Fault Line Forum
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HALLELUJAH!

Earthquake Issues Make Breakthrough in the 1994 Legislature

by Janine L. Jarva
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We have reported for six years in the *Wasatch Front Forum (WFF)* on the fate of legislative initiatives related to earthquake issues in Utah (see for example *WFF*, 1990, v. 7, no. 2, p. 3; 1990, v. 6, no. 1-2, p. 2). There have been few successes to cheer. We are therefore delighted to bring the news that the state seized the opportunity to take its most positive actions to date (nudged in the right direction by the timely Northridge, California, and Draney Peak, Idaho earthquakes). Every initiative related to earthquakes in the recently-completed 1994 Legislature passed! Dr. Lee Allison, Director of the Utah Geological Survey, commented, "This Legislative session was the most successful in the last 10 years and possibly in Utah's history, for addressing earthquake issues."

Establishment of the Utah Seismic Safety Commission

After the January 17, 1994 Northridge, California earthquake resulted in renewed calls for a "full-fledged public policy discussion of earthquake preparedness along the Wasatch Front" (Salt Lake Tribune editorial, January 19, 1994, "Place Earthquakes on Utah Agenda"), State Representative Kim Burningham (R-Bountiful) introduced a bill to create a Utah Seismic Safety Commission (USSC). The USSC bill passed and will become effective July 1, 1994, the beginning of the next fiscal year. Current Chairperson of the Utah Earthquake Advisory Board (UEAB), Lorayne Frank, said, "We are very pleased with the passage of this legislation. We have been working on getting Legislative recognition for the UEAB for several years." The USSC will replace the existing UEAB while continuing its mission to

- review earthquake-related hazards and risks to the state of Utah and its inhabitants,
- prepare recommendations to identify and mitigate these hazards and risks,
- prioritize recommendations and present them to state and local government or other appropriate entities for adoption as policy or loss-reduction strategies, and
- act as a source of information for individuals and groups concerned with earthquake safety and as a promoter of earthquake loss-reduction measures.

In addition, the legislation creating the USSC directs it to

- prepare a strategic planning document to be presented to the State and Local Interim Legislative Committee before the 1995 annual general session of the Legislature, and
- periodically update the planning document and monitor progress toward achieving the goal of loss reduction.

The USSC will be an independent body whereas the UEAB was established as a committee of the Governor's cabinet-level Disaster Emergency Advisory Council. It will have 13 members, including a member of the House of Representatives, appointed biennially by the Speaker of the House; a member of the Senate, appointed biennially by the President of the Senate; and the Commissioner of the Department of

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Public Safety, as well as the current 10 positions comprising the UEAB (see *WFF*, 1993, v. 9, no. 3-4, p. 12-13). The Commission will annually select one of its members to serve as Chair. Direct participation by members of the Utah State Legislature should strengthen the USSC's ability to promote improvement in Utah's short- and long-term seismic safety and preparedness. Their involvement should also serve to increase the visibility and effectiveness of the USSC among the citizens of Utah.

Additional Funding for Seismic Monitoring

As reported in the *WFF* (1993, v. 9, no. 1-2, p. 1-3), the University of Utah Seismograph Stations (UUSS) was facing termination of earthquake recording throughout major parts of southwestern, central, and eastern Utah after July 1, 1993, due to inadequate funding for operations. A joint effort by several state agencies and the University of Utah secured short-term funding to continue full network operations through the 1993-1994 fiscal year ending June 30, 1994. With strong leadership and support from the Governor's Office, the 1994 Legislature then passed a direct appropriation to the UUSS which will provide an on-going, base-budget increase of $75,000 annually. These funds will enable the UUSS to continue and improve seismic monitoring and emergency earthquake notification outside the Wasatch Front area, particularly in the seismically hazardous areas of Richfield, Beaver, Cedar City, St. George, and Kanab as well as the region of coal-mining induced seismicity in Carbon and Emery Counties. Dr. Walter Arabasz, Director of the UUSS, believes that the involvement of the Governor's office was vital in the success of the UUSS funding initiative. In Arabasz's view, "The Governor and his staff are uniquely positioned to effectively address and plan for the long-term needs of the state beyond immediate urgencies."

Approval for Purchase of Strong-Motion Instruments

The Utah Geological Survey (UGS) received authorization to use the $50,000 carried over-from the 1992-1993 appropriation for the strong-motion program (see *WFF*, 1993, v. 9, no. 1-2, p. 7; 1992, v. 8, no. 2, p. 3; 1992, v. 8, no. 1, p. 4-5; 1991, v. 7, no. 4, p. 3), to purchase up to seven strong-motion instruments for Utah. The UGS tentatively plans to deploy these instruments in free-field sites in St. George, Beaver, Salina, Santaquin, Draper, Kaysville, and Tremonton. These were the sites identified for the first year of the program developed in 1993 by the UGS and approved by the Utah Strong Motion Instrumentation Advisory Committee (see *"Preliminary policies and development plan for the Utah Geological Survey component of the Utah Strong-Motion Instrumentation Program"*, 1993, Utah Geological Survey Open-File Report 302). The U.S. Geological Survey (USGS) has tentatively agreed to install and maintain the instruments. The new instruments will be added to the approximately 30 that already exist throughout Utah, mostly in engineered structures and dams. Although this one-time deployment of a few instruments does not satisfy Utah's need for additional strong-motion instrumentation, it will increase the likelihood that a magnitude 5 or larger earthquake in the Intermountain seismic belt (for example the M_L 5.8 St. George, Utah, earthquake of September 2, 1992) will be recorded by at least one instrument. Utah engineers need strong-motion records from Utah earthquakes to design and construct more cost-effective and earthquake-resistant structures. Because Utah has unique geologic and seismologic conditions, large uncertainties exist when records from other tectonic regimes are used to estimate ground motions for sites in Utah.

The foundation for these successes has been the long-term commitment of the Utah earthquake community, which persevered through years of legislative inaction. The recent successes represent small but significant steps which we hope are the beginning of a long-term commitment to earthquake safety and preparedness in Utah. Sustaining this trend of legislative successes will continue to move Utah toward the achievement of its earthquake-hazard-reduction goals outlined in "Utah Tomorrow," the Legislature's own strategic planning document for Utah's future.

Organizational Changes at USGS

The National Earthquake Strong Motion Program has been a part of the U.S. Geological Survey Branch of Engineering Seismology and Geology. In a recent reorganization, that branch was dissolved and the Strong Motion Program transferred to the Branch of Earthquake and Geomagnetic Information. The basic objectives and operations of the program remain unchanged, as do the personnel and their locations. The Branch of Earthquake and Geomagnetic Information is responsible for the U.S. National Seismograph Network and supports the operation of the Global Seismograph Network. These activities share with the Strong Motion Program the mission of providing accurate, timely, and practical information for scientific and engineering uses.

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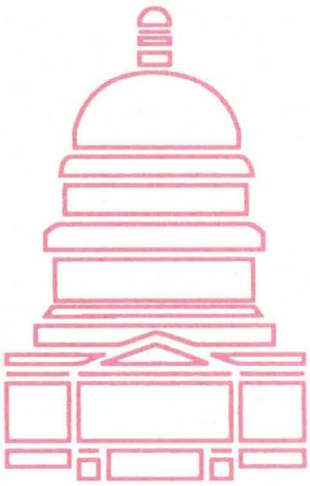
Earthquakes and Politics Get Involved!

by Janine L. Jarva
Utah Geological Survey



As previously noted in this issue, the 1994 Legislature created the Utah Seismic Safety Commission (USSC), effective July 1, 1994. The USSC will replace the current Utah Earthquake Advisory Board (UEAB) and is mandated to prepare a long-term, strategic-planning document outlining Utah's earthquake threat and recommending measures to reduce earthquake hazards and risks. This document is to be presented to the 1995 Legislature for discussion and, hopefully, adoption. The USSC is further required to periodically update the planning document and monitor progress toward achieving its goals of loss reduction in Utah.

