Mackay School of Earth Sciences and Engineering
College of Science
University of Nevada, Reno

NEVADA BUREAU OF MINES AND GEOLOGY

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Biennial Report of the Nevada Bureau of Mines and Geology

2010

Jonathan G. Price
State Geologist and Director

PREPARED FOR

The Board of Regents of the Nevada System of Higher Education

Contents

Executive Summary	3
Introduction	4
Statutory Mandates	6
Addressing Nevada's Critical Needs - Economic Development	7
Addressing Nevada's Critical Needs - Natural Hazards and Economic Stability	9
Addressing Nevada's Critical Needs - Education and Services for the Public	10
Active Projects	11
Budget	17
Staffing Levels and Changes	18
Staff of the Nevada Bureau of Mines and Geology	19
Relations with Other Agencies	20
Contributions to the Educational Mission of the University	20
Goals and Objectives	21
Earth-Science Research	21
Geological Information and Long-Term Data Preservation Plan	22
Earth-Science Education	24
Strategies to Reach these Goals and Objectives	24
Creating and Responding to Opportunities	24
NBMG Strategic Initiatives	24
Outcome-Related Performance Measures for NBMG	29
Research Productivity	29
Customer-Service Questionnaire	33
Quality of the Research and Public Service Products	34
Acknowledgments	36
APPENDIX A. Activities of NBMG in 2008 and 2009	36
Publications	36
Active Research Grants	45
Presentations, Abstracts, and Websites	49
Honors and Awards	64
Other Professional Activities	64
APPENDIX B. Statutory Mandates of NBMG	72
APPENDIX C. Customer Service Questionnaire	81
Fact sheet on the National Cooperative Geologic Mapping Program in Nevada	84
List of NBMG Advisory Board members, emeritus and adjunct faculty	Inside back cover
Generalized Geologic Map of Nevada	Back cover

Cover photograph:
The University of Nevada, Reno’s new Great Basin Science Sample and Records Library opened in 2009 and is operated by the Nevada Bureau of Mines and Geology’s publication-sales and information-office staff on the campus of the Desert Research Institute, 2175 Raggio Parkway in Reno. With the exception of four windows in the rock-examination room, the windows have a 17.3-nanometer-thin coating of gold, which lowers heating and air-conditioning costs by reflecting heat. Approximately one troy ounce of gold is all that was needed for the entire building.

Biennial Report of the
Nevada Bureau of Mines and Geology
2010

EXECUTIVE SUMMARY

The Nevada Bureau of Mines and Geology (NBMG) stimulates economic diversification and development in the state, saves lives, and protects property from natural disasters. NBMG is the statewide research and public service unit of the University of Nevada, Reno that serves as the state geological survey. NBMG's mission, to provide the state's needs for geological and energy- and mineral-resource information and research, is defined in its enabling legislation. Established by the Nevada Legislature as a department within the public service division of the Nevada System of Higher Education, NBMG is part of the Mackay School of Earth Sciences and Engineering within the College of Science and one of the Statewide Programs at the University of Nevada, Reno. NBMG scientists conduct research and publish reports that focus on the economic development, public safety, and quality of life in urban and rural areas of Nevada.

URBAN GROWTH - NATURAL HAZARDS AND ECONOMIC STABILITY

- Earthquakes
- Floods
- Subsidence and Fissures due to Groundwater Withdrawal
- All Hazards

MINERAL, ENERGY, AND WATER RESOURCES VITAL TO ECONOMIC EXPANSION

- Precious and Base Metals
- Industrial Minerals, including Construction Raw Materials
- Geothermal Energy and Other Forms of Renewable Energy
- Petroleum
- Uranium

ENVIRONMENTAL CONCERNS

- Mercury and Other Chemical Hazards from Historical Mining and Natural Sources
- Global Change
- Waste Isolation
- Riparian Restoration

SCIENCE TO UNDERPIN THE APPLICATIONS

- Geologic Framework – With Applications in Resources, Hazards, and Environment
- Tectonics and Earth Processes
- Global Geodesy

EARTH SCIENCE EDUCATION AND OUTREACH TO THE PUBLIC

- Outreach to the General Public, K-12 Teachers, and Students
- Outreach to Professionals

This report provides details on the activities of NBMG scientists and support staff during the past two years. The University of Nevada, Reno is strategically planning for the future, and this report incorporates key elements of NBMG's strategic plan for the next five to ten years. As indicated in the lists of publications, research grants, and other professional activity, NBMG has been highly productive and valuable to the State of Nevada. In accordance with Nevada Revised Statute 514.070, which calls for a biennial report on NBMG activities, it is my pleasure to transmit this report on behalf of the NBMG staff.

Jonathan G. Price
State Geologist and Director

INTRODUCTION

NBMG scientists conduct research and publish reports on mineral and energy resources, engineering geology, environmental geology, earthquakes and other hazards, groundwater, and geologic mapping in Nevada. The maps and geologic reports produced by NBMG provide basic information used by a broad spectrum of individuals, including engineers involved in construction, conservationists, exploration geologists, miners, highway planners, urban planners, emergency managers, historians, students, professors, K-12 teachers, tourists, and Nevadans enjoying outdoor recreation.

In addition, NBMG provides special services in the areas of analytical geochemistry and assay standards, mineral and rock identification, sample curation, earth-science education and in-service teacher training, continuing education for professional geoscientists, geologic and geotechnical information, information on strain measured with precise geodetic instruments, mineral- and energy-resource information, geographic information systems, electronic databases, and historical information, particularly regarding mining and natural hazards. NBMG works closely with many local, state, and federal agencies. Considerable information about NBMG can be found on the Web (www.nbmg.unr.edu).

Major research projects are being conducted throughout Nevada. Geologic maps are being produced in areas that will be undergoing urban and suburban development, in areas where environmental concerns are most critical, and in areas where the potential is high for the development of mineral, energy, and water resources. It typically takes one to two person-years of effort to complete each 7.5-minute (1:24,000-scale) quadrangle. These maps provide the basis for nearly all geological research and for many engineering applications. Significant hazards in southern Nevada include flash floods, subsidence and related open cracks in the ground (fissures), swelling and collapsing soils, and earthquakes. In northern Nevada, earthquake, landslide, flood, and soil-condition hazards dominate, but other concerns, including locally high concentrations of naturally occurring radon and arsenic, are also best understood from a basis of geologic maps. Geologic mapping in northeastern Nevada is revealing much about the origin of the gold deposits that have made Nevada the nation's foremost gold-producing state and the United States a leading producer of gold in the world.

Research on land subsidence in Las Vegas Valley provides valuable information about the rates of subsidence resulting from groundwater withdrawals and the development of fissures that can cause considerable damage to buildings. NBMG researchers, in collaboration with other experts, are using the most current technologies to attack this problem—geodetic measurements using the global positioning system (GPS) and interferometry using synthetic aperture radar (InSAR), a remote-sensing technique. NBMG is also evaluating concerns regarding subsidence and fissures in other desert valleys, where groundwater is being pumped to supply the needs of expanding populations or for mines.

NBMG and Nevada Seismological Laboratory scientists assess earthquake hazards throughout the state. NBMG geologists evaluate the geologic record for evidence of prehistoric earthquakes, and NBMG geodesists measure strain using the global positioning system (GPS). There is abundant evidence that nearly all parts of Nevada have experienced earthquakes with magnitudes in excess of 6.5 during the last several hundred thousand years, and maps of strain may identify the areas that are most likely to experience earthquakes in the future. NBMG's research complements the work of the Nevada Seismological Laboratory, which monitors earthquakes ranging from magnitudes less than one to the largest earthquakes in the world. From historical and instrumental records, we know that Nevada experiences a magnitude 7.0 or greater earthquake about once every 30 years. The largest earthquakes yet recorded in the state, the magnitude 7.1 to 7.8 event in Pleasant Valley near Winnemucca, occurred in 1915. The last magnitude 7 earthquake was at Fairview Peak near Fallon in 1954. Much more needs to be done, scientifically and in outreach to the public, to reduce the risks from natural hazards.

The magnitude 6.0 earthquake near Wells in February, 2008, and the swarm of earthquakes that included a magnitude 4.7 at Mogul in April of 2008 highlighted our need to be prepared for earthquakes. NBMG's leading earthquake geologist, Craig dePolo, joined the Nevada Division of Emergency Management's team that responded to the Wells earthquake, and we were successful in putting NBMG Special Publication 27, *Living with Earthquakes in Nevada*, in the hands of residents in the Mogul area before the largest of the earthquakes. Because residents followed the publication's instructions for securing items to avoid damage during an earthquake, perhaps millions of dollars in potential damage was avoided. With the assistance of the Federal Emergency Management Agency (FEMA), we were also able to distribute this publication as a Sunday supplement in the Reno Gazette-Journal. The public's heightened awareness about earthquakes will help to save lives. We have used FEMA's loss-estimation model, HAZUS, a computer simulation of earthquakes of a given size, to indicate that a major earthquake either in the Las Vegas or Reno-Carson City areas, like ones that have occurred in the geological past and will occur in the future, could cause hundreds of fatalities and billions of dollars in economic loss, if we are not prepared.

Floods along major streams and flash floods along normally dry washes are all too common phenomena in Nevada. NBMG research is helping to understand the frequency and severity of past floods. Efforts are underway in southern, northwestern, and north-central Nevada to determine the timing, magnitude, and frequency of these events.

Geological aspects of waste disposal are being addressed with the aid of geologic maps, which are essential in understanding groundwater flow at and away from all sites, including landfills and radioactive waste sites. Other important considerations regarding nuclear waste issues that have been addressed by NBMG investigations include tectonic strain and related earthquake and volcanic hazards and the potential for mineral-resource development.

Mineral-resource assessments are routinely needed by federal agencies with land-management responsibilities. NBMG scientists with expertise in economic geology have contributed to resource assessments by the Bureau of Land Management, Department of Defense, Department of Energy, Fish and Wildlife Service, and U.S. Geological Survey. NBMG has also evaluated environmental concerns about mining, such as potential acid-mine drainage and associated release of potentially toxic elements from abandoned and inactive mines; mercury pollution from the early days of mining on the Comstock and elsewhere, when amalgamation was the preferred method of extracting gold and silver from the ores; and predicting the future chemistry of pit lakes when modern-day open pits fill with water after mining stops.

NBMG publishes many maps and reports that assist in the exploration for, and environmentally sound development of, mineral, energy, and water resources. NBMG publishes geologic maps that are produced not only by NBMG geologists but also by geologists from industry and at universities throughout the world. The maps and reports are reviewed by peers with knowledge about the local geology.

NBMG scientists also routinely publish in peer-reviewed, internationally recognized scientific journals. NBMG scientists have fine reputations within the scientific community, and several have won awards for their extraordinary contributions. NBMG's research projects are led by teams with broad expertise in the geological sciences and geography. The geodesy team, which we have named the Nevada Geodetic Laboratory, has made significant contributions to global geophysics and space science while also focusing on issues critical to Nevada. The scientists' efforts are supported by an excellent staff in the areas of cartography, graphic design, geographic information systems (GIS), analytical services, technical assistance in the field, publication sales, information technology, finance, and administration.

NBMG has leadership roles in several statewide efforts. NBMG, along with the Nevada Seismological Laboratory, provides operational support for the Nevada Earthquake Safety Council (with funding from a FEMA grant that is passed through the Nevada Division of Emergency Management). The Nevada Earthquake Safety Council facilitates public input, develops consensus about seismic issues within the

public and private sectors, and is the public advisory body for state seismic policy and the Nevada Earthquake Risk Reduction Program of the Division of Emergency Management. The Board of Directors of the Council, which votes on policy recommendations, has 22 members, from both southern and northern Nevada, representing business and industry; city, county, and state agencies, including the Assembly and Senate; geosciences; engineering; community organizations; universities; building officials; insurance; and primary-secondary education. The Council has made significant progress in improving earthquake awareness and preparedness, largely through a number of activities supported by NBMG and the Nevada Seismological Laboratory.

The NBMG Director, Jon Price, chairs the State Mapping Advisory Committee (SMAC), and NBMG's Chief Information Officer, Ron Hess, serves as its executive secretary. In the early 1980s the Governor named the NBMG Director as the chair of SMAC. SMAC provides input to the United States Geological Survey on issues related to updating topographic maps, digital map products used in GIS, and geologic mapping. The Geologic Mapping Subcommittee of SMAC helps set priorities for geologic mapping according to the National Cooperative Geologic Mapping Program. Membership in SMAC is open to Nevada representatives of local, state, and federal agencies, universities, and individuals from the private sector with interests in mapping. SMAC's efforts in coordinating requests to the U.S. Department of Interior have helped make many new digital products available, including new statewide digital aerial photographs. These products are free on the Web through the University’s library.

