



INSIDE THIS ISSUE:

<i>Understanding EQ's in Utah</i>	2
<i>USSC New Commissioners</i>	2
<i>USSC Meeting Notes</i>	3
<i>USSC New Web Site</i>	3
<i>U of U Seismicity</i>	4
<i>U of U Seismicity</i>	5
<i>Comments from the Chair</i>	6

Calendar of Events

- APRIL 2004**
- 28
Effects of Non-Structural Mitigation Strategies
Verdi, Nevada
- MAY 2004**
- 14
Quarterly Leader Workshop
Salt Lake City, Utah
- 16-19
Seismic Hazards Summit II
Reno, Nevada
- 24-28
5th Inter-Mountain HazMat Conference
Park City, Utah
- SEPTEMBER 2004**
- 26-30
WSSPC Annual Conference
St. Louis, Missouri

Next issue: Look for more U of U Quarterly Seismicity

UNDERSTANDING EARTHQUAKE HAZARDS IN UTAH
BY GARY E. CHRISTENSON, UTAH GEOLOGICAL SURVEY

INTRODUCTION

Four technical earthquake working groups were established in 2003 by the Utah Geological Survey (UGS) and U.S. Geological Survey (USGS) to help set priorities for earthquake studies in Utah and develop a consensus among experts on earthquake-hazards mapping needs. The Ground Shaking, Liquefaction, Earthquake-Induced Landslide, and Quaternary Fault Parameter Working Groups met again on February 27, 2004, to re-evaluate last year's plans and define research goals for the coming year and beyond. A summary of the process, funded through a grant from the USGS, and updated working-group plans are posted on the UGS Web site (geology.utah.gov). In preparation for this year's working group meetings, an earthquake conference with the theme and title *Earthquake Hazards in Utah: Improving our Understanding* was held on February 26, 2004, the day before the working-group meetings, to review last year's plans and bring working-group members and others in the Utah geoscience community up-to-date on the results of recent studies. Recent UGS publications and some of the work presently being performed in Utah are summarized below, excerpted from a recent summary published in UGS Survey Notes (v. 36, no. 2, 2004).

GROUND SHAKING

The soil type in the upper 100 feet of the soil column, deeper soil conditions, and depth to bedrock are all important in predicting levels of ground shaking. The prime soil characteristic used to predict earthquake ground-shaking amplification or reduction is shear-wave velocity, or the speed at which earthquake-generated shear waves pass through the soil. The International Building Code (IBC) uses this soil characteristic in estimating ground motions for earthquake-resistant building design.

The UGS, in cooperation with Brigham Young University engineers, developed a database and map of Salt Lake Valley showing soil types in the upper 100 feet grouped according to average shear-wave velocities based on existing data. To improve the map, Utah State University (USU), with assistance from the UGS and University of Utah (U. of U.) Seismograph Stations, is collecting additional shallow shear-wave-velocity data using geophysical techniques. USU collected data at 44 sites along the Wasatch Front in 2003. The geophysical equipment used by USU uses a drop-weight to artificially generate shear waves, and records them on geophones strung in a line about 300 feet long. The system can measure shear-wave velocities of soils to depths of up to 150 feet.

On a basin-wide scale, the depth and configuration of bedrock and semi-consolidated sediments deeper than 100 feet also affects the degree to which seismic waves are reflected within the basin and amplified or reduced. The UGS has compiled a database of existing information regarding deep-basin structure and depth to bedrock, which includes deep water wells and oil-company seismic lines (mostly in and around Great Salt Lake). To better characterize this deep-basin structure, the USGS performed a 2-mile-long seismic-

UNDERSTANDING EARTHQUAKE HAZARDS IN UTAH CONTINUED

BY GARY E. CHRISTENSON, UTAH GEOLOGICAL SURVEY

reflection survey in South Jordan along 3200 W. Street in September 2003. The USGS system uses a “vibroseis” truck that literally shakes the ground in a manner similar to a small earthquake. Geophones strung along 3200 W. Street recorded the shaking, and analysis of the records determines shear-wave velocities and depths to bedrock and semi-consolidated layers down to about 2500 feet.

This information on shallow shear-wave velocities and deep-basin configuration will ultimately be used to generate a “community velocity model.” This 3D model will depict Salt Lake Valley’s shape and shear-wave-velocity profile at any given location, and will be used to improve seismic design of buildings and bridges.

LIQUEFACTION AND LANDSLIDES

The USGS funded the U. of U., USU, and UGS in 2004 to develop state-of-the-art Geographic Information Systems (GIS) methods to make maps of probabilistic liquefaction potential and liquefaction-induced ground failure for the Wasatch Front. The project will focus on northern Salt Lake County and will begin by compiling a geotechnical database from existing consultant’s reports. The database will be used to produce GIS maps to show both liquefaction potential and the type and amount of associated ground failure (settlement, lateral spreading, flow failure).

Along the Wasatch Front, little is known regarding the earthquake-induced landslide hazard, and the Earthquake-Induced Landslide Working Group recommended several studies to improve our understanding. In conjunction, the UGS has compiled a database of geotechnical soil shear-strength tests from landslide studies throughout Utah to characterize geologic units for generalized landslide-hazard mapping and to indicate where more data are needed. As a pilot project, the UGS is studying several landslides in Salt Lake County and nearby Wasatch Front areas to determine whether they may have been generated or reactivated by earthquakes. One goal of the project is to date landslide movements and compare them to the timing of known large earthquakes determined from fault studies to assess whether the landslides may have moved as a result of earthquakes.

FAULTS

Quaternary faults are those that have moved in the past 1.6 million years and thus are considered capable of producing modern earthquakes. Fault parameters such as earthquake timing, slip rate, and recurrence interval are important in making the probabilistic earthquake ground-shaking maps used in the IBC and for design and retrofit of bridges and dams in Utah.

In 2003, the UGS published a new map and database summarizing what is presently known about prehistoric large earthquakes and rates of earthquake activity on faults in Utah (UGS Map 193DM). The publication is an interactive compact disk; the map and database are also posted on the UGS Web site. Results of trenching studies on Utah faults are currently under scrutiny by the Utah Quaternary Fault Parameter Working Group to derive consensus values for average recurrence and slip rates. These values will be used in the next update of the USGS National Seismic-Hazard Maps used in the IBC, and by consultants to develop site-specific ground-shaking design levels.

In addition to causing earthquakes and resulting ground shaking, faults may also rupture the ground surface in large earthquakes (magnitude 6.5 and greater). Surface fault rupture beneath a building may cause severe damage and possible collapse, and represents a life-safety as well as property-damage concern. The UGS has just published new *Guidelines for Evaluating Surface-Fault-Rupture Hazards in Utah* (UGS Miscellaneous Publication 03-6). The purpose of the new guidelines is to recommend appropriate surface-fault-rupture hazard-investigation techniques and report content to ensure adequate studies are performed to aid in land-use regulation and to facilitate risk reduction.

USSC NEW COMMISSIONERS

The USSC has two new Commissioners. Nannette Rolfe replaces Scott Behunin as Director of Emergency Services and Homeland Security. She previously headed the Bureau of Criminal Investigation with the Department of Public Safety. Matthew Cassel was appointed by the American Public Works Association and replaces Jake Arslanian. Matt works for Psomas, a civil engineering firm.

UTAH SEISMIC SAFETY COMMISSION MEETING NOTES

JANUARY 16, 2004 BY AMISHA LESTER

The Utah Seismic Safety Commission (USSC) held its January meeting at the Alcoholic Beverage Control Warehouse in Salt Lake City, Utah.

Nancy Lyon, Lee Siegel, and Sarah Michalob, University of Utah, gave a presentation on the University of Utah Marriott Library renovation project. The USSC held an open discussion of the seismic safety aspects of the project. The USSC decided to endorse the Marriott Library renovation project to 2004 legislature, with implied endorsement of other building renovations of similar nature.

Ned Leonard, Fred A. Moreton Company, and Hank Perry and Chris Austin, International Catastrophe Insurance Managers, gave a presentation on earthquake insurance in Utah and how it is rated.

Walter Arabasz gave a report on the strategic planning meeting that was held on December 16, 2003. More focused discussion, with input from all the Commissioners, will be on the agenda for the next USSC meeting.

Other Commission notes...The Utah Earthquake Conference will be held on February 26-27, 2004. On the 26th a general earthquake session will be held. The geotechnical working groups will meet on February 27th. This conference will be mainly geoscience related.

It is time for the Western States Seismic Policy Council (WSSPC) Conference award nominations to be submitted. One of the Commission's possible nominations will be the Metro Water District for all of their seismic policy efforts. The parapet and ground-shaking brochure are both under consideration for nomination.

The Commission briefly discussed the celebration of the USSC 10-year anniversary. The USSC will use the April meeting to prepare for the 10-year anniversary.

Provo High School, South Summit Middle School and Judge High School have submitted for the student research grant program. The USSC July meeting will be the target date to have the schools present their research findings.

USSC will allocate up to \$500 to help assist the 2004 Utah Earthquake Conference.

USSC is planning on sending a letter of encouragement and support to Draper City for their adoption of a Geologic Hazard Ordinance.

NEW LOOK FOR USSC WEBSITE

The Utah Seismic Safety Commission (USSC) website has just recently received a much needed face lift. The home page has been dedicated to current events, hot topics and news. The website has links to many earthquake publications, such as, Fault Line Forum volumes, Utah Seismic Safety Commission (USSC) meeting minutes, USSC Strategic Plan and Progress Reports, plus the Parapet and Ground-Shaking brochures. The USSC Standing Committees have their own web page containing a statement from each committee, membership information and current events. Many resource links have been added for your convenience, along with a list of schedule of events. The "Who We Are" web page contains the Commissions mission statement and explains their purpose. Please take a moment and log on at www.des.utah.gov/ussc.

You will notice that the new web site has taken on a similar look as the Fault Line Forum. Simple, neat and to the point. The web site is still a work in progress. If you have something that you would like to add to the website or have any questions or comments, please submit them to Amisha Lester at alester@utah.gov.

UNIVERSITY OF UTAH QUARTERLY SEISMICITY SUMMARY

EARTHQUAKE ACTIVITY IN THE UTAH REGION

January 1 – March 31, 2003

by Susan J. Nava

with significant contributions by Fabia Terra and Paul Roberson

University of Utah Seismograph Stations

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During the three-month period January 1 through March 31, 2003, the University of Utah Seismograph Stations (UUSS) located 252 earthquakes within the Utah region (see accompanying epicenter map). The total includes four earthquakes in the magnitude 3 range and 59 earthquakes in the magnitude 2 range. Earthquakes that have magnitudes of 3.0 or larger (plotted as stars and specifically labeled on the epicenter map) are described below. There was one earthquake reported felt during the report period. (Note: All times indicated below are local time, which was Mountain Standard Time for the report period.) Additional information on earthquakes within the Utah region is available from the University of Utah Seismograph Stations.

Online Reports

A complete copy of this report, including maps and the earthquake catalog is available on the UUSS Web site at <http://www.seis.utah.edu/catalog/quarterly.shtml>. ShakeMaps, computer maps of the ground shaking produced by an earthquake, are automatically produced by UUSS for magnitude 3 and larger earthquakes located within the Wasatch Front urban area. The ShakeMaps are available on the UUSS Web page at <http://www.seis.utah.edu/shake>. ShakeMaps produced for any seismic events during this report period are indicated below. The U. S. Geological Survey automatically posts Community Internet Intensity Surveys (CIIS) for magnitude 3 and larger seismic events felt in the Utah Region on the Web page at <http://pasadena.wr.usgs.gov/shake/imw>. Residents are urged to enter their felt earthquake reports on this Web site. Felt information is available by zip code on the CIIS Web pages or from UUSS directly. CIIS maps created for any seismic events during this report period are indicated below.

Earthquakes of Magnitude 3.0 or Larger (or Felt)

ML 3.6 January 2 10:02 p.m. 2 mi WNW of Huntsville, UT (ShakeMap, CIIS maps available) Reported felt in Huntsville, Ogden, and surrounding areas.

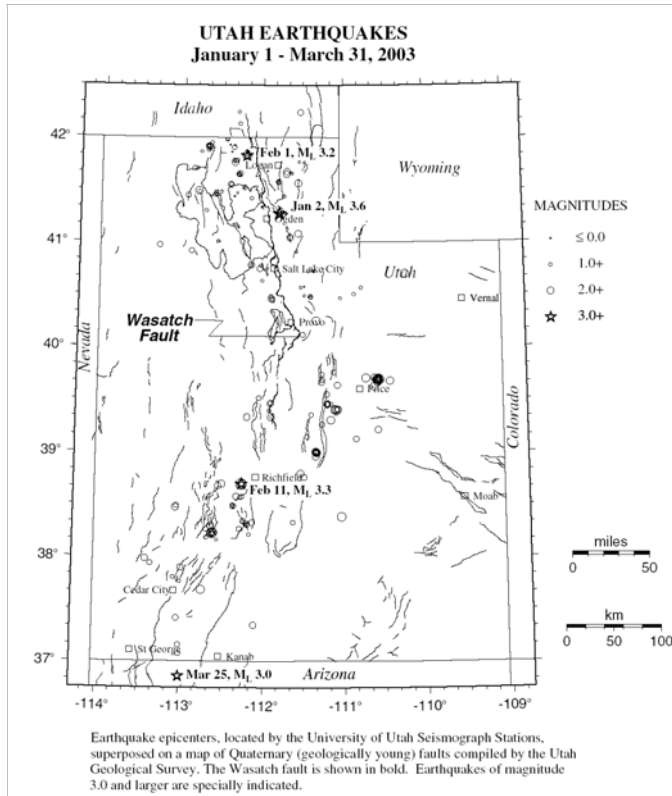
ML 3.2 February 1 1:37 p.m. 7 mi NW of Garland, UT

ML 3.3 February 11 2:00 a.m. 6 mi W of Elsinore, UT

ML 3.0 March 25 2:11 p.m. 9 mi S of Colorado City, AZ

Other Notable Seismicity (see map)

During the report period, there were two notable clusters of seismicity. For reporting purposes, we define a cluster as ten or more earthquakes occurring within a 10-km radius during the report period. Descriptions of these clusters follow below. *Northern Utah:* A cluster of ten earthquakes occurred about 30 miles SW of Malad City, Idaho (~50 miles WNW of Logan, UT). The shocks (0.9 $\leq M \leq$ 2.0) occurred from March 18 to 20. *Southwestern Utah:* Throughout the report period, a cluster of 13 earthquakes (0.8 $\leq M \leq$ 2.9) occurred about 4 miles SE of Beaver (~50 miles NE of Cedar City). *Central Utah:* Seismic events that are densely clustered to the southwest of Price and scattered immediately to its north spatially coincide with sites of active underground coal mining in the eastern Wasatch Plateau and Book Cliffs, respectively, and are interpreted to be mining-related. These include a total of 71 located shocks (1.1 $\leq M \leq$ 2.4) during the report period.



UNIVERSITY OF UTAH QUARTERLY SEISMICITY SUMMARY

EARTHQUAKE ACTIVITY IN THE UTAH REGION

April 1 – June 30, 2003

by Susan J. Nava

with significant contributions by Fabia Terra and Paul Roberson

University of Utah Seismograph Stations

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email: nava@seis.utah.edu

URL: <http://quake.utah.edu> During the three-month period April 1 through June 30, 2003, the University of Utah Seismograph Stations (UUSS) located 264 earthquakes within the Utah region (see accompanying epicenter map). The total includes one earthquake in the magnitude 4 range, two earthquakes in the magnitude 3 range and 68 earthquakes in the magnitude 2 range. Earthquakes that have magnitudes of 3.0 or larger (plotted as stars and specifically labeled on the epicenter map) are described below. There was one earthquake reported felt during the report period. (Note: All times indicated below are local time, which was Mountain Standard Time from April 1 through April 5 and Mountain Daylight Time for the remainder of the report period.) Additional information on earthquakes within the Utah region is available from the University of Utah Seismograph Stations.

Online Reports

A complete copy of this report, including maps and the earthquake catalog is available on the UUSS Web site at <http://www.seis.utah.edu/catalog/quarterly.shtml>. ShakeMaps, computer maps of the ground shaking produced by an earthquake, are automatically produced by UUSS for magnitude 3 and larger earthquakes located within the Wasatch Front urban area. The ShakeMaps are available on the UUSS Web page at <http://www.seis.utah.edu/shake>. ShakeMaps produced for any seismic events during this report period are indicated below. The U. S. Geological Survey automatically posts Community Internet Intensity Surveys (CIIS) for magnitude 3 and larger seismic events felt in the Utah Region on the Web page at <http://pasadena.wr.usgs.gov/shake/imw>. Residents are urged to enter their felt earthquake reports on this Web site. Felt information is available by zip code on the CIIS Web pages or from UUSS directly. CIIS maps created for any seismic events during this report period are indicated below.

Earthquakes of Magnitude 3.0 or Larger (or Felt)

ML 4.2 April 16 07:04 p.m. 4 mi SSW of Levan, UT (ShakeMap available) Reported felt in Juab Valley, including Levan and Nephi.

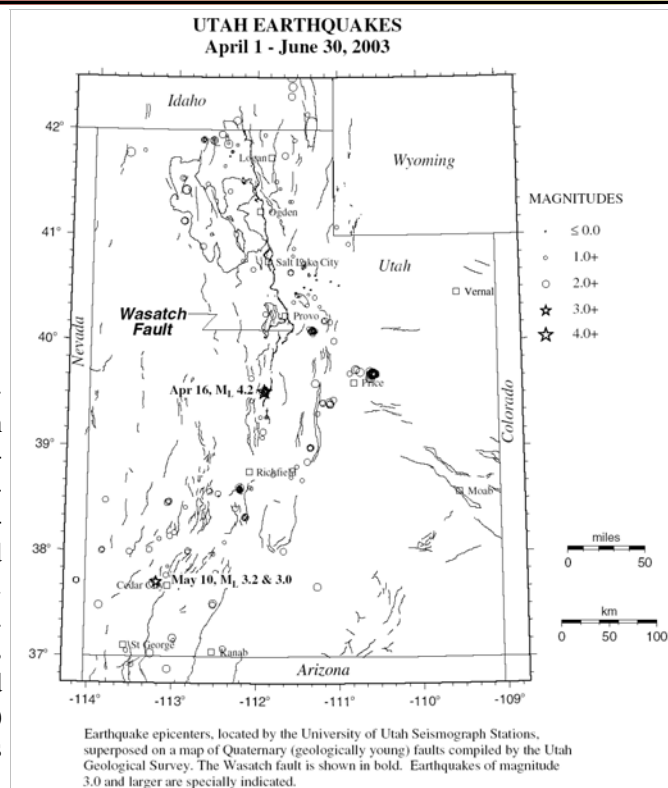
ML 3.0 May 10 11:13 a.m. 8 mi W of Cedar City, UT

ML 3.2 May 10 11:20 a.m. 8 mi W of Cedar City, UT

Other Notable Seismicity (see map)

During the report period, there were several notable clusters of seismicity. For reporting purposes, we define a cluster as ten or more earthquakes occurring within a 10-km radius during the report period. Descriptions of these clusters follow below.

- A cluster of 15 earthquakes occurred about 14 miles E of Mapleton (~20 miles SE of Provo, UT). The shocks (1.1 \leq M \leq 2.2) occurred primarily on May 1.
- Sixteen aftershocks (1.1 \leq M \leq 2.7) occurred following the ML 4.2 earthquake on April 16, located about 3 miles SSW of Levan, UT (~50 miles S of Provo, UT). The majority of the aftershocks occurred from April 16 through 19.
- On May 25, a cluster of 25 earthquakes (0.8 \leq M \leq 2.5) occurred about 3 miles ENE of Sevier, UT (~10 miles S of Richfield, UT).
- Seismic events that are densely clustered to the southwest of Price and scattered immediately to its north spatially coincide with sites of active underground coal mining in the eastern Wasatch Plateau and Book Cliffs, respectively, and are interpreted to be mining-related. These include a total of 60 located shocks (1.4 \leq M \leq 2.5) during the report period.





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COMMENTS FROM THE CHAIR

BY BARRY WELLIVER

As I listen to the Congressional inquiries about what was known and not known prior to the September 11th terrorist attacks, I think about the responsibility knowledge brings. There is an expectation that if a particular danger is suspected, warnings and defensive actions need to be taken.

I'm not planning my "defense" should an earthquake strike and the questions of "what did you know and when did you know it?" come my way, but still it helps motivate the message in my mind. If I "know" that unreinforced masonry buildings are unsafe and yet I don't "do" something about it, then shame on me. A theme you may hear in the April 2nd Commission meeting is "We want you to (do)...". It has been bandied about in the matrix/strategy meetings and is a recurring idea to help breakdown the seemingly overwhelming task of "selling" earthquake safety. Our target audiences are decision-makers and affected peoples.

Lastly, the California Seismic Safety Commission recently held their monthly meeting at the Paso Robles Inn. This, you will recall, was the town most affected by the December 2003 San Simeon earthquake. Their agenda included a hearing on the effects of the earthquake and I hope to share some information regarding this at our next Commission meeting.