Since the UEAB's establishment in late 1991 as a committee of the Governor's cabinet-level Disaster Emergency Advisory Council, it has provided leadership in promoting and supporting actions that address earthquake preparedness, hazard and risk reduction, emergency response, and short- and long-term planning in Utah. To achieve its objectives, the principal activity of the UEAB has been to develop a strategic-planning document informally entitled "Utah at Risk." So the task of fulfilling the new responsibility given to the USSC is already underway.

The strategic-planning process fits well into the present political context in the state of Utah. Strategic planning is promoted by the current administration. Governor Leavitt outlined five key objectives at the beginning of his administration, one of which was "to make a safe environment for Utah's citizens." State-agency proposals are evaluated on how they meet or promote the Governor's objectives. Similarly, the Legislature spent two years producing a planning document entitled "Utah Tomorrow." It was adopted during the 1994 Legislative Session. The Legislature's objective is to incorporate more foresight into state government by establishing goals and standards for agencies and the Legislature to use in policy and planning activities. Any future initiatives for expanding or redirecting state government will have to show compatibility with that planning document as well.

It seems appropriate at this juncture to review earthquake planning in Utah, relate what has been learned from our experiences in the political arena, and discuss how to accomplish our goals in the present political climate. How do we create a strategic road map for the future?

Attempts to plan for earthquakes have a long history in Utah, beginning in 1977 with establishment of the Utah Seismic Safety Advisory Council (USSAC). Over a four-year period ending in 1981, the USSAC produced an impressive collection of technical reports and a comprehensive list of recommendations. The USSAC was disbanded after completing its mission, and without a group to follow through, few of their recommendations were implemented. Interest was renewed in 1983, however, and the "Utah earthquake community" convened many conferences during the 1980's, beginning with "The Governor's Conference on Geologic Hazards" in 1983, to solicit ideas for long-range earthquake planning. The experience of the 1983-1988 National Earthquake Hazards Reduction Program (NEHRP) in Utah further refined our understanding of the earthquake threat and attempted to address the problems associated with achieving meaningful change. We also have the experience of developing many earthquake-related legislative initiatives, particularly for the 1990 Legislature following the 1989 Loma Prieta (San Francisco) earthquake.

All of this experience has made it evident that we must attend to the needs for preparedness, emergency response, mitigation, and improvements in earthquake engineering. We must also ensure that the fundamental geoscience information necessary to characterize and understand the hazards and risks is available. Addressing these needs requires broad action, and our experience has also made it clear that fostering such broad action will not be easy, despite the obvious benefits for life-safety and long-term cost savings.

The magnitude of our earthquake problem is overwhelming. The comprehensive list of necessary actions is daunting. Many of us began with a naivete about what it takes to persuade government to act. A reluctance exists at the state level to spend new money and to impose new governmental regulations. The importance of earthquake-related actions surfaces whenever an

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earthquake occurs, but this awareness is fleeting. Achieving a broad consensus among government leaders to direct money to earthquake issues poses an incredible challenge. Many individual legislators and government officials acknowledge the importance of taking earthquake actions, but actions that cost money immediately compete with other needs. To create an outline for what should be done to make Utah safe is one thing, but to accomplish things that will really make a difference and that will get the executive and legislative branches behind them is quite another.

We have learned that the incremental approach is important to pursue. We must persuade people that the answer is long-term. The challenge is to progressively increase Utah's ability to mitigate and respond to the earthquake threat. Equally important is the challenge to maintain interest and attention over the long term without the frequent "reminder" earthquakes that are so common in California. Convincing elected officials and citizens of the value of preparing for an event that may not happen in their term of office, their residence time in Utah, or even their lifetime, is difficult. To achieve progressive, incremental goals is better than to have a one-time input of money or human energy that is short-lived and quickly forgotten.

At present, the UEAB is the group responsible for outlining the strategic earthquake plan. Its original 10 members represent the principal governmental entities and professions that deal most with earthquake issues (emergency responders, scientists, architects, engineers, and planners). They recognized that consensus and coalition-building requires input early in the development process. So, to expand community involvement and cultivate a broader base for preparing the document, as well as building subsequent support for its initiatives, the UEAB established five standing committees in 1993: (1) engineering and architecture, (2) earth sciences, (3) emergency planning, (4) earthquake awareness, and (5) intergovernmental relations. Committee membership numbers over 30 at present. The committees now meet regularly to give the plan some shape and form by developing and refining recommendations while keeping an eye on the political realities and paying attention to the planning process within the executive and legislative branches. Lorayne Frank, current Chairperson of the UEAB said, "We have made great progress on the Utah at Risk planning document. This long-term strategic plan will promote seismic safety programs in Utah well into the 21st century." The UEAB will have a draft of the strategic plan completed by summer 1994.

To complete the process of soliciting input, the UEAB (to be replaced by the USSC) plans to convene a statewide conference (probably this fall) to present the draft plan to all interested constituencies. Having solicited input from this larger group, the final step in the process will be some keen, executive decision-making by the USSC, in concert with the Governor's office and the Legislature, to come up with priority initiatives that are consistent with the Governor's agenda and with "Utah Tomorrow" and that represent some specific, achievable actions that have a good chance of success. To think that the Governor or Legislature will readily implement any broad, expensive, multi-initiative program is probably unrealistic. Therefore, the incremental approach, the progressive transformation over the long term, must be our strategy. We hope that "Utah at Risk" will be a balanced document with broad-based support which addresses the state's critical needs both now and into the future. It will be finalized in time for the 1995 Legislative Session.

Success breeds success. The successes of this year were achieved with relatively non-threatening proposals. The amount of money involved was below the threshold of great concern. Future initiatives will receive more scrutiny and possible challenges if we ask for more sizeable amounts of money or if we ask for things that carry governmental regulation with them. Anything that costs money or creates new regulations is likely to meet resistance. The political challenges will be formidable and future gains will require broad support for any hope of success. Still, Dr. Lee Allison, Director of the Utah Geological Survey believes that, "Utah is on the verge of major advances in preparing for and mitigating the earthquake threat."

Anyone interested in earthquake issues or wishing to provide input into the planning process is invited to attend the quarterly UEAB meetings and the conference this fall. *Fault Line Forum (FLF)* readers are uniquely placed to make a significant contribution. Sponsors and legislators need vocal support from constituents, local governments, and professional organizations to get legislation passed. *FLF* readers represent a diverse group which includes professionals involved in all aspects of earthquake issues. We strongly encourage you to get involved and take an active role in supporting earthquake-related legislation introduced in the 1995 Legislature! For information on UEAB (and USSC, after July 1, 1994) activities and meetings, contact the Utah Division of Comprehensive Emergency Management at (801) 538-3400.

*The M 5.9 Draney Peak, Idaho Earthquake of February 3, 1994 A Preliminary Report**

by Susan J. Nava, Walter J. Arabasz,
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University of Utah Seismograph Stations

An earthquake of M_W 5.9 occurred at 09:05 (UTC) on February 3, 1994, in a mountainous area of southeast Idaho 18 km west of Afton, Wyoming. The earthquake, which occurred squarely within an active part of the 1500-km-long Intermountain seismic belt (figure 1), was preceded by foreshocks as large as magnitude 4.7. The main shock was broadly felt throughout parts of Idaho, Wyoming, Utah, and Colorado. One injury and minor structural damage were reported in the vicinity of Star Valley on the Idaho-Wyoming border.