Jon Price also chairs the Nevada Hazard Mitigation Planning Committee, which advises the Division of Emergency Management on the allocation of funds set aside by FEMA for mitigation of future disasters. Because NBMG has considerable expertise in geological hazards (particularly floods, earthquakes, landslides, subsidence, and other unstable ground conditions), NBMG has much to contribute to the efforts of reducing risks from natural disasters.

The Nevada State Board on Geographic Names was established by the Legislature to coordinate and approve geographic names within the state for official recommendation by the United States Board on Geographic Names. The State Board has representation from NBMG, faculty of the University of Nevada, Reno and the University of Nevada, Las Vegas, the State Library and Archives, State Department of Transportation, State Department of Conservation and Natural Resources, Nevada Historical Society, U.S. Bureau of Land Management, U.S. Forest Service, and the Inter-Tribal Council of Nevada, Inc. Officially recognized geographic names must be approved by both the State and U.S. Boards.

STATUTORY MANDATES

Please refer to Appendix B for the wording of NBMG's statutory mandates under NRS 514 (establishing NBMG and its mission), NRS 396 (concerning the analysis of ores, minerals, soil, and water submitted by residents of Nevada), NRS 327 (concerning the Nevada State Board on Geographic Names), NRS 519A (concerning fees collected by the Nevada Division of Environmental Protection to fund cooperative agreements between NBMG and the U.S. Geological Survey), NAC 522 (concerning responsibilities to archive samples and records from oil and gas wells), NAC 534A (concerning responsibilities to archive samples and records from geothermal wells), and 43 USC Sec. 31c (concerning requirements for participation in the National Cooperative Geologic Mapping Program).

Addressing Nevada's Critical Needs - Economic Development

Geologic maps and related reports on applied research are excellent incentives for economic development. As an example, geologic mapping and related interpretation of the regional geological structures were an integral part of the discovery of the Carlin gold deposit in 1961. In the last 35 years, mining companies in Nevada have produced tens of billions of dollars' worth of gold and silver from deposits of this type and have directly and indirectly provided high-paying jobs for tens of thousands of Nevadans. There is still much mineral wealth to be found in Nevada, particularly buried under volcanic rocks and alluvium in basins between the mountain ranges. In 1988, we estimated that the undiscovered mineral resources in Nevada were likely to have a value in the range of $120 billion to $1.2 trillion, and those figures still provide a reasonable estimate of the untapped mineral wealth of Nevada. Nevada's gold production, 162 million troy ounces since the Carlin deposit began operation in 1965 through 2009, would have a value of approximately $225 billion at current prices.

Geologic maps in urban areas help businesses avoid unstable areas (such as active faults and locations prone to liquefaction during earthquakes, flash floods, landslides, subsidence, and swelling soils) and help to protect valuable groundwater resources. Approximately 20% of the state is geologically mapped at a scale that is adequate for most applications in mineral, energy, and water resources; hazards; and environmental protection. At our current rate of production, including NBMG programs that encourage more geologic mapping by individuals from the U.S. Geological Survey, universities, and the private sector, we have several decades of work ahead of us in geologic mapping alone. A fact sheet explaining the work in Nevada through the National Cooperative Geological Mapping Program is appended at the end of this report.

Another activity that relates to economic development is the storage of records and rock and ore samples from various locations throughout the state. These are exceptionally valuable, in some cases practically irreplaceable, samples needed in exploration for mineral, oil and gas, geothermal, and groundwater resources. Through regulations of the Commission on Minerals Resources and the Division of Minerals, NBMG stores cuttings, core, and paper records from oil and gas and geothermal wells drilled in Nevada. NBMG also stores selected, representative samples of ores and typical rocks from active and inactive metal and industrial mineral mines.

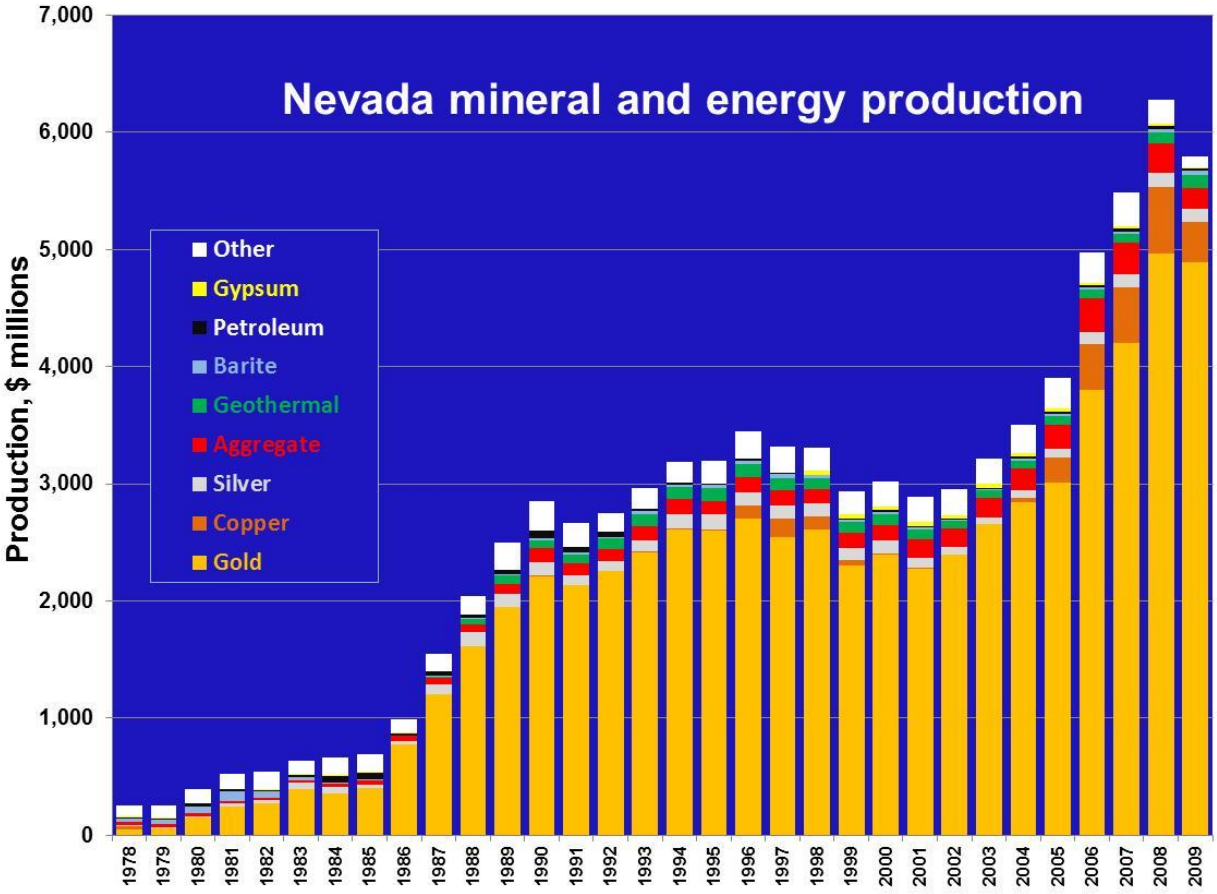
We are pleased to report that Phase I of the Great Basin Science Sample and Records Library was completed, and the building opened in April of 2009. Funded by the U.S. Department of Energy in federal fiscal year 2006 at a level of $3.465 million, Phase I covered construction of approximately 10,000 square feet of a building that initially was planned to have a footprint of 15,000 square feet. With Phase I, we have an excellent, functioning facility that houses most of NBMG's geoscience samples and its now combined publication sales and information offices. We have proposed Phase II to complete construction of the originally planned facility and to undertake a five-year effort to capture digital data and acquire critical physical samples. The new building is on the Reno campus of the Desert Research Institute, which can use the facility for permanent archival of its geoscience samples.

Moving samples and publications to the new building freed space in the Scrugham Engineering-Mines Building on the UNR campus for expanding NBMG research and other activities. NBMG recently assisted the University to acquire what is now called the Mackay-Stanford Ore Deposits Ccollection, which had been assembled by Stanford University professors and students over the last 150 years from ore deposits throughout the world. This priceless collection, now managed by the W.M. Keck Museum of the Mackay School of Earth Sciences and Engineering, contains many samples from Nevada (including a few donated by John Mackay, the famous Comstock miner for whom the Mackay School is named) and is being used in graduate student research and teaching.

An exciting area for NBMG has been the move toward making information available free online. We do not

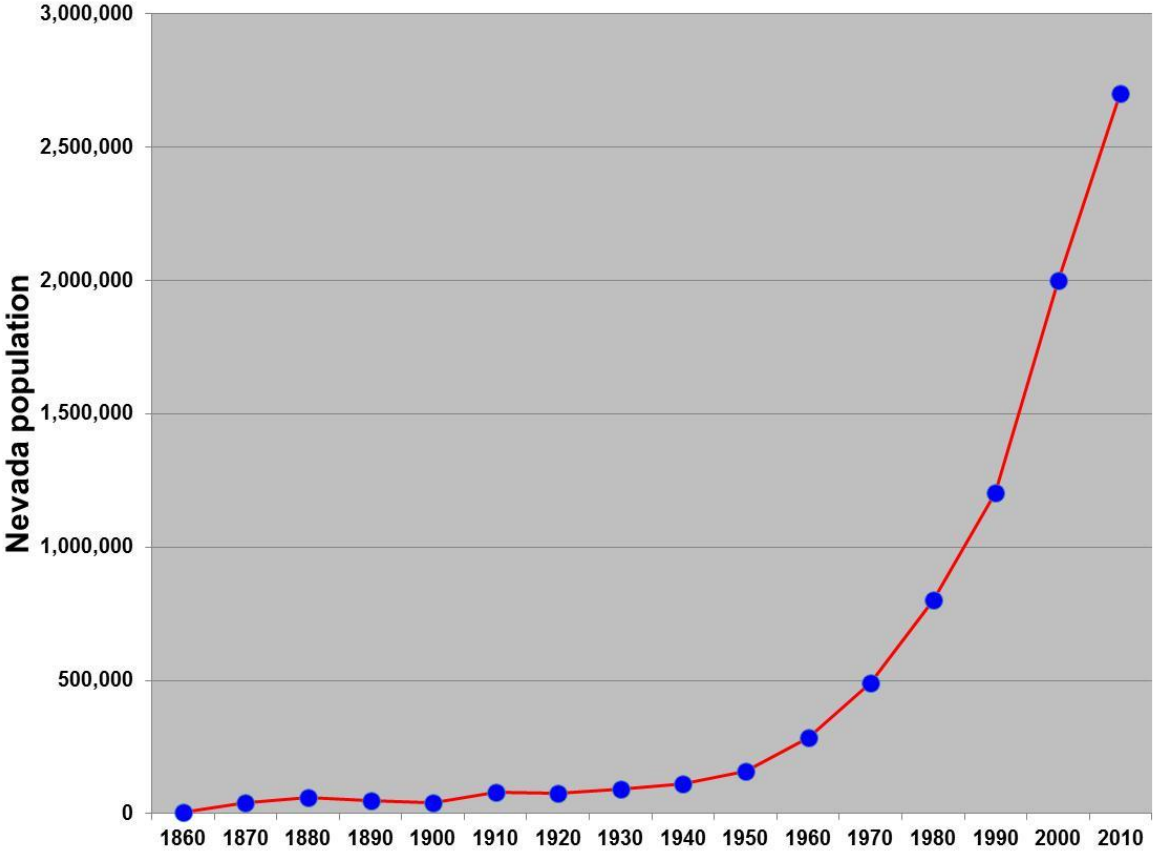
see the end of the era of paper maps and reports, but we do see tremendous benefits to an expanding array of users who get information on the Web and use it on computers in the office and in the field. Thanks in large part to a generous donation from Mrs. Ann Burgess, the Jay A. Carpenter Fund was established in honor of her grandfather, former Director (1939-51) of the Nevada Bureau of Mines and Geology. This donation was used to help convert large maps and other documents in the NBMG Information Office files into digital formats for posting on the Web. The information helps stimulate exploration for mineral and energy resources and is useful in a wide array of environmental and public safety applications. Additional funding for digitizing efforts at the Great Basin Science Sample and Records Library has come from the Nevada Commission on Mineral Resources/Division of Minerals, the U.S. Department of Energy, the U.S. Geological Survey, and the private sector.

We are in the midst of the biggest gold-mining boom in American history. Nevada accounts for approximately 75% of current annual production of gold in the U.S. and 7% of the world production. Value of mineral production in Nevada reached a record of nearly $6.26 billion in 2008. The drop to $5.81 billion in 2009 was partly due to the weak U.S. economy. (Data are from NBMG, the Nevada Division of Minerals, and the U.S. Geological Survey.) The high price of gold has resulted in vigorous exploration activity, which should help sustain the boom in Nevada for at least 20 more years.



Addressing Nevada's Critical Needs - Natural Hazards and Economic Stability

NBMG's urban-area geologic hazard investigations, particularly studies of earthquake hazards, land subsidence and ground cracks due to groundwater withdrawal, and flash-flood hazards, help all businesses be better prepared for natural disasters. Nevada's gaming economy would suffer greatly if we were not able to rapidly recover from a major disaster, such as an urban earthquake. NBMG goes well beyond the identification of geologic hazards on maps and in technical reports; we also publish planning scenarios for major disasters and a series of maps, pamphlets, brochures, and Web pages geared toward the general public. As an example, since its publication in 1996, NBMG Special Publication 20 (*Planning Scenario for a Major Earthquake in Western Nevada*) has been used repeatedly in emergency management, response and recovery exercises, and planning by local, state, and federal officials. The probability of a magnitude 6 or greater earthquake occurring in the Reno-Carson City area within the next 50 years is significant, approximately 65 to 70%. A major earthquake would likely cause billions of dollars in damage and economic loss. Another major disaster for which we can be better prepared is flooding on alluvial fans. As Nevada's population has grown, much of the development has moved onto alluvial fans, unfortunately not always with full knowledge of the flash-flood hazards. Geologic mapping and careful evaluation of the frequencies and extents of past floods seen in the geologic record are critical to reducing the risks from these hazards.



Nevada's population has risen dramatically in recent decades, placing demands on geological and other natural resources and heightening concerns regarding risks from natural hazards and environmental issues, particularly in urban areas. (Data in the graph are from the U.S. Census Bureau.)

Addressing Nevada's Critical Needs - Education and Services for the Public

NBMG produces many scientific publications that are used in schools. A part-time, only partially state-funded effort at NBMG is dedicated to getting these materials in the hands of teachers. NBMG staff members have been involved in the writing of the Nevada and National Science Education Standards, and we produce standards-based content material that can be used in schools. NBMG staff members regularly participate in the highly effective and popular teacher-education workshops that are sponsored by the Nevada Mining Association and jointly supported by the Nevada Division of Minerals. In addition, NBMG staff members help coordinate field trips and other activities for the public and for K-12 teachers and students during Earth Science Week (second full week of October), and staff scientists often judge science fairs. NBMG also produces some publications specifically for the general public, such as our popular field guides on the geology and natural history of the Las Vegas, Reno-Carson City-Lake Tahoe regions, U.S. Highway 50, and U.S. Highway 93. Long-term plans include books for U.S. Highways 95 and 6 and Interstate 80.

NBMG has direct contact with the public through several venues, including thousands of customers each year visiting the Great Basin Science Sample and Records Library, participation in exhibitions, Earth Science Week, and lectures at local schools and civic organizations. Frequently, professional staff members assist individual citizens with issues related to their personal property, such as location of groundwater wells, septic systems, faults, or soil stability. Increasingly, NBMG is reaching more of the public through its websites. Because many products that NBMG produces are heavily used by geological and engineering professionals, NBMG staff also make good efforts to participate in activities of the geological and professional organizations in the state, particularly the Geological Society of Nevada, Nevada Petroleum Society, Geothermal Resources Council, and local meetings of the Association of Environmental and Engineering Geologists, American Institute of Professional Geologists, and Society for Mining, Metallurgy, and Exploration.

The following table provides some measures of workload in sales of publications (according to NRS 514.070) and analytical services (according to NRS 396.600).

Year	Publication Sales[1]	Analytical Services
1998	$134,987	$20,655
1999	128,816	15,843
2000	160,240	15,116
2001	150,143	41,181
2002	130,675	65,399
2003	151,321	27,910
2004	152,452	37,925
2005	128,212	28,956
2006	185,296	30,830
2007	121,743	49,219
2008	132,181	30,052
2009	105,218	22,363

[1] These figures include sales of NBMG maps, bulletins, reports, electronic files on discs, and photocopies of open-file reports, topographic maps, and related items. The figures are updated from the last report using NBMG records.

NBMG does not make a profit on its publication sales; revenues generated from the sales go into a revolving fund that helps pay for the production, printing, and sales of future maps and reports. Most items are free on the Web through http://www.nbmg.unr.edu.

ACTIVE PROJECTS

The following is a list of active projects at the Nevada Bureau of Mines and Geology (NBMG). Titles of funded projects are listed, followed in parentheses by the names of the principal investigators. The projects are funded by a variety of federal, state, and local agencies and the private sector. Although many individual projects listed below will result in maps, reports and other publications with multiple uses, the projects are listed in this table by their intended primary applications. Please note that geologic maps and most projects in basic science that underpins applications generally have many uses; the typical geologic map in Nevada has applications in earthquake, flood, and land-surface stability hazards; mineral and water resources; and environmental protection. As publications are released, they will be posted on the NBMG Web site (www.nbmg.unr.edu) or, for external publications in the scientific literature, listed in the next NBMG Biennial Report (also available on the NBMG website). Feel free to contact the NBMG principal investigators to find out more about the status of these projects.

URBAN GROWTH - NATURAL HAZARDS AND ECONOMIC STABILITY

- **Earthquakes**

  Development of Real-Time Tsunami Warning Systems Using Continuous GPS
  (Geoff Blewitt, Bill Hammond, Corné Kreemer, and Hans-Peter Plag)

  Earthquake Hazard Reduction – Outreach Products
  (Jon Price, Craig dePolo, Gary Johnson, and Jennifer Mauldin)

  Earthquake Risk Mitigation in Nevada – Support for the Nevada Earthquake Safety Council
  (Craig dePolo, Jon Price, Terri Garside; John Anderson, Graham Kent, and Diane dePolo, Nevada Seismological Laboratory)

  Earthquake Scenarios for 31 Communities in Nevada
  (Jon Price, Gary Johnson, Christine Ballard, Heather Armeno, Irene Seeley, Linda Goar, Craig dePolo, and Jordan Hastings)

  Fault Trenching for the Pit River No.3 Dam, California
  (Craig dePolo)

  Geodetic Constraints on the Slip Rate of the Mohawk Valley Fault Zone, California
  (Corné Kreemer and Bill Hammond)

  Geologic Mapping of the Gass Peak SW Quadrangle
  (Alan Ramelli; William Page, U.S. Geological Survey; Craig Manker and Kathleen Springer, San Bernardino County Museum)

  Geologic Mapping of the Reno Area
  (Chris Henry, Alan Ramelli, Kyle House, and John Bell)

  Geologic Mapping of the Seven Lakes Mountain Quadrangle
  (Chris Henry, Alan Ramelli, and Jim Faulds)

  GPS-Based Rapid Earthquake and Tsunami (GREAT) Alert System
  (Geoff Blewitt and Hans-Peter Plag)

  Modeling Seismic Moment Rate in San Andreas Fault –Great Basin system: Combination of seismological and geodetic approaches
  (Ilia Zaliapin, UNR Department of Mathematics and Statistics; Corné Kreemer; John Anderson and Aasha Pancha, Nevada Seismological Laboratory)

  Nevada Earthquake Response GPS Network (NEARNET)
  (Geoff Blewitt, Bill Hammond, Corne Kreemer, and Hans-Peter Plag)

  Nevada Earthquake Safety Council Inventory of Buildings
  (Jon Price and Gary Johnson)

  Quaternary Fault Map of Nevada
  (Craig dePolo)

  Report on the Wells Earthquake
  (Craig dePolo, Jon Price; and Glenn Biasi, Nevada Seismological Laboratory)

Seismic Hazards Posed by Faults in the Modoc Plateau, California
(Craig dePolo)
Spatial and Temporal Patterns of Fault Slip Rates on the Genoa Fault
(Alan Ramelli and John Bell)

- **Floods**

Geologic Mapping in the Spirit Mountain SE and Spirit Mountain NW Quadrangles
(Kyle House and Jim Faulds)
Geologic Mapping Along the Walker River between Weber Dam and Walker Lake
(Kyle House and Ken Adams, Desert Research Institute)
Impact of Extrafluvial Events on River Valley Evolution, Owyhee River, Oregon
(Kyle House; Lisa Ely, Central Washington University; and Liz Safran, Lewis and Clark College)

- **Subsidence and Fissures due to Groundwater Withdrawal**

Baseline InSAR Study of Groundwater Basins in Southeastern Nevada
(John Bell)
InSAR Study in the Diamond-Kobeh Valley Area
(John Bell)
Operation and Analysis of Subsidence Data from A Continuous GPS Station in Las Vegas Valley
(John Bell)

- **All Hazards**

Hazard Mitigation Plan Subcommittee
(Jon Price and D.D. LaPointe)
Nevada Hazard Mitigation Planning Committee
(Jon Price and Terri Garside)
Risk Assessment Update for the State of Nevada Multi-Hazard Mitigation Plan
(Jon Price; Jeff Underwood, Department of Geography; and Ron Hess)

MINERAL, ENERGY, AND WATER RESOURCES VITAL TO ECONOMIC EXPANSION

- **Precious and Base Metals**

Annual Update on Metallic Mineral Resource Production and Exploration in Nevada
(John Muntean)
Carlin-Type Gold Deposits of the Getchell District
(John Muntean; and Jean Cline, UNLV)
Characterization of the Time-Space Relationships between Hydrothermal Alteration, Gold Mineralization, and Intrusive Phases in the RBM Pit, Bald Mountain Mining District, White Pine County, Nevada
(John Muntean)
Debunking Mining Fraud
(Paul Lechler)
Eocene Magmatism, Tectonics, and Carlin-Type Deposits
(Chris Henry)
Fluid Pathways, and Metal Transport and Deposition in Carlin-Type Gold Deposits: Insights From the Getchell System
(John Muntean and Jean Cline, UNLV)
Geology and Gold Deposits of the Jerritt Canyon District
(John Muntean and Chris Henry)
Geology of the Caetano Caldera and its Relationship with the Ore Deposits near Cortez
(Chris Henry; David John and Joe Colgan, USGS)

Geologic Mapping of the Flowery Peak Quadrangle
(Steve Castor and Kyle House)
Geologic Mapping of the Virginia City Quadrangle
(Steve Castor, Larry Garside, Chris Henry; and Don Hudson, consultant)
Gordon Research Conference on Geochemistry of Mineral Deposits
(John Muntean)
Mineral Resource Assessment of Northern Nye County, Nevada
(John Muntean, Chris Henry, Larry Garside, David Davis, and Jordan Hastings)
Mining Cooperative Fund Research
(Jon Price)
Recovery of Platinum and Palladium from Fortified Fire Assay Charges of Quartz and Gabbro
(Paul Lechler)
Standard Reference Materials for Precious Metal Analysis
(Paul Lechler and Mario Desilets)
Zonation of Hydrothermal Alteration around the High-Grade Gold Veins in the Jarbidge Mining District
(John Muntean)

- **Industrial Minerals, including Construction Raw Materials**

Mineral Resources of the Reno 30x60-Minute Quadrangle
(Larry Garside)
Annual Update on Industrial Mineral Production and Exploration in Nevada
(David Davis)

- **Geothermal Energy**

Annual Update on Geothermal Power Production and Exploration in Nevada
(Lisa Shevenell and Ron Hess)
Characterization of Active Faulting and Neotectonics at Nevada Geothermal Sites
(John Bell and Alan Ramelli)
Characterizing Structural Controls on Geothermal Systems in the Northwestern Great Basin through Integrated Geologic and Geophysical Analyses
(Jim Faulds; Gary Oppliger, Department of Geological Sciences and Engineering; and Mark Coolbaugh, Great Basin Center for Geothermal Energy)
Comprehensive Structural Analysis of the Great Basin and Adjacent Regions for Geothermal Exploration
(Jim Faulds and John Bell)
Construction of Probes for Shallow Temperature Surveys on Kodali Inc. Properties
(Lisa Shevenell)
Geochemical Sampling of Thermal and Non-thermal Waters in Nevada: Evaluation of Geothermal Resources for Electrical Power Generation and Direct-use Applications
(Lisa Shevenell, Larry Garside, Paul Lechler; and Mark Coolbaugh, Great Basin Center for Geothermal Energy)
Geologic and Geophysical Analysis of the Desert Peak-Brady Geothermal Fields
(Jim Faulds; Gary Oppliger, Department of Geological Sciences and Engineering; and Larry Garside)
Geological mapping of the Bunejug Mountains Quadrangle, Churchill County, Nevada
(Nick Hinz, John Bell, and Jim Faulds)
Geothermal Applications of Multi-Gas Geochemistry
(Paul Lechler, Larry Garside, Lisa Shevenell; and Mark Coolbaugh, Great Basin Center for Geothermal Energy)
Geothermal Resource Assessment of the Hawthorne Army Depot and Fallon (BR16) areas for the Navy Geothermal Program Office
(Lisa Shevenell; Mark Coolbaugh, Great Basin Center for Geothermal Energy; Jim Faulds, John Bell; and John Louie, Nevada Seismological Laboratory)

Geothermal Research and Outreach at the Great Basin Center for Geothermal Energy
(Lisa Shevenell)
Geothermal Resource Location Map of Nevada
(Lisa Shevenell)
Low Sun-Angle Quaternary Fault Analysis of the Hawthorne Army Weapons Depot
(John Bell)
National Geothermal Database and Website
(Lisa Shevenell, Jordan Hastings, Robin Penfield, and Larry Garside)
Participation in the Nevada Geothermal Energy Technical Advisory Board
(Lisa Shevenell, Jim Faulds, and Larry Garside)
Pattern and Timing of Active Faulting along Nevada Geothermal Systems
(John Bell and Alan Ramelli)
Research to Locate Concealed Geothermal Systems
(Mark Coolbaugh, Great Basin Center for Geothermal Energy; Paul Lechler, and Lisa Shevenell)
Shallow temperature survey at Hands on Ventures properties
(Lisa Shevenell and Chris Sladek, Department of Geological Sciences and Engineering)
Structural Controls of the Reese River Geothermal System, Central Nevada
(Jim Faulds and Nick Hinz)
Structural Controls on Geothermal Activity in Western Turkey: Analogues to the Western Great Basin, USA
(Jim Faulds)
Structural study of the Desert Queen geothermal area, Churchill County, Nevada
(Jim Faulds)
Targeting Potential Geothermal Resources in the Great Basin Using Regional Relationships Between Geodetic Strain and Geological Structures
(Geoff Blewitt, Corné Kreemer, and Bill Hammond)
Training the Geothermal Workforce
(Lisa Shevenell)
Water Sampling along Garfield Road to Evaluate Geothermal Potential of the Area
(Lisa Shevenell and Robin Penfield)

- **Petroleum**

Annual Update on Petroleum Production and Exploration Activity in Nevada
(David Davis)

- **Uranium**

Geology of the McDermitt Caldera Complex
(Chris Henry and Steve Castor)

ENVIRONMENTAL CONCERNS

- **Global Change**

Developing the Global Geodetic Observing System into a Monitoring System for the Global Water Cycle
(Hans-Peter Plag)
Synthesis of NASA Data on Earth's Changing Geometrical and Gravitational Shapes to Assess Change in Terrestrial Water Storage and Its Effect on Sea Level, Lithospheric Loading, and Earth Rotation
(Geoff Blewitt)

- **Nuclear Waste**

Geodetic Monitoring of the Yucca Mountain Region using Continuous Global Positioning System Measurements
(Jon Price, Geoff Blewitt, Hans-Peter Plag, Corné Kreemer, Bill Hammond; Brian Wernicke, California Institute of Technology; and James Davis, Harvard-Smithsonian Center for Astrophysics)

- **Riparian Restoration and Ecosystems**

Ecosystem Flow Recommendation Study, Bill Williams River, Arizona
(Kyle House)
Ecosystem Indicators in Clark County, Nevada
(Kyle House and Jill Heaton, UNR Department of Geography)
Walker Lake
(Kyle House)

SCIENCE TO UNDERPIN THE APPLICATIONS

- **Geologic Framework – With Applications in Resources, Hazards, and Environment**

Clark County Geologic Mapping Program
(Jim Faulds, Kyle House, Alan Ramelli, Craig dePolo, Nick Hinz, and Larry Garside)
Collaborative Research: Chronostratigraphy of the Lower Colorado River - Exploring Potentially Transient Responses along a Continental-Scale River
(Kyle House)
Geologic Mapping in the Grimes Point Quadrangle
(John Bell and Kyle House)
Geologic Mapping in the Lahontan Mountain Quadrangle
(John Bell; John Caskey, San Francisco State University; and Kyle House)
Truckee Meadows geologic compilation and modeling
(Chris Henry)

- **Tectonics and Geodynamics**

An Integrated Geologic and Geodetic Study of Strain Accumulation and Release in the Northern Walker Lane
(Steve Wesnousky, Department of Geological Sciences and Engineering; Bill Hammond, and Corné Kreemer)
Geologic Mapping of the Fernley West Quadrangle
(Jim Faulds, Chris Henry, and Alan Ramelli)
Geologic Mapping of the Hazen Quadrangle
(Jim Faulds and Alan Ramelli)
Improving the Spatial and Temporal Resolution of Strain Rate Models of Continental Deformation
(Corné Kreemer)
Neogene Development of the Northern Walker Lane: An Evolving Transform Plate Boundary
(Jim Faulds, Chris Henry; and Pat Cashman, Department of Geological Sciences and Engineering)
Paleogene Paleovalleys in Nevada and Eastern California
(Larry Garside, Chris Henry, and Jim Faulds)
Revealing the Nature of Contemporary Uplift and Collapse in the Sierra Nevada - Great Basin System
(Geoff Blewitt, Bill Hammond, and Hans-Peter Plag)
Quasi-Block Modeling of Walker Lane Belt Tectonic Deformation, Using Geodetic and Geologic Data to Constrain System Complexity and Time-Variable Behavior
(Bill Hammond, Geoff Blewitt, and Corné Kreemer)
Tertiary-Quaternary Magmatic-Tectonic-Hydrothermal Evolution, Central Nevada to the Sierra Nevada
(Chris Henry)

Temporal and Spatial Changes of Stress and Strain
(Corné Kreemer)
Thermal Contraction, Oceanic Intraplate Deformation, and Plate Circuit Closure
(Corné Kreemer)
Time-Dependent Modeling of Seismic Moment Release
(Ilia Zaliapin, UNR Department of Mathematics and Statistics; Corné Kreemer; John Anderson, and Aasha Pancha, Nevada Seismological Laboratory)

- **Global Geodesy**

A New Technique to Enhance Global GPS Accuracy and Resolution for Earth Science
(Geoff Blewitt)
Detecting Transient Deformation Signals in GPS time-series
(Corné Kreemer and Ilia Zaliapin, UNR Department of Mathematics and Statistics)
Geodetic Imaging of Earth's Surface Deformation using Integrated InSAR and GPS Observations
(Bill Hammond, Geoff Blewitt, Corné Kreemer, and Hans-Peter Plag)
Improvements to the GPS Data Analysis System as Implemented at JPL
(Geoff Blewitt)
Surface Mass Loads from GRACE, GPS, and Earth Rotation Measurements
(Hans-Peter Plag, Geoff Blewitt; and R.J. Gross, Jet Propulsion Laboratory)
The Global Geodetic Observing System: Meeting the Requirements of a Global Society on a Changing Planet in 2020
(Hans-Peter Plag)

- **Other Earth Processes**

Elucidating Physical Processes in Upper Crustal Magma Systems - Evidence from Miocene Intrusive and Extrusive Sequences in Southern Nevada
(Jim Faulds)
Initiation of the Yellowstone Hotspot: Silicic Magmatism in Northwestern Nevada and Southeastern Oregon
(Chris Henry)

EARTH SCIENCE EDUCATION AND OUTREACH TO THE PUBLIC

- **Outreach to the General Public, K-12 Teachers, and Students**

EarthCache and GeoCache Sites in Nevada
(D.D. La Pointe and Jon Price)
Earth Science Week Field Trips for the Public
(D.D. La Pointe and Jon Price)
Educational Supplies for Teachers
(D.D. La Pointe)
Nevada Earth/Space Science Initiative
(D.D. La Pointe and David Crowther, UNR College of Education)
Traveling the Great Basin Highway: A Guide to the Geology and Natural History along U.S. Highway 93 in Nevada and Arizona
(Jon Price, Joe Tingley, and Kris Pizarro)
Teachers Workshops Sponsored by the Nevada Mining Association
(D.D. La Pointe and Jon Price)

- **Outreach to Professionals**

Conversion of Geologic Maps into Geographic Information Systems
(Gary Johnson)

Enhancement of the Great Basin Science Sample and Records Library
(Jon Price, Ron Hess, David Davis, Martha Henson, and Bret Pecoraro)
Great Basin Science Sample and Records Library (new building to house core and cuttings from exploration and production wells and other geoscience samples, publications, and information)
(Jon Price)
Inventory of Geologic Data and Information
(David Davis)
Scanning of Files on the Geology, Mineral and Energy Resources, and Hazards in Nevada
(Martha Henson, Ron Hess, and David Davis)
Mackay-Stanford Ore Deposits Collection
(Jon Price)
NASA Geophysical Space Geodesy Course Development
(Bill Hammond)
Organizing Core and Cuttings
(David Davis, Ron Hess, and Bret Pecoraro)

BUDGET

In recent years, nearly half of the funds expended by NBMG have come from the Legislature as part of the Statewide Program funding for the University of Nevada, Reno. The bulk of these funds cover salaries and fringe benefits for NBMG employees. The state does not provide a substantial amount of operating funds ($27,945 per year after the budget cuts in fiscal years 2010 and 2011). This results in little discretionary operating money at the beginning of any fiscal year, unless someone is on sabbatical leave or there is a vacancy. In part because the workforce is quite stable and few employees leave before retirement, and because other employees cannot always fill in when vacancies do occur, this forces NBMG to seek external funds from a variety of grants and contracts to help pay for the essential work. Fortunately there are a number of opportunities for cost sharing with federal, state, and local agencies, such that generating sufficient external research funds has not been a large problem. Seeking grants and contracts is a significant duty of the Director and of many of the senior staff. The University provides support through its Office of Sponsored Projects. The University also provides overhead support for NBMG, which covers such items as electricity, heat, building maintenance, human resources, and financial reporting. Grants and contracts secured by NBMG employees typically cover the indirect costs (including these overhead expenses) associated with those additional activities.

The fiscal crisis affecting the state and world economy has had a significant impact on NBMG's ability to do its work, although core missions are still covered. In February 2008, the University instructed NBMG to cut $200,000 from its biennial budget for fiscal years 2007-2009. This was accomplished through the retirement of our Editor and Webmaster at the end of March 2008, removing two graduate research assistantships from our budget, and not spending salary savings from the phased-in retirement of one of our senior geologists. This resulted in savings of approximately $33,000 in fiscal year 2007-2008 and $167,000 in fiscal year 2008-2009. The cuts to the editor/Webmaster position and graduate research assistantships resulted in permanent cuts to NBMG's base budget of $100,000 per year. In December 2008, the University instructed NBMG to further permanently cut its base budget for fiscal year 2009-2010. We lost state support for additional classified support-staff positions and planned to replace a retiring faculty member at a lower salary. We retained most classified support staff, because we were successful in covering salaries with new grants and contracts that were secured by NBMG's State-funded and grant-supported professional staff.

State funding for the Nevada Bureau of Mines and Geology

State-funded budget item	Fiscal Year 2008-2009 budget	Fiscal Year 2009-2010 budget	Fiscal Year 2010-2011 budget
Professional	$1,371,250	$1,354,136	$1,285,770
Classified	490,394	392,482	351,935
Graduate Assistants	0	0	
Fringe Benefits	496,750	451,342	443,257
Operating	46,635	46,026	27,945
Funds that would have been allocated but were rescinded	95,461	7,878	-
Subtotal, beginning budget	2,500,490	2,251,864	2,108,907
Funds rescinded	-166,467	-40,000	-
Total	2,334,023	2,211,864	2,108,907

STAFFING LEVELS AND CHANGES

As of October 1, 2010, NBMG had 51 employees, including 12.39 full-time equivalent (FTE) faculty (professional) positions and 5.43 classified staff FTE funded by the State. State budget cuts have forced us to reduce State-funded FTE from 21.43 as of July 1, 2008 (12.62 faculty plus 8.81 classified staff FTE) to 17.82 today. Several positions are only partially covered by state funds; the rest comes from grants and contracts. The additional faculty, classified staff, and undergraduate and graduate student assistants were covered by various grants and contracts, mostly from federal and local agencies plus some from state agencies and the private sector. Wages are competitive with those at comparable universities, and we have been able to attract a staff with excellent national and international scientific reputations. Turnover has been at an acceptable level; some, but few, staff members have left before retirement.

We wish **Steve Castor** and **Larry Garside** well in retirement. Both continue to conduct research at NBMG and publish new items in NBMG's map and open-file report series. **Kris Pizarro** from our cartography staff retired in 2009 after twenty years of service to NBMG. She continues to assist UNR on special graphics projects. We were sad to see **Heather Armeno** resign from our cartography staff, but look forward to hearing about her success in her new adventure, teaching in Taiwan. **Matt Richardson** and **Irene Seelye** are welcome, new additions to the cartography staff, which has expanded its services to include managing the NBMG website as well as map production, GIS analysis, and assistance with graphics for publications, posters, displays, and oral presentations.

We were able to preserve the faculty positions vacated by Steve and Larry. We are pleased that **Cornelis (Corné) Kreemer**, who joined the NBMG staff as a postdoctoral researcher in 2004, secured one of the positions. Corné earned his Ph.D. in 2001 from the State University of New York, Stony Brook, and is an expert in crustal deformation, application of space geodesy in tectonics and geodynamics, global plate dynamics, earthquakes, and related natural hazards.

We welcome **Sean Long**, who earned his Ph.D. in 2010 from Princeton University, to the geologic mapping team at NBMG. Sean's expertise is in structural geology and tectonics. He has mapped and unraveled fold and thrust belts in the Himalayan Mountains and extensional feathers in Idaho. We look forward to his contributions to understanding the complex geology of Nevada. His first project is in the Eureka area.

We will miss **Ron Hess**, NBMG's Chief Information Officer, who is retiring in February 2011, **Paul Lechler**, NBMG's Chief Geochemist, who is retiring in March 2011, and **Kyle House**, who led NBMG's efforts in evaluating flood hazards through geomorphic mapping before moving to a research position with the U.S. Geological Survey in Flagstaff, Arizona. Faculty searches are underway for new hires in economic geology and geothermal systems (for Paul's replacement) and either Quaternary geology, geomorphology,

neotectonics, hydrogeology, or 3D modeling that integrates geophysical and geological observations and interpretations (for Kyle's position).

A list of current NBMG staff, divided by major areas of responsibility and annotated with principal areas of expertise, is given below.

Staff of the Nevada Bureau of Mines and Geology

Jonathan G. Price, State Geologist and Director - management, mineral deposits, & geochemistry

Scientific Research Staff

Economic Geology, Geologic Mapping, and Geologic Framework

James E. Faulds, Research Geologist - structural geology, tectonics, & paleomagnetism
Nicholas Hinz, Research Geologist – geologic mapping & structural geology
Christopher D. Henry, Research Geologist - volcanic stratigraphy & geochronology
Sean Long, Research Geologist – structural geology and tectonics
John Muntean, Research Economic Geologist/Assistant Research Professor – metallic mineral deposits

Geologic Hazards, Engineering Geology, and Geophysics

John W. Bell, Research Engineering Geologist - Quaternary stratigraphy & urban geology
Geoffrey Blewitt, Research Professor - geodesy & geodynamics
Bret Pecoraro, Development Technician II - technical support on geodetic equipment
Craig M. dePolo, Research Geologist - earthquake geology & neotectonics
William Hammond, Assistant Research Professor – geodesy & geodynamics
P. Kyle House, Research Geologist - fluvial geomorphology & paleohydrology
Corné Kreemer, Assistant Research Professor – geodesy & geodynamics
Elliot Klein, Postdoctoral Researcher – geodesy & geodynamics
Hans-Peter Plag, Research Professor – geodesy & geodynamics
Alan R. Ramelli, Research Geologist - neotectonics & Quaternary stratigraphy

Environmental Geology and Hydrogeology

Paul J. Lechler, Chief Chemist/Geochemist - analytical geochemistry & precious metals
Lisa Shevenell, Research Hydrogeologist - hydrogeology & geothermal resources
Robin Penfield, Staff Research Associate I - geochemistry

Science Education

Daphne D. LaPointe, Research Geologist - science education, mineral deposits, & editing

Support Staff

Cartography and Publications Support

Jordan Hastings, Chief Cartographer and GIS Manager – GIS & cartography
Gary Johnson, Information Systems Specialist - GIS & systems administration
Jennifer Mauldin, Cartographer – GIS, cartography, web development, graphic design, & publication design
Jack Hursh, Jr., Cartographer – web development, publication design, & graphic design
Matthew Richardson, Cartographer – GIS, cartography, graphic design, & publication design
Irene Seelye, Cartographer – GIS & cartography

Analytical Laboratory

Paul J. Lechler, Chief Chemist/Geochemist - analytical geochemistry & precious metals
Mario Desilets, Chemist and Quality Assurance Officer - analytical geochemistry

Information and Publication Sales

Ron Hess, Chief Information Officer - GIS, remote sensing, & systems administration
David Davis, Geologic Information Specialist - Nevada geology & mining history
Martha Henson, Administrative Assistant II – document scanning & publication sales backup
Bret Pecoraro, Development Technician II - technical support on geodetic equipment
Charlotte Stock, Sales Manager - publication sales, editing

Administration

Terri M. Garside, Program Officer I - finance, contract management, & administration
Monique Smith, Administrative Assistant II – administration
Linda D. Goar, Accounting Assistant II – project accounting & administration

RELATIONS WITH OTHER AGENCIES

There are no alternate providers of NBMG services. NBMG works closely with several other state agencies and with some federal and local agencies, but in all cases the programs of these agencies are complementary with those of NBMG and are not overlapping. The U.S. Geological Survey (USGS) also produces geologic maps, but their priorities are established by federal needs. NBMG works closely with the USGS through the State's Mining Cooperative Fund (see NRS 514.060 and NRS 519A.260), the National Cooperative Geologic Mapping Program (see 43 USC Sec. 31c), and, along with the Federal Emergency Management Agency and the Nevada Division of Emergency Management, the National Earthquake Hazards Reduction Program.

NBMG also works closely with the Nevada Division of Minerals. The Division of Minerals regulates drilling operations of oil, gas, and geothermal wells; administers a program to identify, rank, and secure dangerous conditions at abandoned mines; and manages the state reclamation performance bond pool. NBMG does none of these activities, but our programs are complementary. NBMG co-produces with the Division of Minerals annual mineral and energy production statistics, and we jointly support educational efforts regarding mineral and energy resources. We also have worked together on projects with the Western Governors Association regarding issues of abandoned mines. NBMG's role is in scientific research and related scientific data collection. NBMG also archives and makes available to the public records and samples collected from oil, gas, and geothermal wells regulated by the Division of Minerals (according to NAC 522 and NAC 534A).

NBMG's participation in several statewide bodies helps insure that there is no unnecessary duplication of services or efforts. The Nevada Earthquake Safety Council and the Nevada Hazard Mitigation Planning Committee include representatives from a wide range of state and local governmental agencies, nonprofit groups, and the private sector; NBMG's participation in these groups helps to coordinate efforts. In the case of the Nevada Earthquake Safety Council and in areas of earthquake research, NBMG works closely with the Nevada Seismological Laboratory, another Statewide Program in the Mackay School of Earth Science and Engineering at the University of Nevada, Reno. Whereas the Laboratory covers earthquake hazards largely from a seismic monitoring and research perspective, NBMG’s expertise is in earthquake geology (neotectonics), geodesy, geodynamics, structural geology, and tectonics. In addition, NBMG has an advisory committee that includes representatives of several organizations with which we interact regularly.

NBMG works with the W.M. Keck Earth Science and Mineral Engineering Museum at the Mackay School of Earth Sciences and Engineering to further the collection of geological and mineralogical specimens and with the DeLaMare Library to improve the collection of published and unpublished information on the geology and mineral resources of the state (see NRS 514.040).

CONTRIBUTIONS TO THE EDUCATIONAL MISSION OF THE UNIVERSITY

NBMG is a major UNR research unit (with both applied and basic research funded by a wide array of federal, state, and local agencies and the private sector). Through support of graduate and undergraduate research assistantships and service as faculty advisors of graduate students, NBMG faculty members are enriching the educational experience of UNR students. Many graduate and undergraduate students gain practical experience through work on NBMG projects. NBMG normally employs approximately six graduate research assistants (supervised by NBMG faculty and financially supported on their research grants) and ten undergraduate student assistants (some in research-support positions, including learning skills in geographic information systems and geology; some in support of our analytical chemistry laboratory; some in support of our administrative duties; and some in support of our information and publication sales office). In the FY’08 round of budget cuts, NBMG lost the only two state-funded graduate research assistantships it had. Students are now entirely funded on non-state funds.

NBMG scientists often volunteer to help with university classes. Although not primarily responsible for teaching, some NBMG faculty and one of its classified staff members have taught University courses on a fairly regular basis, generally in the Department of Geological Sciences and Engineering and in the Geography Department, and frequently lecture in courses in those and other University departments. Another classified staff member teaches cartographic classes at Western Nevada College. Most NBMG faculty members are members of the UNR Graduate Faculty through the Department of Geological Sciences and Engineering. Several NBMG faculty members also participate in UNR's interdisciplinary Hydrological Sciences graduate program. As a Statewide Program, with numerous research projects in southern Nevada, NBMG scientists also collaborate with colleagues in the Geoscience Department at UNLV. This involves research, support of UNLV graduate students and postdoctoral scholars, and lecturing, particularly on topics of interest in southern Nevada.

NBMG faculty are also engaged in the governance of the University through service on various college and university committees and the Faculty Senate. They have the same rights and responsibilities as instructional faculty and tend to be heavily involved in outreach to communities throughout Nevada and to professional organizations.

NBMG scientists add greatly to the reputation of the University. We have several award-winning scholars and international leaders in their specialties, particularly in the fields of geodesy, economic geology (metals and geothermal resources), and engineering geology. We publish routinely and broadly in the peer-reviewed literature, significantly expanding the exposure of UNR scholars. We generate a major portion of the external funding within the geosciences at UNR, making UNR one of the leading universities in the country in terms of external geoscience funding. We are the only university in the country that has both the state geological survey and a seismological laboratory along with a teaching department in geological sciences.

GOALS AND OBJECTIVES

From discussions that have been ongoing over the last several years, NBMG has developed the following goals and objectives for the next five to ten years.

Earth-Science Research

Our goal is **to improve the quality of life of Nevada citizens and visitors by conducting applied and basic earth-science research that encourages economic development; minimizes losses to lives, property, and businesses from natural disasters; and protects the environment.** We strive to anticipate issues, such as new areas for urban growth and new waves of mineral exploration, before they arise. NBMG's research productivity is measured in terms of publications and grants. Other measures include recognition from peers, such as honors and awards from scientific and professional organizations. In recent years, NBMG has become an important contributor to the University's grant and contract acquisition, mainly from governmental funds. We have also developed research programs that are supported by private industry. In addition to applied research, NBMG recognizes the need for basic research in earth sciences, particularly in Nevada, and our research objectives include both types of work. Part of this goal is to maintain high levels of significant research publications, including ones released by NBMG and ones in the broader scientific literature.

Specific objectives under this goal include the following:

- Accelerate the construction and completion of fully reviewed, published **geologic maps**. Geologic maps at various scales are needed to support mineral- and energy-resource exploration and assessment, reducing risks from natural hazards, water-resource investigations, environmental work, and fundamental science. With total costs to adequately map a quadrangle being on the order of $150,000 each, the task is enormous. Nonetheless, by setting priorities with the help of the State Mapping Advisory Committee and

other governmental and private groups, our goal is to continue to map, and to support mapping by others, in the highest priority areas. The ultimate objective of our geologic mapping efforts is to cover the entire state with detailed, generally 1:24,000-scale, geologic maps. Publishing five new geologic maps per year would be a laudable accomplishment for a geological survey of our size.

- Expand programs to reduce risks from **natural hazards**, particularly earthquakes and floods, in urban and rural communities in Nevada. The compilation and public communication of information on geologic and environmental hazards in Nevada, particularly in metropolitan areas but also in small communities and rural areas, is an important responsibility. Although we have accomplished much, our goal is to do even more in the following areas: earthquake hazards, flood and landslide dangers, land subsidence and other engineering-construction problems, groundwater resources, and natural and human-induced geochemical hazards. Assistance in emergency planning and mitigation efforts in these areas is an important part of this responsibility. We expect to work closely with local governments in these efforts.

- Expand programs in **natural resources**. As mandated by the Nevada Legislature, NBMG intends to continue to provide information on the natural resources needed to sustain a well-diversified state economy. This includes research in economic geology for assessment and environmentally sound development of **metal and industrial mineral resources** in Nevada. Mining of metals and industrial minerals has been, and will continue to be, important to Nevada. Participation in the development of wise land-use decisions involving natural resources is part of this objective. We also plan to expand programs in **water quality and resources**, particularly as related to geological factors, such as natural contamination from mineralized areas and structural controls on the flow of groundwater. We are developing new programs in **energy resources**, with the intent of helping Nevada to be more secure in its production of electricity and other uses of energy. In collaboration with UNR's Great Basin Center for Geothermal Energy, NBMG research is stimulating geothermal exploration and development in Nevada and nearby states. Opportunities exist for more NBMG involvement in assessing wind, solar, uranium, oil, and gas resources and for conducting research on these resources. Our objective is to supply, in collaboration with other governmental agencies and industry, the information that is needed to develop these resources in environmentally and economically responsible ways.

- Develop **management structures for support staff** that facilitate improved service to NBMG researchers and the public. With funding from grants, in recent years we have added support staff in two areas: (a) cartography/GIS and (b) information and publication sales. Unfortunately, the budget cuts have resulted in reducing state funds for the support staff. We hope, but are not assured, that we will be able to cover the needed support staff with new grants and contracts. Moving our information and publication sales offices together into a new building has led to workload efficiencies and new opportunities for external funding.

- Develop **project and program teams** that facilitate building of NBMG research programs, creating opportunities for funding, and being prepared to respond to emerging issues. Our geodesy team, now with four faculty positions, several graduate students, one temporary research faculty, one postdoctoral scholar, one technician, and several collaborators within and outside NBMG, is likely to continue to expand in response to exciting scientific opportunities and applications in GPS and InSAR.

Geological Information and Long-Term Data Preservation Plan

Our goal is to make information regarding geological issues in Nevada available to the public via the Internet and other means. The capabilities of cell phones and tablet computers have expanded tremendously in recent years, and we plan to package NBMG information for use with these and emerging technologies. We want to assure that the State of Nevada is adequately integrating geographic and geologic information into policy decisions and government programs. To assist in this effort, our objective is to develop a digital information office and work closely with the University of Nevada, Reno library, federal agencies, local

and state agencies, and the Geographic Information Systems Subcommittee of the State Mapping Advisory Committee to provide easily accessible, publicly available digital products. The digital products should be free and easily found on the Web.

The paper files in our information office and NBMG publications are progressively being converted to digital format. With funding assistance from private donations and the Commission on Mineral Resources/Nevada Division of Minerals, and with funds allocated by the state to the Nevada Bureau of Mines and Geology, we have made good progress on digitizing the maps and one-of-a-kind reports in our Jay A. Carpenter Mining District Files. In 2008, we released digital scans of electrical logs from oil and gas exploration and production wells to the public, and selected aerial photographs in urban areas have been scanned and will be made available free on the Web. Our long-term plan is to scan all NBMG publications and non-copyrighted documents in our open files and make digital copies freely available to the public on the Web. Anticipating changing computer technologies, we established a fund from private donations ($25,000 endowment generating income of approximately $1,250 per year) that will allow us to migrate the digital files to new formats and hardware when needed.

NBMG works closely with the W.M. Keck Earth Science and Mineral Engineering Museum (also part of the Mackay School of Earth Sciences and Engineering) to build and maintain useful sample collections. The museum focuses on museum-quality specimens for display and research, while NBMG focuses on samples that are used in exploration for, and assessment of, energy, mineral, and water resources; geologic hazard assessment; environmental protection; and geoscience research. The NBMG collections include samples from petroleum and geothermal wells (which we are required by state regulations to curate), mineral deposits, characteristic altered and unaltered rocks from Nevada mining districts, and samples collected during NBMG geologic mapping and research projects. Samples are currently housed in four locations—the Great Basin Science Sample and Records Library, the museum on the University campus, the first floor of NBMG's offices on the University campus (the Mackay-Stanford ore deposits collection), and in storage containers on University land in the town of Stead, approximately 10 miles north of campus.

Our long-term data preservation plan includes the following elements:

1. Complete scanning of all NBMG publications, including open-file reports (currently, many are awaiting going out of print before being put in the queue for scanning).
2. Eliminate our backlogs in accessioning paper records (geological and mineral-resource reports) donated to NBMG by consulting geologists and companies by scanning these items and entering metadata on them into the national catalog, then encourage additional donations of exploration drilling results; geologic, geochemical, and geophysical maps; geological reports, etc.
3. Eliminate our backlog in accessioning physical samples (core and cuttings donated to NBMG by companies and rock and other geoscience samples from NBMG and other University research projects) by properly boxing, indexing, shelving, and creating metadata for the national catalog.
4. Update mineral-resource databases for use by decision makers.
5. Scan remaining oil, gas, and geothermal well logs in Nevada.
6. Acquire sufficient computer-storage media for digital aerial photographs and mining-district files.
7. Build interactive Web-based maps with data on mineral and energy resources and related geographic data used in land-management decisions.
8. Design and implement a Web-based reporting system for exploration results.
9. Solicit new physical samples from mineral deposits (particularly representative samples from closing mines) and research collections, along with location maps and related information to be scanned and entered into the national catalog. Samples from today's mines should be preserved for study during the next exploration and mining booms.
10. Scan microfiche files and archived photos and slides.
11. Convert scanned written information (currently in tiff and pdf files) through optical character-recognition software into fully searchable text files, and make the information available free on the Web.

12. Migrate digital files and metadata to new software and hardware to assure that no data are lost and that users from the general public have easy access.
13. Expand the Great Basin Science Sample and Records Library with Phase II, an additional 5,000 square feet of sample-storage area plus finishing off the second-floor storage area for paper publications.
14. Build or convert existing buildings into sample and records libraries in two other locations in Nevada—near Elko, the center of the gold-mining industry, and in southern Nevada.

Earth-Science Education

Our goal is **to translate scientific information to help the public make informed decisions regarding resources, hazards, and the environment.** NBMG has had a long tradition of providing earth-science information to not only the geological and engineering communities but also to K-12 teachers, students, and the general public. In addition, we have participated with the University of Nevada, Reno Department of Geological Sciences and Engineering and external geoscience organizations in offering short courses for continuing education of professionals. Our objective is to expand our programs in educational outreach. We will continue to work with the W.M. Keck Earth Science Mineral and Engineering Museum, the Nevada Mining Association, the Geological Society of Nevada, the Nevada Earthquake Safety Council, and the American Geological Institute's Earth Science Week in our K-12 and general public outreach efforts.

STRATEGIES TO REACH THESE GOALS AND OBJECTIVES

Creating and Responding to Opportunities

We expect to expand geoscience research in Nevada through a combination of creating opportunities and responding to emerging and existing opportunities. We create new programs by working with local, state, and federal agencies, and some private companies, that have needs and interests that mesh with our expertise in such areas as geologic mapping, natural hazards, natural resources, and environmental concerns. The fact that approximately 87 percent of the land in Nevada is managed by federal agencies requires that we work closely with these agencies to structure programs of mutual benefit to the State of Nevada and the federal government. We will also continue to work closely with state and local agencies that have complementary missions and interests.

NBMG’s scientists will continue to seek funding for basic and applied research through competitive programs in a number of federal agencies. We have been particularly successful with such programs in the U.S. Department of Energy, the National Aeronautics and Space Administration, the National Science Foundation, and the U.S. Geological Survey. We expect to continue that success. As new opportunities arise within these and other agencies, we will respond within our constraints of available staff.

NBMG Strategic Initiatives

The Nevada Bureau of Mines and Geology has developed several strategic initiatives for consideration by the administration of the University of Nevada, Reno and others. These fall into two broad categories: (1) Economic Stimulation through Geoscience Data and Information and (2) Earthquake Risk Reduction in Nevada. Each has separate components and budget estimates, which are summarized in the table below. We will strive to obtain the necessary resources through grants and contracts from federal, state, and local governmental agencies and private sources and from direct state and federal appropriations. Approximate costs are summarized in the following table, and details for each initiative are given below.

Strategic initiatives involving the Nevada Bureau of Mines and Geology

Economic Stimulation through Geoscience Data and Information

- Great Basin Science Sample and Records Library
  - Phase II of the building in Reno: $2.2 million
  - Digital data capture and sample acquisition: $6.8 million (5 years to complete)
  - Facility in or near Elko: $5.7 million
  - Facility in southern Nevada: $5.7 million
- Geologic Mapping Program: $600,000 per year (50% federal funds)
- Dynamic Land-Surface Information Service: $7.7 million (3 years to develop)
- Mineral and Energy Resource Assessments
  - Comprehensive Mineral and Energy Resource Assessment of Nevada: $10.4 million (5 years to complete)
  - Strategic and Critical Minerals for Defense: $2.2 million (3 years to complete)

Earthquake Risk Reduction in Nevada

- Urban Washoe County Fault Study: $11.5 million (6 years to complete)
- Statewide Assessment of Active Faults: $8.6 million (5 years to complete)
- Faults on Military Lands in Nevada: $3.0 million (3 years to complete)

Great Basin Science Sample and Records Library

There are tremendous benefits to preserving geoscience data and sample collections. They have many applications for the public good. Among the applications most relevant to Nevadans are:

- **economic development**, particularly regarding **mineral and energy resources**;
- assessment of **ground-water resources** and **water-quality** protection;
- minimization of **environmental impacts** from land disturbance;
- **land management** in areas of potential mineral and energy resource extraction and urban growth;
- evaluation of **natural hazards**, particularly earthquakes, landslides, and floods;
- long-term monitoring of **waste disposal** sites and ground impacted by nuclear explosions; and
- improvement of the **scientific knowledge** of Earth processes and expansion of **research opportunities**.

Congress allocated $3.465 million for Phase I of the Great Basin Science Sample and Records Library in the appropriations for the Department of Energy in fiscal year 2006. Phase I was completed in 2009 with construction of a 10,000-square-foot two-story sample warehouse plus office and sample- and records-examination space in a new building on the Reno campus of the Desert Research Institute. The primary purpose of the building is to preserve geoscience data and samples, which have been collected at the cost of hundreds of millions of dollars by local, state, and federal agencies; the private sector; and university researchers.

The National Research Council highlighted the need for facilities to preserve critical geoscience data and samples in its 2002 report on *Geoscience Collections and Data: National Resources in Peril*. In response, Congress authorized the National Geoscience Data Preservation Program Act as part of the Energy Policy Act of 2005. As the State agency authorized by the Nevada Legislature to curate geoscience collections and data, NBMG has become a part of the national data archive system. In 2010, the National Science Foundation (NSF) announced a policy that requires preservation of all data, samples, physical collections, and other supporting materials from NSF-sponsored Earth-science research. The national programs and policies, coupled with the fact that approximately 87% of the land in Nevada is managed by the federal government, justify the use of federal funds for geoscience data and sample preservation in Nevada.

Geologic Mapping Program

The Nevada Bureau of Mines and Geology has been a significant participant in the National Cooperative Geologic Mapping Program, with a total of $6.0 million in state and federal funds dedicated to geologic mapping projects since the program's inception in federal fiscal year 1993. New, detailed geologic maps and easy-to-access digital versions of maps are meeting needs in broad areas of application, from risk reduction from natural hazards (floods, earthquakes, landslides, rock falls, expansive and collapsing soils, etc.) to resource development (water, minerals, energy) and environmental protection (wellhead and aquifer protection, isolation of waste in disposal facilities, etc.). We expect to continue to apply for funding from the National Cooperative Geologic Mapping Program at the current maximum level of $300,000 per year in federal funds per state, to be matched with non-federal funds (either state, NBMG salaries or funds from local governments or private sources).

Dynamic Land-Surface Information Service

This is an innovative concept for a geoscience service similar to what the National Weather Service provides for weather forecasting. It would use Nevada as the example for a service that would put diverse and abundant geographic data sets (involving satellite, airborne, and on-the-ground data) in the hands of the public. Information that would be available to the public through this service would include geological, geophysical, and tectonic maps at various scales; dynamic data and interpretations from seismological, geodetic, hydrological, and meteorological networks; and land cover from various remote sensing platforms. We anticipate this will stimulate both UNR research and economic development.

Mineral and Energy Resource Assessments

A comprehensive mineral- and energy-resource assessment of Nevada will further stimulate Nevada's economy and provide upgrades to Mackay inorganic analytical equipment used by researchers in the Departments of Geological Sciences and Engineering, Mining Engineering, Chemical and Metallurgical Engineering, NBMG, and others. A separate project on strategic and critical materials for defense would undertake commodity-specific studies of strategically challenging mineral resources in the global economy, focusing on geographically unbalanced resources and U.S. Department of Defense needs for high-tech applications. The University of Nevada, Reno is uniquely qualified to undertake these studies, given its strengths in economic geology, mineral engineering, and extractive metallurgy; its Center for Strategic Materials Research, Policy, and Education; and its Mackay-Stanford ore deposits collection. The proposed work covers acquisition of a top-priority inorganic analytical instrument identified by Mackay researchers, a new scanning electron microscope with all the necessary attachments for state-of-the-science research. This instrument could help place Mackay/UNR in the top five among mining schools throughout the world.

Urban Washoe County Fault Study

This initiative calls for faults in the urban area of the county to be mapped with the location accuracy needed for zoning by the cities and county to avoid building on active faults. The larger faults will be characterized in terms of how frequently they have moved in the past, how large the displacements have been during past earthquakes, and how likely they are to have major earthquakes in the future. This work includes dating of geological materials using various techniques. It also includes geodetic observations, using highly accurate GPS instruments, to determine areas of highest strain and changes in strain with time. We chose this part of the state because it has the highest earthquake hazard of our major urban areas.

Statewide Assessment of Active Faults

NBMG research has documented over 1,500 faults in Nevada that are considered active in the sense that they have a reasonable likelihood of moving during earthquakes in the future. We recognize faults that have moved during various geologic intervals, and, on the basis of historical earthquakes on known faults, we are most concerned with faults that have moved most recently within the last 130,000 years, although we recognize that essentially any fault that moved in the last 2.6 million years has some potential for movement during an earthquake. The recent development of light detection and ranging (LiDAR) technology has given us the opportunity to map these faults much more accurately than had previously been done using conventional aerial or low-sun-angle photography. Furthermore, where detailed geological studies have been undertaken, we generally discover more active faults than earlier studies had indicated. This project will update the statewide fault map and related database on individual faults to modern standards and set the stage for future research.

Faults on Military Lands in Nevada

Several military installations in Nevada are critical for national defense. These include the “Top Gun” Navy pilot-training facilities near Fallon, the Air Force pilot-training areas at Nellis, the unmanned vehicle operations at Creech Air Force Base, and the munitions depot at Hawthorne. The latter houses the Department of Defense’s stockpile of mercury and various explosives. Assessing the likelihood of earthquakes at these facilities, particularly where the ground is likely to break during an earthquake, can be vital to securing these assets. This project will address fault and related earthquake hazards on these military lands.

Other Aspects of Earthquake Risk Reduction

Reducing risks from earthquakes in Nevada also calls for action beyond the areas of immediate responsibility of the Nevada Bureau of Mines and Geology. Specifically, we recognize the need for the Nevada Seismological Laboratory, another statewide program within the University of Nevada, Reno, to upgrade and expand its seismic network, so that we have more accurate locations and measurements of earthquakes – information that is vital in emergency response and recovery and in understanding earthquake hazards. Combined with GPS instruments, a denser network of seismic stations will also open possibilities for real-time earthquake warning (for alerts before the most damaging ground shaking hits) and will strengthen scientific forecasting of earthquakes. In addition, through the Nevada Earthquake Safety Council, we are quantifying Nevada’s vulnerability to loss of life and property from collapse of unreinforced masonry buildings (URMs). These are the types of buildings that typically collapse during earthquakes in the United States, as was the case during the 2008 earthquake that damaged buildings in Wells, Nevada and in 2003 when URMs caused two deaths in an earthquake near Paso Robles, California. NBMG supports UNR’s efforts to retrofit or replace the URMs on its campus.

Setting priorities for positions and for filling of vacancies as they occur is an ongoing process with input from NBMG staff, the NBMG Advisory Committee, University administrators, and representatives of local, state, and federal agencies and the private sector who have good ideas regarding needs and opportunities for applied geological research. The full needs of the strategic initiatives described above would add more than 21 positions to NBMG's staff. Ideally, some of the new positions would be located in Las Vegas, where issues of urban growth are creating large demands for geologic maps and applied research. Appropriate operational, travel, communications, and facilities costs would need to be added along with the increases in FTE. Staffing needs for both NBMG’s primary mission and the strategic initiatives are summarized in the following table.

Current staff and staffing needs to meet NBMG's primary mission and strategic initiatives, in terms of full-time equivalent positions, FTE

Area of expertise	Current staff[1]	Needed for primary mission	Needed for strategic initiatives[2]
Economic geology[3]	2 *(2.00)*	3	6
Structural geology/mapping[4]	4 *(2.98)*	3	4
Earthquake geol./geomorphology[5]	3 *(2.32)*	3	6
Geodesy/geophysics[6]	5 *(2.28)*	3	8
Information dissemination[7]	4 *(2.27)*	4	4
Analytical geochemistry	2 *(1.96)*	2	2
Hydrogeology/hydrology[8]	0	1	1
Research technicians	2 *(0.00)*	1	2
Cartography[9]	6 *(2.09)*	4	5
Administrative support	4 *(1.92)*	3	2
Graduate research assistants	8 *(0.00)*	2	21
Undergraduate students	11 *(0.00)*	2	11
TOTALS	**51 *(17.82)***	**31**	**72**

[1] Numbers in *parentheses and italics are State-supported FTE*.
[2] additional individuals, beyond what is needed for NBMG's primary mission
[3] includes expertise in metals, industrial minerals, geothermal, oil and gas
[4] includes expertise in structural geology, stratigraphy, tectonics, geologic mapping, 4D modeling, and general geology
[5] includes earthquake geology (paleoseismology, neotectonics), geomorphology, physical geography, and engineering geology
[6] includes geodesy, geodynamics, seismology, remote sensing, and other areas of geophysics
[7] includes expertise in geologic information, public outreach, publication sales, digital data capture, and information technology
[8] Lisa Shevenell handles hydrogeology for NBMG but has concentrated most of her efforts in recent years on geothermal resources; her FTE is counted under "Economic geology."
[9] includes support in cartography, geographic information systems, and web applications; overlaps with expertise in information dissemination

NBMG currently has an efficient supervisory structure. The Director directly supervises 15 scientists who are faculty members, two administrative faculty members, and four of the fourteen classified staff members. The remaining 10 classified staff members, one faculty member, one temporary research faculty, one postdoctoral researcher, and several graduate and undergraduate students are supervised by others. As staff expands, additional supervisory responsibilities would need to be assumed by the Director or by other scientists and support staff members.

We recognize that major additions of research faculty and research-support staff are likely to come from soft money. An important strategy for increasing research activities is to keep attuned to opportunities for research funding from all major sources, including federal, state, and local agencies, industry, and private foundations. We will continue to do so.

OUTCOME-RELATED PERFORMANCE MEASURES FOR NBMG

Research Productivity

Reports, maps, and special publications produced by NBMG, including articles published in scientific journals and elsewhere by the NBMG staff, serve as the best performance indicators. These publications are the chief products of research. Other measures that could be used, such as the numbers of presentations made about NBMG research or the number of research grants or dollars received for research grants and contracts, are proxies for research productivity. Yearly totals of numbers of publications are not necessarily an ideal measure, however, because with a small staff, the workload can vary considerably from year to year as large projects start and finish. Therefore, averages over a number of years are better measures.

Reports, Bulletins, Open-File Reports, and Other Publications of NBMG

Year	Geologic Maps	Yearly Totals[1]	Average (of past three years)	Number of scientists[2]	Average number of NBMG publications per scientist per year
1991	0	15		11	
1992	2	20		11	
1993	7	16	17	11	1.5
1994	4	12	16	11	1.5
1995	6	18	15	11	1.4
1996	3	16	15	11	1.4
1997	4	14	16	11	1.5
1998	5	26	19	11	1.7
1999	21	40	27	11	2.4
2000	8	25	30	11	2.8
2001	10	24	30	11	2.7
2002	3	17	22	11	2.0
2003	26	53	31	11	2.8
2004	8	30	33	11	3.0
2005	13	29	37	11	3.4
2006	15	37	32	11	2.9
2007	3	12	26	11	2.4
2008	5	25	25	11	2.3
2009	10	31	23	10	2.3

[1] Numbers of NBMG publications, including geologic maps, produced during that year.
[2] The number of NBMG scientists supported on grants and contracts rose from three (from 1991 to 2003) to six (from 2003 to 2006) to seven (2007 to present). The number of state-funded scientists had been steady at eleven but dropped to 10 for 2009.

External Publications Produced by NBMG Scientists

Year	Yearly Totals	Average (of past three years)	Number of scientists	Average number of external publications produced per scientist per year
1991	52		11	
1992	52		11	
1993	49	51	11	4.6
1994	72	58	11	5.2
1995	54	58	11	5.3
1996	66	64	11	5.8
1997	76	65	11	5.9
1998	91	78	11	7.1
1999	75	81	11	7.3
2000	72	79	11	7.2

2001	56	68	11	6.2
2002	63	64	11	5.8
2003	70	63	11	5.7
2004	88	74	11	6.7
2005	91	83	11	7.5
2006	105	95	11	8.6
2007	111	102	11	9.3
2008	66	94	11	8.5
2009	73	83	10	8.3

Overall Productivity (Total number of publications per state-funded scientist)

	Average of past three years	Average number of publications (NBMG and external) produced per state-funded scientist per year
1993	68	6.2
1994	74	6.7
1995	74	6.7
1996	79	7.2
1997	81	7.4
1998	96	8.8
1999	107	9.8
2000	110	10.0
2001	97	8.6
2002	86	7.8
2003	94	8.6
2004	107	9.7
2005	120	10.9
2006	142	12.9
2007	128	11.2
2008	106	9.6
2009	91	9.1

With only 18 full-time scientists on the NBMG staff during 2008 and 2009 (only 10 of whom were funded by state appropriations), NBMG has been highly productive. Measured on a per-person basis, publication productivity is outstanding. The strength in recent years is in part the result of adding additional scientists supported on grants and contracts.

These measures of publication productivity allow quantitative comparisons over time and with other organizations, but they don't necessarily indicate the quality of the publications or their applicability to issues in Nevada and beyond. The fact that NBMG scientists are publishing in a broad array of leading, peer-reviewed scientific journals demonstrates the quality of the scientific work; in the last two years, these journals have included *Canadian Mineralogist, EOS, Geological Society of America Special Papers, Geology, Geomorphology, Geophysical Journal International, Geosphere, International Geology Review, International Journal of Environment and Health, International Journal of Geographic Information Science, Journal of Geodesy, Journal of Geophysical Research, Physics and Chemistry of the Earth, Resource Geology, Science, Tectonics, Transactions in GIS, and Water Resources Research.* In addition, NBMG scientists contribute frequently to applied science publications, such as the *Geothermal Resources Council Transactions, Proceedings of the Society for Geology Applied to Mineral Deposits,* and field trip guidebooks and special publications of the Geological Society of Nevada, Association of Environmental and Engineering Geologists, Geological Society of America, and Arizona Geological Society, and to news in professional and trade journals, such as *Mining Engineering*.

NBMG's flagship publications (geologic maps, reports, and bulletins) undergo generally as rigorous a peer review as the refereed journals (more so in the case of geologic maps). A few anecdotal statements from users of NBMG maps and other reports demonstrate some of the applicability of NBMG work.

Alan R. Coyner, Administrator of the Nevada Division of Minerals, in a letter dated 19 October 2009, wrote:

> "I write to express our pleasure with the publication of the new *Geologic Map of the Virginia City Quadrangle*. The NBMG map and accompanying report provide tremendous benefits to exploration geologists, urban planners and developers, geology students, and the general public. This is the most detailed publically available geologic map of the Comstock Lode, one of the greatest ore deposits in American history. The Lode's historical production of 192 million ounces of silver and 8.3 million ounces of gold would have a value of approximately $11 billion today. NBMG's map and accompanying report document the ages and interrelationships of the rocks, hydrothermal alteration, and ore deposits. Your work has replaced the old concept that altered andesites were the Alta Formation and unaltered andesites were the Kate Peak Formation (a concept that has confused volcanic stratigraphy in the Reno area) with a clearer history of at least three andesite volcanoes and three distinct episodes of hydrothermal alteration (one of which is associated with the Comstock silver-gold ores and two of which resulted in large areas of clay-rich soils that are construction hazards today).
>
> The fact that the map was published early in 2009, on the 150th anniversary of the discovery of the Comstock Lode, has provided opportunities to highlight the importance of geology with the public. Its use during this year's Earth Science Week field trips for the general public – two all day trips on October 10 and 11 – was a great success. Participants got to sample unaltered and altered andesites, massive quartz veins and stockwork-veined mineralization from the Comstock Lode, calcite from the slightly younger and lower-grade Occidental Lode, and clay used to make bricks. They also examined faults – evidence of the earthquake hazards in the Reno-Virginia City-Carson City urban area. By making the fieldtrip guide available on line, you have given others from the public the opportunity to enjoy the geology of the Comstock at their leisure."

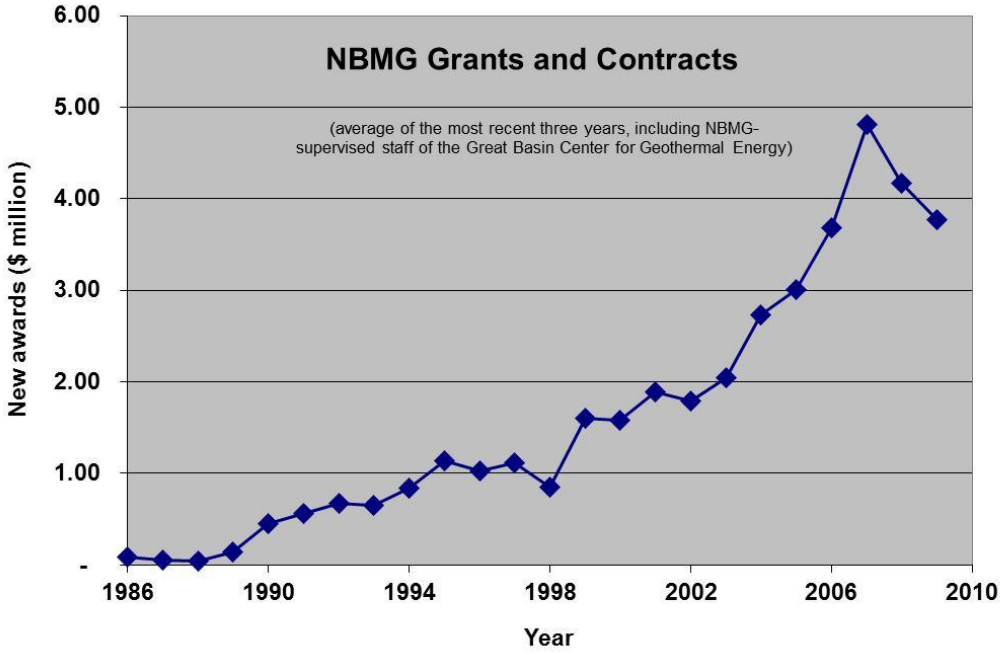
Dick Benoit with Magma Energy Corp, in a letter received on 18 October 2010, stated:

> "We fully support your proposal to the USGS STATEMAP program to complete detailed geologic mapping of the Desert Peak quadrangle in Churchill County, Nevada. As you know, we are currently conducting an extensive geothermal exploration program in the Desert Queen area in the eastern part of the quadrangle. Your previous mapping in the area has been very beneficial to us in understanding the stratigraphic and structural framework of the area, as well as in developing conceptual models for the geothermal systems. The proposed new mapping will provide critical information needed to better define the geothermal systems and select targets for geothermal wells at Desert Queen. In addition, the proposed mapping will further enhance our understanding of the known geothermal systems at Brady's and Desert Peak. Because very few geothermal systems have been mapped in sufficient detail to fully understand the controls on fluid flow, we very much applaud these efforts."

Dr. Jim Combs, Chief Scientist with Vulcan Power Company, in a letter dated 12 October 2009, stated:

> "Vulcan Power Company (Vulcan) fully supports your proposal. As you know, this area of northern Nevada has many indications of geothermal activity and considerable potential for geothermal development. . . . Your geologic mapping will greatly assist the Vulcan exploration and drilling efforts. Because most of the geothermal systems in this region are fault controlled, a detailed geologic map delineating the structural and stratigraphic framework, as well as surficial geothermal features (e.g., sinter and tufa mounds), will be particularly useful in selecting drilling sites for our future geothermal production wells. Your completed mapping in the west half of the Hazen Quadrangle has already been very useful to Vulcan in its exploration and development program."

To collect new geological information and conduct geological research, operating money is needed. These funds pay for such expenses as fieldwork, base maps, aerial photographs, research equipment, and chemical analyses of rocks. Grants and contracts also pay salaries of additional researchers and support staff. NBMG also uses some grant funds and some donations to the University of Nevada, Reno Foundation to pay geologists outside the University to submit geologic maps to NBMG for review and publication. Grants and contracts bring new money into the Nevada economy, and they expand the State's research capabilities and increase knowledge about Nevada's geology; mineral, energy, and water resources; natural hazards; and environment. NBMG continues to provide many vital public services to the state with the help of these grants and contracts. In addition, the fact that other agencies and organizations are willing to contribute money to support NBMG projects is a statement of the value and applicability of the work.



Research and Non-Research Grants and Contracts Awarded

Year	Number of Grants and Contracts	Total Awards	Average (of past three years)
1984	4	$ 182,389	
1985	3	37,970	
1986	3	32,790	$ 84,383
1987	3	74,450	48,403
1988	1	7,186	38,142
1989	7	337,658	139,765
1990	15	1,009,440	451,428
1991	4	351,298	566,132
1992	15	650,801	670,513
1993	23	944,687	648,929
1994	14	932,270	842,586
1995	32	1,529,343	1,135,433
1996	14	615,509	1,025,707
1997	17	1,215,298	1,120,050
1998	29	708,603	846,470
1999	32	2,873,711	1,599,204

2000	29	1,164,626	1,582,313
2001	25	1,630,994	1,889,777
2002	41	2,571,242	1,788,954
2003	22*	1,936,308*	2,046,181*
2004	25*	3,698,781*	2,735,444*
2005	19*	3,373,403*	3,002,831*
2006	38*	3,989,817*	3,687,334*
2007	27*	7,066,919*#	4,810,046*#
2008	25*	1,454,921*	4,170,552*#
2009	29*	2,776,568*	3,766,136*#

* These numbers include projects of the Great Basin Center for Geothermal Energy, managed by NBMG scientists.
# These numbers include $3,465,000 for the Great Basin Science Sample and Records Library in 2007.

Customer-Service Questionnaire

In January 2006, NBMG began distributing a questionnaire to patrons (see Appendix C). The quantitative results from 37 respondents from 1 July 2006 through 18 December 2008 are summarized below, using a standard grade-point average (where A = 4, B = 3, C = 2, D = 1, and F = 0). Also listed in parentheses is the percentage of respondents who listed a particular item as A.

Overall Performance of the Nevada Bureau of Mines and Geology

How well is the Nevada Bureau of Mines and Geology serving you? **3.30 (68% A)**

NBMG Publications and Information Office

Quality of NBMG publications	**3.19 (67% A)**
Usefulness of the publications	**3.46 (71% A)**
Number and variety of publications	**3.31 (57% A)**
Quality of NBMG geologic maps	**3.53 (76% A)**
Detail of NBMG geologic maps	**3.41 (68% A)**
Current coverage of geologic maps	**3.18 (53% A)**
Free publications on the Web	**2.97 (53% A)**
Cost of publications for sale	**3.09 (52% A)**
Customer service for sales	**3.24 (71% A)**
Ease of Web sales	**3.13 (55% A)**
Timeliness of receiving Web, mail, and fax orders	**3.14 (59% A)**
Service from Information Office	**3.38 (65% A)**
Air photo coverage	**2.96 (57% A)**
Content of mining district files	**3.25 (61% A)**
Free mining-district, geothermal, and other information on the Web	**3.15 (56% A)**
Hours of operation	**2.72 (47% A)**

External Publications and Professional Service

External publications	**3.10 (59% A)**
Professional service	**2.23 (30% A)**

Outreach to the General Public, K-12 Teachers, and Students

Publications for the general public	**3.31 (63% A)**
Earth Science Week field trips	**3.30 (60% A)**
Helpfulness in answering questions	**3.28 (66% A)**

Analytical Laboratory

Quality of assays	**3.14 (54% A)**
Cost of assays	**3.14 (61% A)**
Turnaround time	**3.00 (46% A)**

We feel that the results of the customer-service questionnaire are quite positive; the overall grade is between an A and B, and the majority of the respondents chose A for most areas. A few areas that stand out with less than a B average, and a few additional written comments, point to significant concerns, but we feel that our strategies are moving us in the right direction to address these concerns.

We are making progress toward offering nearly all NBMG publications free on the Web. With a few exceptions, including the popular geologic and natural history tour guides, most publications are designed for primary distribution free on the Web. As an example, the recent versions of our annual publication on the Nevada Mineral Industry have been designed for Web distribution, which allowed inclusion of color graphics that were too expensive to include in a print run. Customers are welcome to print the pages that they need, and we continue to sell paper copies that are printed on demand, thereby reducing the need for printing extra copies and keeping a large inventory.

In 2009, when we combined the information and sales offices in the Great Basin Science Sample and Records Library, we extended the hours of operation (formerly Monday-Friday, 8:00 a.m. to 3:00 p.m.) to Monday-Friday, 8:00 a.m. to 4:00 p.m. Our customers are pleased with parking and access to the new building, which is on the campus of the Desert Research Institute rather than with the offices of our scientists on the southern part of the University campus, where parking has become progressively more difficult for visitors to find.

Our collection of aerial photographs includes mostly public-sector photographs donated to us from the Nevada Department of Transportation and other agencies. These are frequently viewed by customers who are investigating the historical use of the land and by geologists who are mapping and studying details of the rocks. Our long-term plans include high-resolution scanning of all our air photos. Significant progress was made in collaboration with a private company, which scanned most of the urban-area photographs; these are being made publicly available, thereby making it easy for customers to use the photographs on the Web. A similar arrangement has allowed us to scan and now post for free on the Web electronic copies of the logs from most of the oil and gas exploration and development wells drilled in Nevada. A grant from the U.S. Department of Energy, in collaboration with the Association of American State Geologists, is paying for scanning of logs from geothermal exploration, production, and injection wells.

Our lowest grade from customers who responded to the questionnaire was in service to the profession. Although we continue to support the local professional organizations, including the Geological Society of Nevada, Nevada Petroleum Society, Geothermal Resources Council, and Nevada chapters of the American Institute of Professional Geologists, Association of Environmental and Engineering Geologists, and Society for Mining, Metallurgy, and Exploration, through lectures, volunteering for committee service, and leading field trips, we should strive to do more to support the professions of geology and related fields. Budget constraints have forced us to focus our efforts on research and public service programs for which others are willing to help cover some or all of the costs. The NBMG Director tries to monitor the pulse of the professional community by attending as many local meetings as possible and by encouraging other NBMG staff members to volunteer. One area in which we could do more is offering short courses for professionals in our areas of scientific expertise.

Quality of the Research and Public Service Products

NBMG faculty and some classified staff members are recognized within the state, regionally, nationally, and internationally for their contributions to science and society. Many of these contributions are listed in Appendix A, which provides some details of the activities of the NBMG staff. As examples, in 2008 and 2009 NBMG scientists and members of the technical support staff:

- served as editor or associate editor of two refereed scientific journals, two books, and on the editorial board of two other journals;
- served on five advisory panels, task forces, and committees for the federal governments and Indian

tribes;
- served four times on advisory panels and committees for the Nevada state government;
- served as officers in three international, four national, and eleven state scientific and technical organizations;
- served as an expert witness for the state and federal government in mining-fraud cases;
- chaired 48 committees or conference sessions of international, national, regional, and state scientific organizations;
- served 44 times as committee members or in other capacities for international, national, regional, and state scientific organizations;
- served 18 times as field trip leaders;
- made 345 technical presentations, often with published abstracts, at scientific meetings and other venues;
- taught seven college-level classes and served as guest lecturers six times in classes at the University of Nevada, