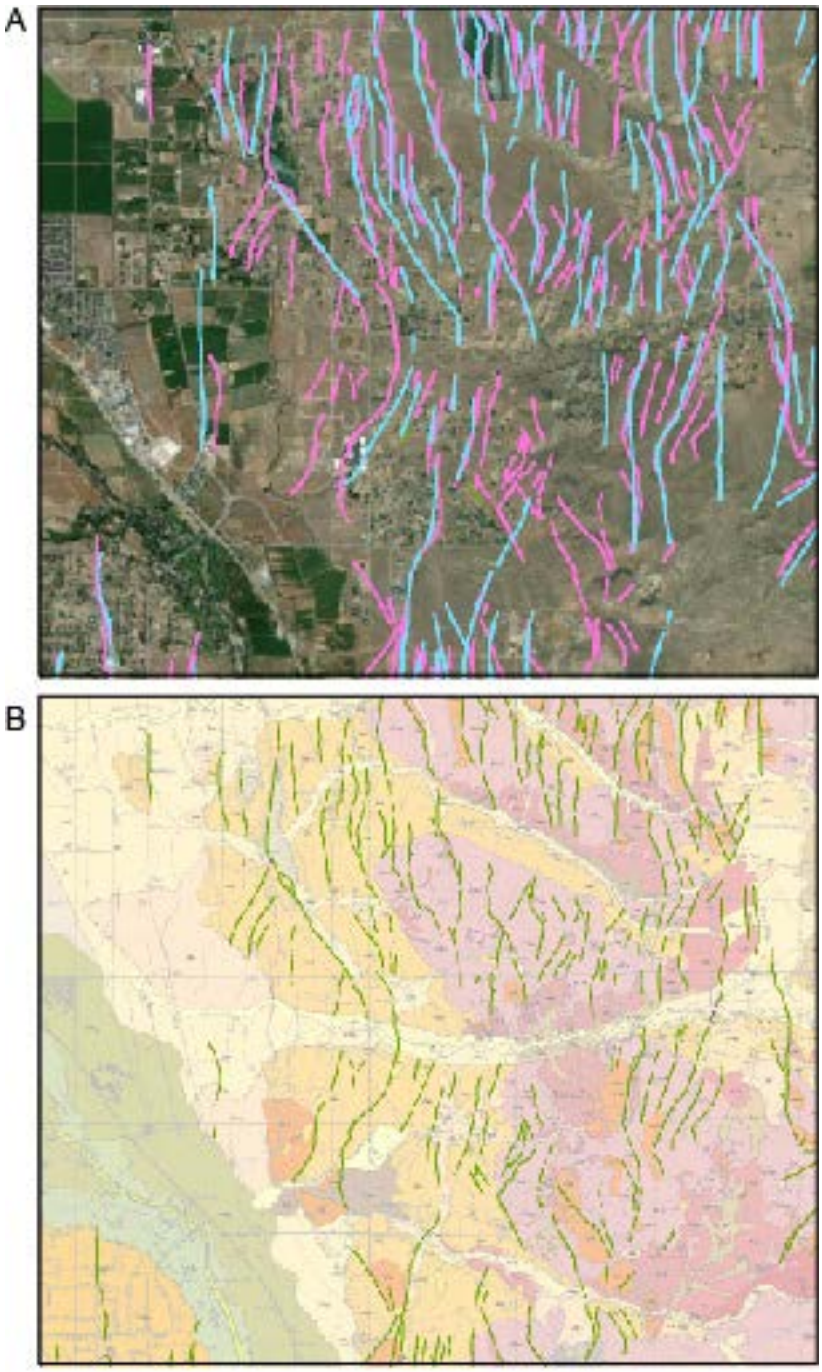
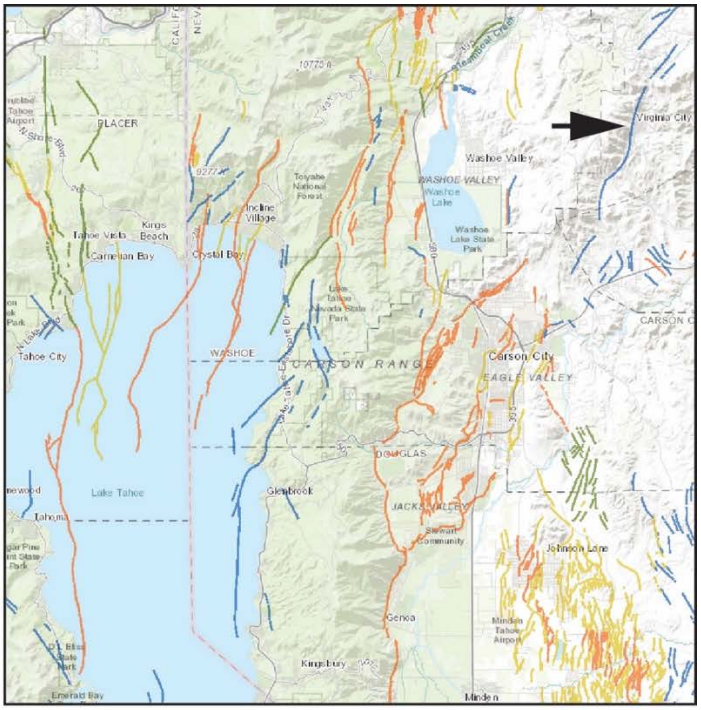


Figure 4. (A) Comparison between Nevada Quaternary fault map (pink) and USGS National Quaternary fault and fold database (light blue) showing discrepancies in fault location for the East Carson Valley fault zone. (B) East Carson Valley fault zone traces depicted on the 1:24,000-scale geologic map of the Gardnerville quadrangle (dePolo et al., 2000).

A



B

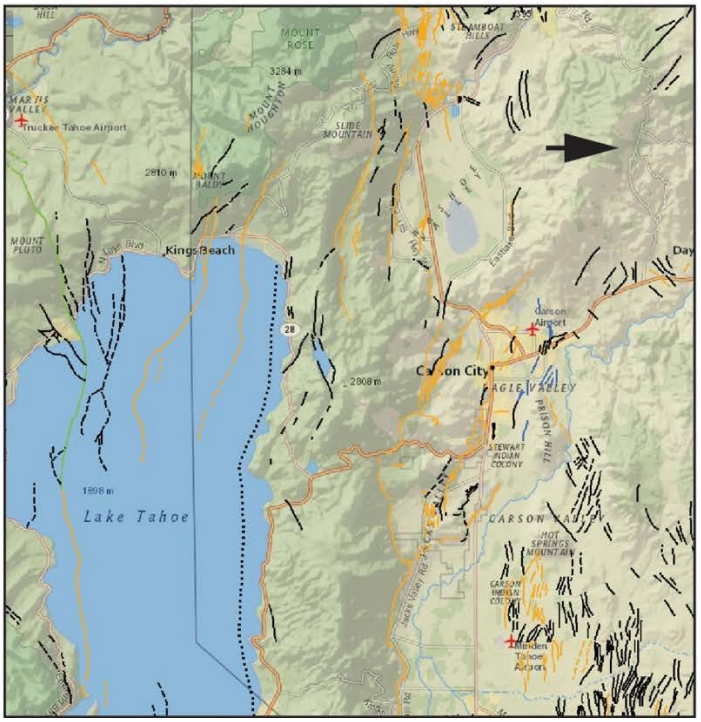


Figure 5. Comparison of Nevada Quaternary map (A) and USGS National Quaternary fault and fold database (B). Note inconsistencies in fault mapping (at tip of black arrow) between the two databases. Additionally, faults mapped as being active in the last 130,000 years on the Nevada map are shown as undifferentiated Quaternary on the USGS map (for example, fault traces immediately northwest of black arrow). Images are screen shots from the USGS Quaternary fault and fold database http://earthquake.gov/hazards/qfaults/map/hazfault2014.html and the NBMG "MyHazards-Nevada" https://gisweb.unr.edu/MyHAZARDS/ web sites.

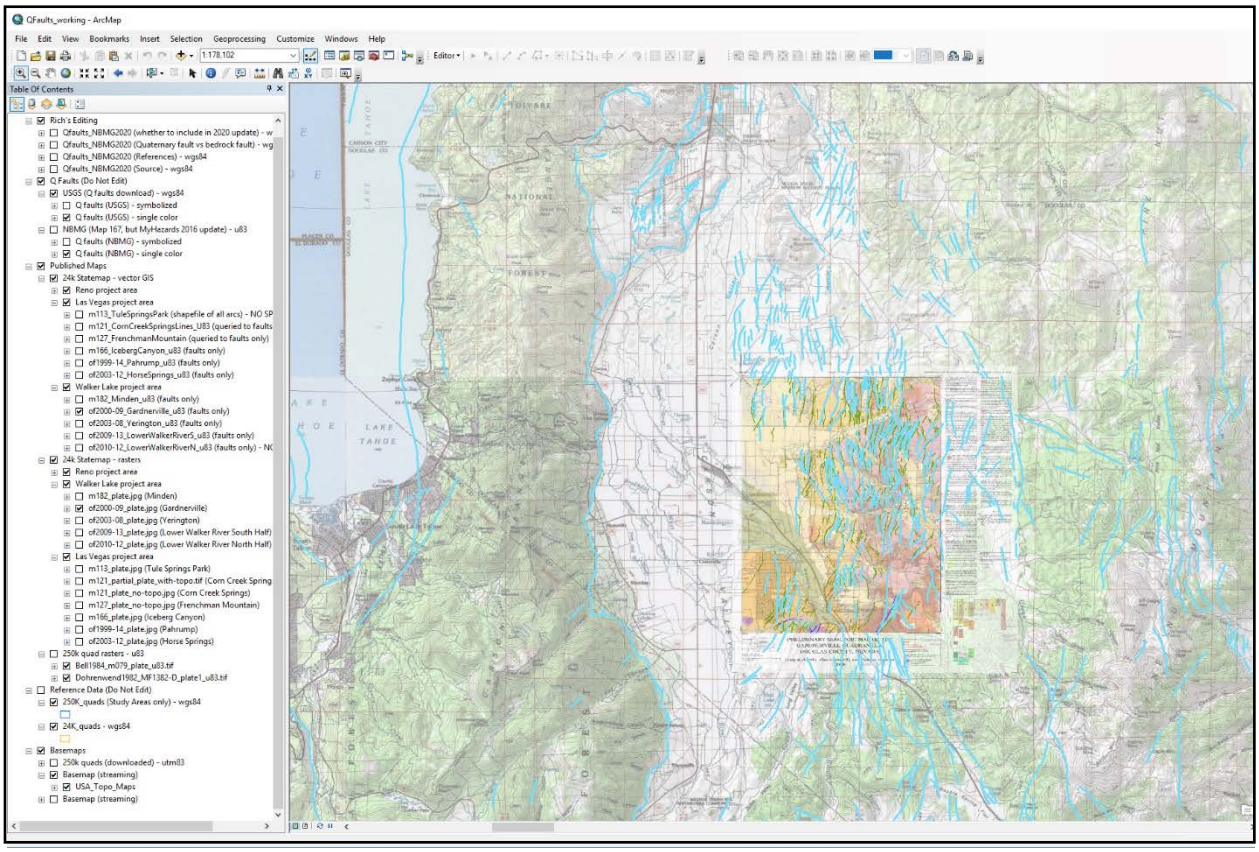


Figure 6. Screen shot of the GIS working mxd showing the Carson Valley and southeast corner of Lake Tahoe. Faults from USGS Quaternary fault and fold database shown in light blue. Colored geologic map for the Gardnerville quadrangle (dePolo et al., 2000) shown in the middle right was registered and used to refine mapping of the East Carson Valley fault zone. Table of Contents panel includes editable layers, Quaternary fault databases (USGS; NBMG), published 1:24,000- and 1:250,000-geologic and fault maps (rasters and shapefiles), and various streaming ESRI base maps.

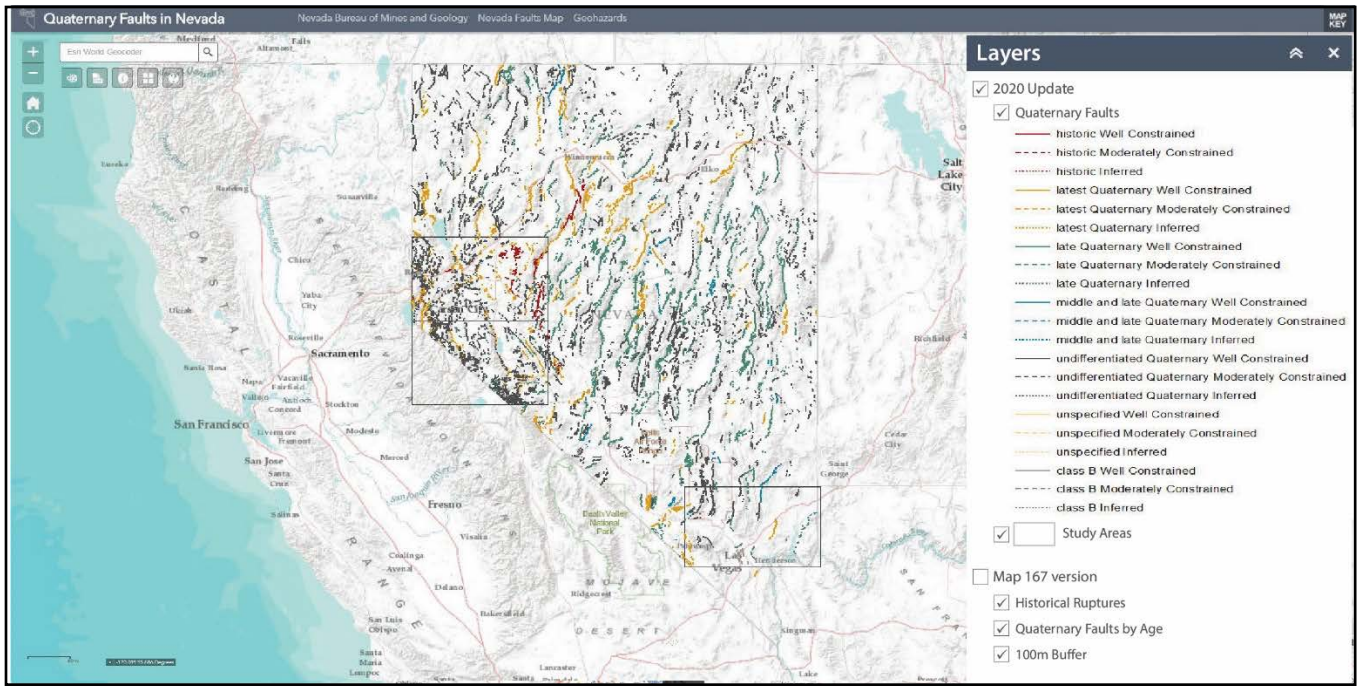


Figure 7. Screen shot of the new 'Quaternary faults in Nevada' web application. Pilot project areas shown by black rectangles including the Reno, Walker Lake, and Las Vegas 1:250,000-scale quadrangles. NBMG Map 167 is shown for areas outside the pilot project area for completeness. Faults differentiated by color to indicate most recent activity including historic, latest Quaternary, late Quaternary, middle Quaternary, undifferentiated age, and class B faults.