The main shock had a normal-faulting focal mechanism, butassociation with a specific fault is uncertain. The nearest major Quaternary fault, the W-dipping Star Valley normal fault, lies about 18 km to the east of the main shock epicenter. No surface rupture has been observed; however, snow-coveredmountainous terrain and harsh winter conditions have precludeddetailed field observations.

At the time of the main shock, the two nearest seismographs to the epicenter were located 47 and 86 km distant (figure 2). To facilitate aftershock studies, a 10-station local seismo-

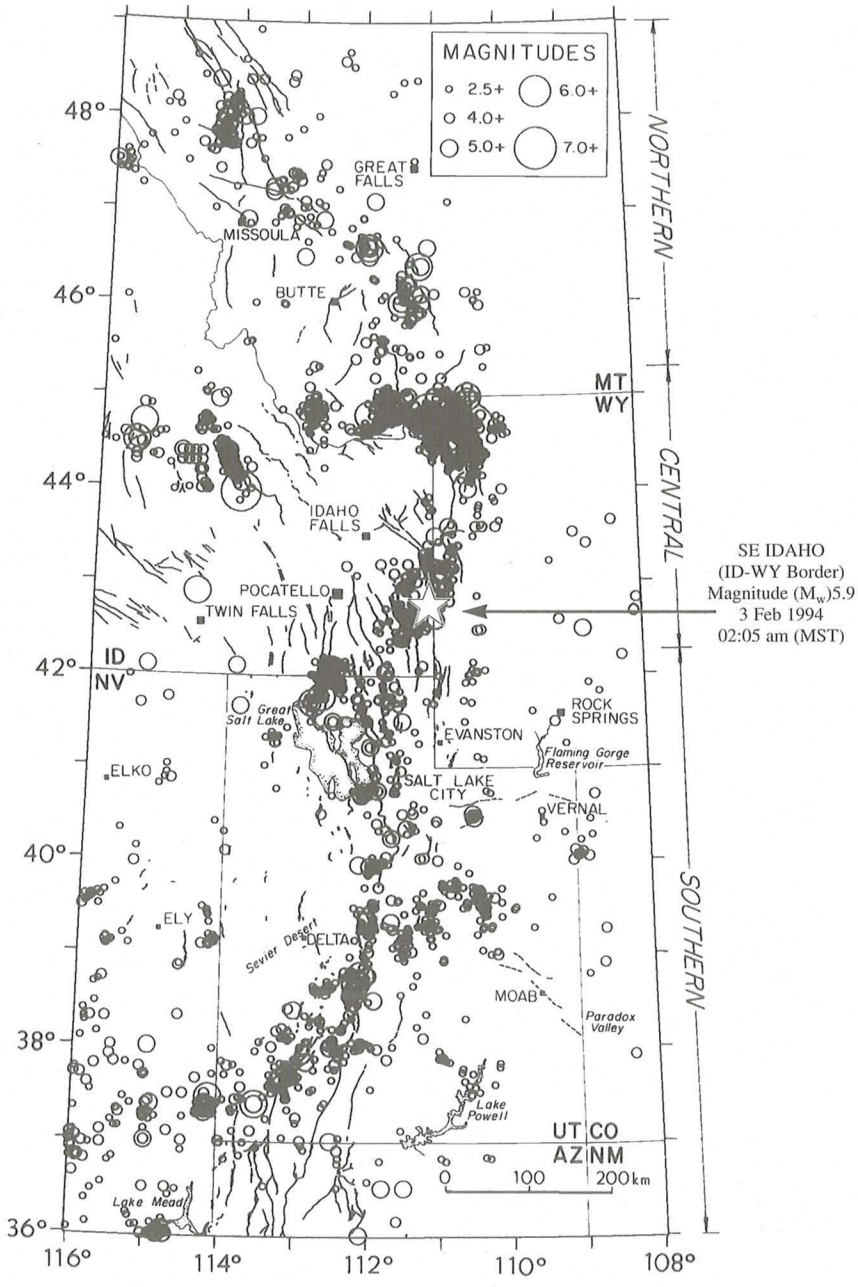

Figure 1. Location map showing epicenter (large star) of Draney Peak, Idaho, earthquake. Base map shows earthquakes in the Intermountain region, 1900-1985 (circles scaled by magnitude), concentrated along the Intermountain seismic belt (ISB). Lines are selected Cenozoic faults (base map from Smith, R.B. and W.J. Arabasz (1991), Seismicity of the Intermountain Seismic Belt, Geological Society of America, Decade Map Volume 1, p. 185-228).

**Modified from an abstract submitted for presentation at the 1994 Seismological Society of America Annual Meeting*

graph network, with five three-component stations, was installed during the two weeks following the main shock. The local network consists of six portable seismographs which telemeter directly to Salt Lake City, and four REF-TEK digital seismographs.

As of February 23, more than 1500 aftershocks (figure 3) had been recorded by the University of Utah, including three of M ≥5.0 and 33 of M ≤ 4.0. The aftershocks form a NNW-trending zone, approximately 30 km long and 12 km wide. The location of the main shock epicenter at the northern end of the zone suggests that the rupture propagated southward.

Support for aftershock field studies and data analysis relating to this earthquake sequence were provided by the U.S. Geological Survey under funding for the University of Utah's seismic-network operations (USGS Cooperative Agreement No. 1434-92-A-0966).

Figure 2. Location of the M_W 5.9 Draney Peak, Idaho, earthquake of February 3, 1994, with respect to regional seismographic coverage (approximate) in the Intermountain seismic belt (ISB). The closest stations to the earthquake are in the U.S. Bureau of Reclamation Jackson Lake network (JL), the University of Utah network (UU), and the Idaho National Engineering Laboratory network (INEL).

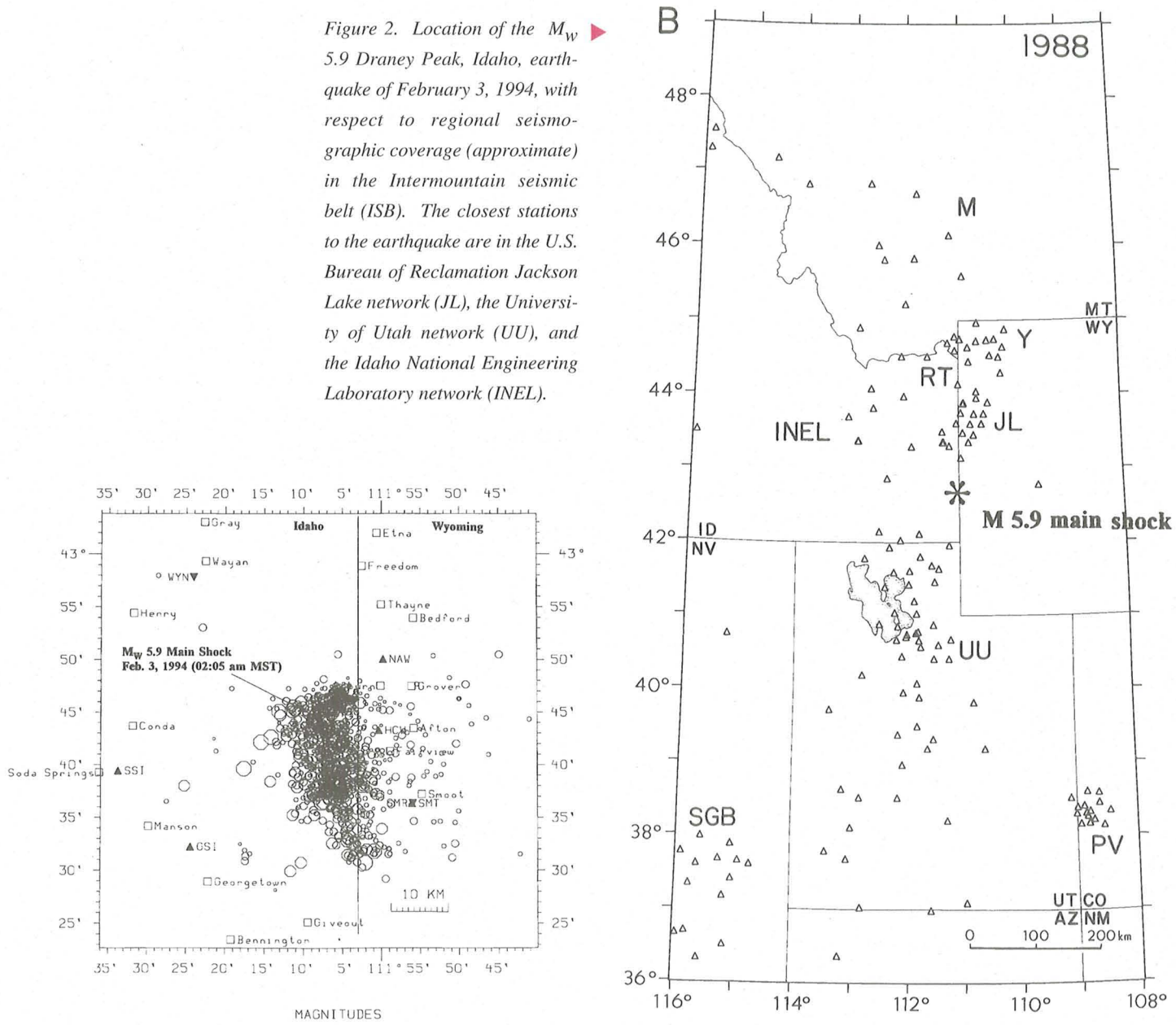

Figure 3. Preliminary earthquake epicenter map showing the locations of aftershocks (octagons scaled by magnitude) of the M_W 5.9 Draney Peak, Idaho, earthquake of February 3, 1994. Only aftershocks occurring during the 10 days following the main shock are plotted on the map. The triangles represent the locations of 10 portable seismograph stations installed by the University of Utah with funding from the U.S. Geological Survey. Not all stations were operating at the same time. Note that the locations of five seismograph stations are obscured by the aftershock data.

Preliminary Isoseismal Maps for the Draney Peak Earthquake

Preliminary isoseismal maps showing Modified Mercalli intensities for the Draney Peak, Idaho, earthquake of February 3, 1994, are shown in figures 1 and 2. Jim Dewey of the U.S. Geological Survey (USGS) in Denver provided these figures. The M_w5.9 Draney Peak earthquake occurred in southeastern Idaho in a remote mountainous area near the Idaho-Wyoming border. The shock was broadly felt in parts of Idaho, Wyoming, Utah, and Colorado. Many residents along the Wasatch Front in Utah felt the earthquake fairly strongly.

After an earthquake of magnitude 5 or greater occurs, the USGS National Earthquake Information Center sends questionnaires to every Post Office in the affected region. These isoseismal maps reflect a first interpretation by the USGS of information contained in returned postal questionnaires and press reports. Some changes in the positions of isoseismals and in intensities assigned to individual points must be anticipated as additional data on earthquake damage are received.

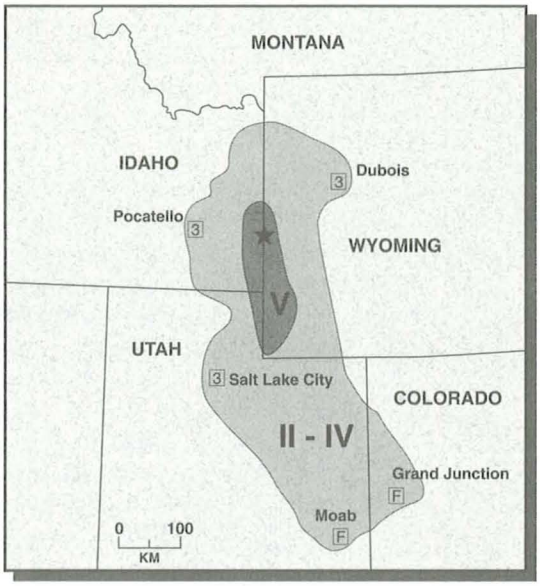

Figure 1. Preliminary far-field isoseismal map. Roman numerals give average Modified Mercalli intensities for the regions between isoseismals; Arabic numerals represent intensities in individual communities. Squares denote towns labeled in figure.

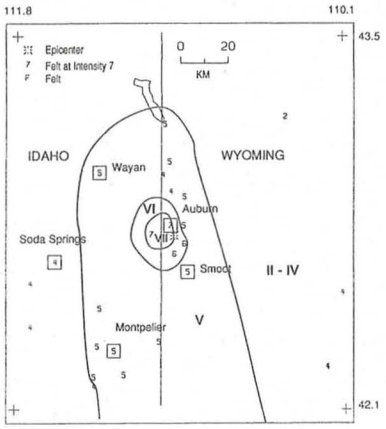

Figure 2. Preliminary near-source isoseismal map. Map lettering and symbols are described in figure 1. The intensity 7 southwest of Auburn represents the Wyoming State Fish Hatchery and is based on press reports.

Insurance Group Launched to Reduce Property Losses

The American Property/Casualty insurance industry recently announced the formation of the Insurance Institute for Property Loss Reduction to help reduce deaths, injuries, and property losses resulting from natural disasters such as earthquakes and hurricanes. It will direct its efforts toward research and public education, drawing expertise from professionals in academia, engineering, architecture, insurance, and government. Inspiration for the new Institute is the existing Insurance Institute for Highway Safety (IIHS) which, for almost 35 years, has conducted research and gathered statistics to further the cause of safety on America's roads and highways.

The new Institute will begin by concentrating on wind and seismic building codes, as well as seeking ways to increase the ability of roofing and other construction materials to withstand the forces of nature. Special emphasis will be placed on the adoption, implementation, and effective enforcement of codes in states at risk from earthquakes and hurricanes.

The Institute will sponsor research projects in a number of areas such as wind engineering and seismic and wind retrofitting. A number of projects and studies are already underway. One effort will see thousands of American communities graded according to the efficacy of their building code inspection efforts. This would parallel the current nationwide system of grading communities for fire suppression capabilities. The results of the grading survey will be made public.

For more information, contact Eugene Lecomte, 73 Tremont Street, Suite 510, Boston, MA 02108-3910, (617) 722-0200, fax (617) 722-0202.

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Earthquake Activity in the Utah Region

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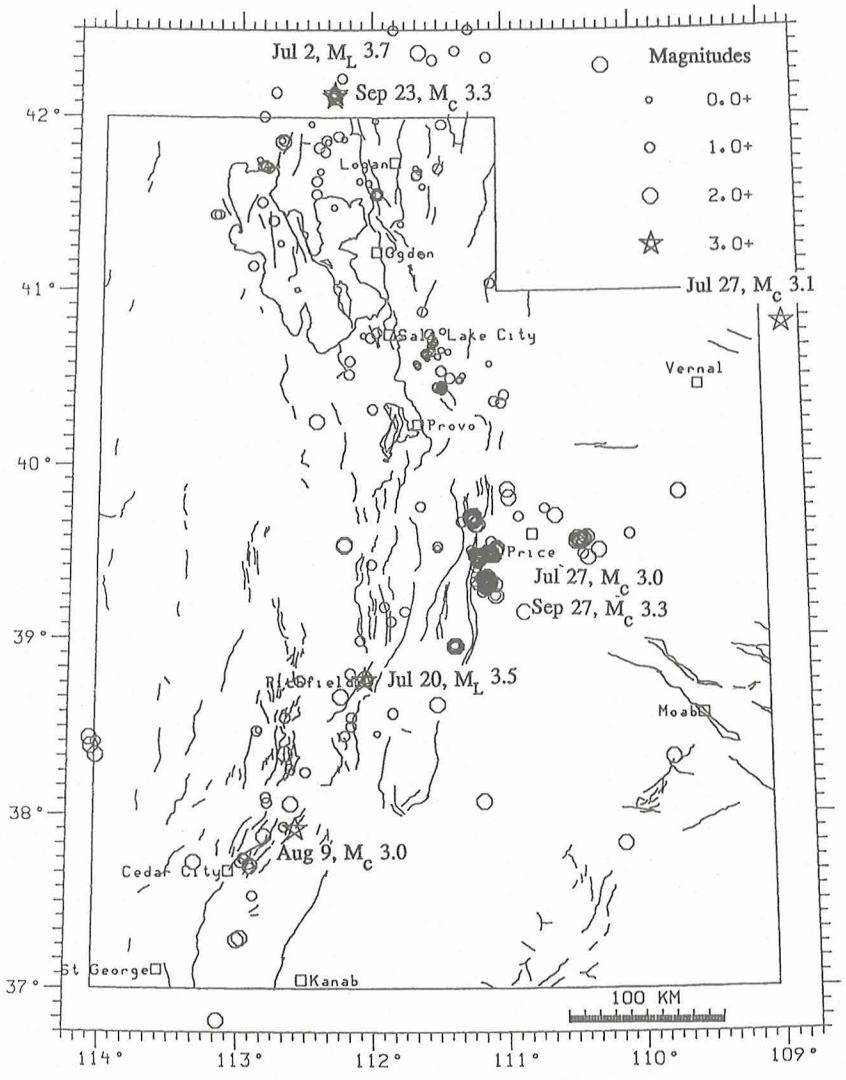


July 1 - September 30, 1993

From July 1 through September 30, 1993, the University of Utah Seismograph Stations located 432 earthquakes in the Utah region. Earthquakes of magnitude 3.0 or larger are plotted as stars. Three earthquakes were reported felt during this period. Magnitude indicated here is either local magnitude, M_L, or coda magnitude, M_C. All times are Mountain Daylight Time.

• Eastern Wasatch Plateau-Book Cliffs area near Price (coal-mining related): Five clusters of seismic events (magnitude 0.9 to 3.3) make up 56% of the shocks that occurred in Utah. These clusters are located: (a) 20 miles E of Price, (b) 25 miles WNW of Price, (c) 20 miles SW of Price, (d) 25 miles SSW of Price, and (e) 35 miles NE of Richfield. Significant shocks:

M_C 3.0	July 27	4:00a.m.	Part of cluster (d)
M_C 3.3	Sept. 27	5:21a.m.	Part of cluster (d)

• Northern Utah: A cluster of eight earthquakes occurred five miles SSW of Malad City, Idaho (30 miles NW of Logan). Most of these earthquakes occurred in late September.

During July and August, a series of 15 earthquakes occurred five miles NW of Park City (15 miles SE of Salt Lake City). The majority of these shocks were less than magnitude 1.0. Seismic activity is sporadic in this area.

Throughout the report period, a series of earthquakes occurred five miles W of Midway (15 miles NE of Provo), in the general vicinity of Deer Creek Reservoir, and ranging in magnitude from 0.2 to 1.6. Seismic activity is sporadic in this area.

• Southern Utah: A cluster of six earthquakes occurred in late August, five miles S of Summit (five miles E of Cedar City). Earthquakes in this cluster ranged in magnitude from 1.5 to 2.2.

Significant earthquakes:

M_L 3.7	July 2	6:16 p.m.	5 miles SSW of Malad City, ID Felt in Malad City, ID
M_C 3.3	September 23	4:04 p.m.	6 miles S of Malad City, ID Felt in Malad City, ID
M_C 3.1	July 27	9:21 p.m.	39 miles N of Dinosaur, CO
M_L 3.5	July 19	9:57 p.m.	2 miles E of Richfield Felt in Annabella, Aurora, Elsinore, Glenwood, Kanosh, Koosharem, and Richfield
M_C 3.0	August 9	1:25 p.m.	10 miles WNW of Panguitch

Additional information on earthquakes within the Utah region is available from the University of Utah Seismograph Stations.

Preliminary Summary of the Earth-Science Aspects of the January 17, 1994, Northridge, California Earthquake

by Gary E. Christenson
Utah Geological Survey

At 4:31 a.m. PST on January 17, 1994, the Los Angeles area was shaken by a surface-wave magnitude 6.6 earthquake centered in Northridge in the San Fernando Valley. Damage was extensive in the San Fernando and Santa Clarita Valleys and the northern Los Angeles basin. The earthquake was the largest in the Los Angeles metropolitan area in historical time, and is estimated to be the most expensive natural disaster in U.S. history.

The earthquake was caused by movement on an unnamed south-dipping thrust fault beneath the San Fernando Valley. The San Fernando Valley and Santa Susana Mountains are on the hanging wall which was thrust to the north. The focal depth was 15 km, and the focal mechanisms of the main shock and aftershocks indicate thrusting on a fault striking roughly N80°W and dipping about 45 degrees to the south. Most active thrust and reverse faults mapped at the surface in the San Fernando Valley and surrounding area dip to the north with movement of the hanging wall to the south. The 1971 San Fernando (Sylmar) earthquake (magnitude 6.5) was on a thrust fault beneath the San Gabriel Mountains which broke the surface in Sylmar in the northern San Fernando Valley. South-dipping thrust faults were known from geologic investigations in the oil fields in the northern San Fernando Valley, but they had not been mapped at the surface and were generally not considered to be seismic sources.

Damage to freeways and buildings, particularly mid-rise (3- to 5-story) structures, was extensive. Unusually high ground accelerations were recorded, including free-field peak horizontal ground accelerations of 1.82 g in Tarzana (7 km from the epicenter) and 0.91 g in Sylmar (15 km from the epicenter). Liquefaction was common but caused little damage. Landslides damaged a house in Pacific Palisades (see photo) and blocked roads and filled steep mountain valleys with loose debris in the Santa Susana, San Gabriel, and Santa Monica Mountains. Unequivicoval evidence for primary surface fault rupture has not been found.

NSF to Fund Special Northridge Earthquake Study

The Northridge earthquake of January 17, 1994, had a serious impact on southern California and the nation. H.R. 3759 makes available a $15 million emergency supplemental appropriation to the Federal Emergency Management Agency (FEMA) to study the earthquake.

The appropriation is intended to increase the scientific understanding of earthquakes and to assess and make recommendations for improving seismic safety throughout the nation based on lessons learned from this disaster.

The National Earthquake Hazard Reduction Program (NEHRP) agencies, consisting of FEMA, the U.S. Geological Survey, the National Institute of Standards and Technology, and the National Science Foundation are organizing this investigation. The NEHRP agencies will direct much of the funding to non-government research grants supporting the goals of the appropriation. NSF has agreed to distribute a special announcement of opportunity, conduct a competitive review of proposals, and manage the successful grants.

For inclusion in the mailing list regarding this research, contact Jim Whitcomb (Geosciences, (703) 306-1556, fax (703) 306-0382, e-mail jwhitcom@nsf.gov) or Bill Anderson (Engineering, (703) 306-1362, fax (703) 306-0319, e-mail wanderso@nsf.gov).

- Reprinted from EOS, Transactions, American Geophysical Union, 1994, v. 75, no. 10, p. 113.

Emergency Response Planning Underway at the Department of Natural Resources

Based on experience gained in RESPONSE 93, the Utah Department of Natural Resources (DNR) is reviewing its emergency response plan. In RESPONSE 93, DNR discovered that it has resources and capabilities unknown outside the department that could be of great value in assisting in an emergency. One such resource is its large "police" force (park rangers, wildlife officers) that could aid in public-safety duties such as securing disaster sites, evacuations, and aiding other public-safety officials (Utah Highway Patrol and local police) in maintaining order. In addition, the department has heavy equipment, communications equipment, many vehicles with radios, and offices throughout the state.

To review the existing DNR emergency-response plan and recommend revisions, an internal "emergency-response committee" was established by Kathleen Clarke, DNR Assistant Director. The committee includes a representative from each division and the department. One of the initial recommendations of the committee is to use an Incident Command System (ICS) team to deal with incidents and manage DNR resources when needed in a large-scale emergency. A DNR representative would be stationed at the State Emergency Operations Center (EOC) to represent the department and communicate needs to the DNR ICS team. All DNR activities would be coordinated by the ICS team which would set up at an appropriate location. As requests for assistance are received from the EOC, all planning, tracking, and logistics would be handled by the DNR ICS team. Each division would have a representative on the DNR ICS team as necessary, to advise the team of available division resources.

For the March 31, RESPONSE 94, state earthquake exercise (see Wasatch Front Forum, 1993, v. 9, no. 3-4, p. 13), a "mock" DNR ICS team was deployed and tested. The ICS team concept worked well and revision of the DNR emergency-response plan to include the team has been recommended. A listing of each division's resources, personnel expertise, and principal contacts is also being compiled as a part of this planning effort.

Site-Specific Strong Ground Motion Estimates for the Salt Lake Valley, Utah

The Utah Geological Survey (UGS) recently released Miscellaneous Publication 93-9, *Site Specific Strong Ground Motion Estimates for the Salt Lake Valley, Utah*, by Ivan G. Wong, Woodward-Clyde Federal Services, Oakland, California, and Walter J. Silva, Pacific Engineering & Analysis, El Cerrito, California. The abstract from this publication is printed below. Copies of the report are available for $5.50 plus $2.50 shipping from UGS Publication Sales, 2363 South Foothill Drive, Salt Lake City, UT 84109-1491, (801) 467-0401, fax (801) 467-4070.

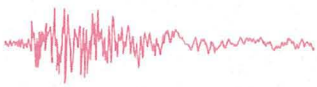
Abstract

The high level of seismic hazard in Salt Lake Valley from potential large earthquakes (surface wave magnitude [MS] ≥ 7) on the Wasatch fault zone has long been recognized. Of obvious importance to hazard mitigation is the prediction of the near-field strong ground shaking that will be generated by such earthquakes. Estimates of strong ground motions in Salt Lake Valley that incorporate the site-specific effects of the shallow subsurface geology and details of the earthquake rupture process, however, have not been available to date. Such estimates are especially important because of the potentially significant effects on ground motions from the alluvial deposits which underlie most of the Salt Lake Valley.

In this study, we have performed such a site-specific characterization of potential strong ground motions in the Salt Lake Valley based upon a methodology that combines aspects of finite earthquake source modeling with the Band-Limited-White-Noise ground motion model, random vibration theory, and an equivalent-linear soil response approach. The objective was to assess the strong ground motions that could be generated assuming a moment magnitude (M_w) 7.0 earthquake occurring on the Salt Lake City segment of the Wasatch fault.

Strong ground motions were estimated for three sites located within the Salt Lake Valley. These sites were selected to represent the range of near-surface conditions in the valley based on the Uniform Building Code (UBC) soil classifications S_1, S_3, and S_4. Geologic and shear-wave velocity profiles were developed for each site based on borehole logs and shear-wave velocity measurements and other subsurface information. For the source, randomized slip models based on a modified version of the M_w 6.8 1983 Borah Peak, Idaho earthquake slip distribution were used in the finite fault modeling.

The site-specific acceleration response spectra were compared with and, in all cases, exceeded UBC seismic zone 3 and 4 spectra for each site. The peak horizontal accelerations were also generally higher than typical empirical median values. The effects of being located on the hanging wall versus the footwall of the fault, in the near-field of large slip areas (asperities) along the rupture plane, site amplification, and possibly rupture directivity appear to be factors which will enhance strong ground shaking. For deep soft soil sites, soil damping is a controlling factor at high frequencies resulting in reduced but still very significant ground motions for locations near the Great Salt Lake.



Damage Potential Index Mapping for Salt Lake Valley, Utah

The Utah Geological Survey (UGS) also recently released Miscellaneous Publication 93-4, *Damage Potential Index Mapping for Salt Lake Valley, Utah*, by Scott M. Adan and Kyle M. Rollins, both of the Brigham Young University Civil Engineering Department. The abstract from this publication is printed below. Copies of the report are available for $6.00 plus $2.50 shipping from UGS Publication Sales, 2363 South Foothill Drive, Salt Lake City, UT 84109-1491, (801) 467-0401, fax (801) 467-4070.

Abstract

Damage potential index (DPI) calculations have been made for the Salt Lake Valley based on ground response analyses at 13 sites where soil and shear wave velocity profiles had been previously defined by the U.S. Geological Survey. The damage potential index is proportional to the ratio of the earthquake induced loads (demand) to the lateral resisting force required by the seismic code. Based on soil conditions, geology, and low-strain amplification measurements, the valley was divided into four zones ranging from stiff shallow sites to deep soft sites. Ground response analyses were performed for three to four sites within each zone using the computer program SHAKE. Each site was subjected to eight M 7.0-7.25 rock input motions with peak accelerations of 0.35 g and 0.70 g. These acceleration levels have a 10% chance of being exceeded in 50 years and 250 years respectively. Based on the ground response studies, representative acceleration response spectra were developed for each of the four zones for the two acceleration levels. For building periods less than about 1.0 second, spectral accelerations were highest for stiff shallow soil profiles. However, for building periods greater than about 1.0 second, spectral accelerations were highest for soft deep soil profiles.

The earthquake demand determined from the response analyses was divided by the equivalent lateral force coefficient specified by past, present, and proposed Uniform Building Code seismic requirements. The damage potential index has been correlated to structural damage based on data obtained in Mexico City. This allowed an estimation of the damage percentage for buildings with various periods constructed according to each building code. For the earlier codes, the damage potential was much higher for soft soils than for stiff soils but for more recent codes, which include a soil coefficient, the damage potential values are less dependent on soil type. Damage percentages for buildings constructed under the earlier codes approach those observed in Mexico City. However, the current code appears to provide reasonable protection for the entire valley for the 50 year acceleration level. At the 250 year acceleration level, the potential for damage is significantly greater with damage intensities as high as 20% over large period ranges. Amplification in Salt Lake Valley soft soil appears to be less than for San Francisco soft soil. However, because Salt Lake City is in seismic zone 3 rather than zone 4, the damage intensity would be about the same for a M 7.0 earthquake. High damage potentials were computed for stiff shallow soils overlying bedrock in comparison with similar soil sites in San Francisco. This poses a significant hazard to low-rise structures located on stiff shallow soils around the edge of the valley. A change from zone 3 to 4 would reduce the damage intensity in the event of an earthquake by 25 percent.

TCLEE Workshop on Damage Assessment of Lifelines

The American Society of Civil Engineers (ASCE) Technical Council on Lifeline Earthquake Engineering (TCLEE), Post-Earthquake Investigation Committee, plans to sponsor a workshop to train individuals in the assessment of lifeline damage caused by earthquakes. The committee is also seeking new members who are interested in evaluating the performance of lifeline systems after a damaging earthquake. Lifeline systems include power, water, sewage, communication, transportation, and liquid and gaseous fuel systems. Past investigations have emphasized the documentation of damage. Recently, however, increased emphasis has been placed on determining the cause of damage and its impact on system response.

The workshop will be held on the west coast and is tentatively scheduled for June of 1994. There will be a registration fee of approximately $150. The committee is seeking individuals with lifeline experience, and investigators who can assess the impact of phenomena such as soil liquefaction on lifeline systems.

If you are interested in participating in the workshop and/or in becoming an investigator, please contact Chuck Farrar, Los Alamos National Laboratory, MS J576, Los Alamos, New Mexico, 87545, (505) 667-4551.

-Reprinted from EERI Newsletter, February 1994

"Paleoseismology of Utah" Special Studies Series

Although the Wasatch fault zone has not experienced a surface-faulting earthquake in historical time, abundant geologic evidence indicates that numerous events have occurred in the recent geologic history.

In 1983 the U.S. Geological Survey (USGS) and the Utah Geological Survey (UGS) initiated a five-year research effort under the auspices of the National Earthquake Hazard Reduction Program (NEHRP) to evaluate earthquake hazard and risk along Utah's heavily populated Wasatch Front. Paleoseismic studies conducted as part of that effort have provided critical information on earthquake timing, recurrence, displacement, slip rate, and fault geometry which is used to characterize the long-term earthquake potential (hazard) and risk from Quaternary faults. To make the results of these paleoseismic investigations in Utah available to geologists, engineers, public planners, decision makers, and the general public, the UGS initiated the "Paleoseismology of Utah" Special Study series.

The Wasatch Front is located within a recognized zone of earthquake activity, the Intermountain seismic belt, and is faced with the threat of significant property damage and loss of life due to large earthquakes. Nearly 85 percent of Utah's population of 2.2 million people live within 16 km (10 mi) of the Wasatch fault zone, the longest and most active extensional fault in the western United States. Although the Wasatch fault zone has not experienced a surface-faulting earthquake in historical time, abundant geologic evidence indicates that numerous events have occurred in the recent geologic past. Volumes 1 through 3 (detailed below) of the "Paleoseismology of Utah" Special Study series, published in 1991, are a result of the initial NEHRP efforts and are tangible evidence of the close cooperation that exists at the state and federal levels on an issue that affects the life, safety, and well being of the citizens of Utah.

Many other active faults are located in Utah, and the historical seismic record indicates that an unknown number of buried faults capable of causing damaging earthquakes are also present in the state. So after 1991, the scope of the "Paleoseismology of Utah" Special Study series was extended beyond the "Wasatch Front Earthquake Hazard and Risk Analysis Program." Volumes 4 and 5 (described below) are the result of this expansion. The UGS hopes that other investigators, like McCalpin and West, below, will take advantage of this series to publish the results of their studies of other Quaternary faults in Utah.

The UGS recently published Volume 5 in this series, *"Neotectonic deformation along the East Cache fault zone, Cache County, Utah,"* by James P. McCalpin (UGS Special Study 83, available for $5.00 plus $2.50 shipping). The East Cache fault zone trends along the eastern side of northern Utah's Cache Valley, at the base of the precipitous Bear River Range. Fault scarps in geologically young deposits (latest Pleistocene and Holocene) and well-developed faceted spurs along the range front have long indicated to geologists the active nature of this fault. In this report the results from two detailed trenching investigations, evaluation of Bonneville-highstand shoreline deformation, and geomorphic analysis of Bear River Range front faceted spurs are used to characterize the prehistoric seismic behavior and the earthquake potential of the East Cache fault zone.

The UGS will soon release Volume 4 (currently in press), *"Seismotectonics of north-central Utah and southwestern Wyoming,"* by Michael W. West. This report presents a comprehensive evaluation and regional synthesis of the seismotectonic setting along the Utah-Wyoming border. Results of the study provide strong evidence for Quaternary normal-slip reactivation of thrust faults along the leading edge of the Wyoming part of the Sevier orogenic belt. Work in the study area was initiated as part of a seismic-hazard evaluation for the Meeks Cabin and Stateline Dams on the north flank of the Uinta Mountains.

Volume 3, *"The number and timing of Holocene paleoseismic events on the Nephi and Levan segments of the Wasatch fault zone, Utah,"* by Michael Jackson (UGS Special Study 78, available for $6.50 plus $2.50 shipping) reports the Holocene history of ground-rupturing earthquakes on the Nephi and Levan segments of the Wasatch fault zone. This study is of particular interest because it extensively uses the relatively new thermoluminescence (TL) technique to date past ground-rupturing earthquakes. Originally developed by archaeologists for dating pot shards, efforts to adapt the TL technique to dating paleoearthquakes are exciting because the TL method can be applied to mineral grains in commonly abundant silt and fine-sand deposits. In the dry, sparsely-vegetated regions of western Utah, organic material required for conventional radiocarbon dating is generally rare or absent. The availability of a reliable dating technique

that can be readily applied in organic-poor arid environments represents a significant advance in our ability to interpret the earthquake history of active faults.

Volume 2, *"Paleoseismic analysis of the Wasatch fault zone at the Brigham City trench site, Brigham City, Utah and the Pole Patch trench site, Pleasant View, Utah,"* by Stephen F. Personius (UGS Special Study 76, available for $6.00 plus $2.50 shipping) consists of two reports on fault-trenching studies of the north-central part of the Wasatch fault zone. Fault-trenching studies like these provide critical information that can be used to characterize seismic-source zones and to evaluate the long-term potential and risk from active faults.

Volume 1, *"Fault behavior and earthquake recurrence on the Provo segment of the Wasatch fault zone at Mapleton, Utah County, Utah,"* by William R. Lund, David P. Schwartz, William E. Mulvey, Karin E. Budding, and Bill D. Black (UGS Special Study 75, available for $7.00 plus $2.50 shipping) reports the Holocene behavior of the Provo segment of the Wasatch fault zone near Mapleton, Utah, and summarizes the paleoseismic investigations undertaken in Utah from 1875 (by G.K. Gilbert) to the present day.

Any volume in this series is available by contacting UGS Publication Sales, 2363 South Foothill Drive, Salt Lake City, UT 84109-1491, (801) 467-0401, fax (801) 467-4070.

Attention Paleoseismic Investigators!

Numerous paleoseismic studies have been conducted in Utah, but only a few have been published in readily available scientific journals. The results of many investigations exist only as abstracts of talks presented at professional meetings, or as unpublished literature in agency reports of limited distribution. The authors of those studies are urged to contact the UGS regarding publishing the results of their work in the "Paleoseismology of Utah" Special Study series. The UGS may also publish the results of future paleoseismic investigations in this series, so that new information on the behavior of active faults in Utah is made available to those individuals and organizations responsible for mitigating earthquake hazards and risk in Utah.

1993 NEHRP Professional Fellowship Report

Farzad Naeim, recipient of the 1993 EERI/FEMA National Earthquake Hazard Reduction Program Professional Fellowship, has completed his research and published the results of his work in a report titled *Classification and Evaluation of Earthquake Records for Design.* Naeim is a director of research and development at John A. Martin & Associates, Inc. in Los Angeles. Based at the University of Southern California in Los Angeles during the fellowship, Naeim teamed with James Anderson, Associate Professor of Civil Engineering, who co-authored the 300-page report.

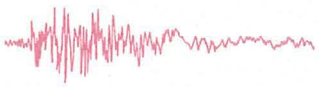
Naeim spent the six-month fellowship developing an extended database from more than 5,000 earthquake records, and classifying the data according to selected parameters. His goal was to provide processed data that would help a seismic-design engineer determine the critical earthquake by identifying the earthquake ground-motion components that would drive the structure being designed to its critical response.

The results of the research are presented in tables, in which the significant records from the database are sorted by various response parameters. Plots of constant strength inelastic response spectra, constant ductility inelastic response spectra, elastic and inelastic input energy spectra, and hysteretic energy spectra for 120 of the most significant records are included in the report. Statistical procedures were used to investigate correlations between different parameters. The authors hope that the extensive energy-related information presented in the report will be used to accelerate formulation of new and novel energy-based approaches to earthquake-resistant design of structures.

To obtain a free copy of Naeim's report, please contact the Earthquake Engineering Research Institute at 499 14th Street, Suite 320, Oakland, California 94612-1902, (510) 451-0905, fax (510) 451-5411.

-Reprinted from EERI Newsletter

Paleoseismology Workshop Accepting Papers



A workshop on paleoseismology will be held September 18 - 22, 1994, at the Marconi Conference Center in Marshall, California, on Tomales Bay, north of San Francisco. The workshop is sponsored by Task Group II-3 of the International Lithosphere Program and the U.S. Geological Survey. Topics to be discussed include recognition of paleoearthquakes in the geologic record, Quaternary dating techniques applicable to the precise dating of paleoearthquakes and estimates of fault slip rates, models of earthquake occurrence and fault behavior, and characteristic earthquakes, earthquake clustering, fault segmentation, and slip distribution. A one-day field trip to trench sites in the Bay Area is planned.

If you are interested, contact Robert S. Yeats, Department of Geosciences, Oregon State University, Corvallis, OR 97331, e-mail yeatsr@bbc.orst.edu, or Carol Prentice, U.S. Geological Survey, MS 977, 345 Middlefield Road, Menlo Park, CA 94025, e-mail cprentice@isdmni.wr.usgs.gov.

Papers are also solicited for a special section of the Journal of Geophysical Research-Solid Earth on paleoseismology. Manuscripts must be submitted before September 18. 1994. If you are interested in contributing to this special section, contact Robert Yates at the address given above, for further information.

- Reprinted from EOS, Transaction of the American Geophysical Union, v. 75, no. 14, p. 163.

Recent Publications

Anders, M.H., 1994, The role of intrabasin highs in the growth of normal faults [abs.]: Geological Society of America Abstracts with Programs, v. 26, no. 2, p. 34.

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Missouri-Rolla, 3 volumes, hard bound, $500 (plus $25 for surface mail, $100 for air mail), Continuing Education, University of Missouri-Rolla, Rolla, MO 65401-0249.

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Meetings and Conferences

- July 10-14, 1994, **Fifth U.S. National Conference on Earthquake Engineering, "Earthquake Awareness and Mitigation Across the Nation,"** organized by the Earthquake Engineering Research Institute, Marriott Downtown Hotel, Chicago, Illinois. The conference will provide an opportunity for both researchers and practitioners to share the latest knowledge and techniques for understanding and mitigating the effects of earthquakes. For further information, contact the Earthquake Engineering Research Institute, 499 14th Street, Suite 320, Oakland, CA 94612-1902, (510) 451-0905, fax (510) 451-5411.
- July 15-16, 1994, **Monitoring and Assessment of Natural Hazards Using Space Technology,** Hamburg, Germany. Topics will include various techniques for monitoring natural hazards, assessment of damages due to natural hazards, and prediction of natural hazards, including methods using airborn and space-born techniques. For more information, contact Ramesh P. Singh, Institute fur Weltraumwissenschaften (WE 4), Freie Universitat Berlin, Faveckstr. 69, 1000 Berlin 33, Germany, 49-30-838-66-66, fax 49-30-832-86-48.
- August 3-5, 1994, **First World Conference on Structural Control,** Pasadena Ritz Carlton Hotel, Los Angeles, California, sponsored by the U.S. Panel on Structural Control Research, the Japan Panel on Structural Response Control, and the International Association of Structural Control. This conference will bring together engineers, scientists, architects, builders, and others interested in the general field of active or hybrid vibration control and monitoring of buildings and civil infrastructure systems. The conference will focus on topics related to building structures, including adaptive structures, intelligent/smart materials and systems, health monitoring and damage detection, actuators, sensors, vibration isolation, and hybrid vibration control of civil infrastructure components under the action of earthquakes, wind, and man-made loads. For further information, contact the 1WCSC Organizing Committee, U.S. Panel on Structural Control Research, c/o Department of Civil Engineering, University of Southern California, Los Angeles, CA 90089-2531, (213) 740-0581, fax (213) 744-1426, e-mail: uspanel@vivian.usc.edu.
- October 2-7, 1994, **Association of Engineering Geologists Annual Meeting, "Engineering Geology: Past, Present and Future,"** Williamsburg, Virginia. By May 2, 1994, submit abstracts to Lanny Helms, Vice Chairman-Technical Program, c/o Target Environmental Services, 9180 Rumsey Road, Columbia, Maryland 21045, (410) 992-6622, fax (410) 992-0347. For information, contact AEG, Suite 2D, 323 Boston Post Road, Sudbury, MA 01766, (508) 443-4639.
- October 24-27, 1994, **Geological Society of America Annual Meeting,** "Geology At the Leading Edge," Washington State Convention and Trade Center, Seattle, Washington. The theme emphasizes both the geographical position of Seattle, situated on the leading edge of a convergent plate margin, and the application of "leading edge" theoretical approaches to and technological advances in the elucidation of geological problems. Theme sessions and symposium proposals are sought in all aspects of Pacific Rim and convergent-margin geology, with particular emphasis on the utilization of new technology. For information, call the GSA Meetings Department, Boulder, Colorado, (303) 447-2020.

The Fault Line Forum (formerly Wasatch Front Forum) is the newsletter of the Utah Earthquake Advisory Board. It is published quarterly by the Utah Geological Survey (UGS). It makes information available to the public which may be preliminary or unavailable in other published form, but is considered to be of value. It may not necessarily conform to UGS policy, technical review, or editorial standards. Information, contributions, questions, and suggestions concerning future issues may be sent to the Editor at the following address:

Janine L. Jarva, Editor, UGS, 2363 South Foothill Drive, Salt Lake City, UT 84109-1491, (801) 467-7970, fax (801) 467-4070.

Deadlines for Future Issues

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v. 10, no. 4.....October 31, 1994

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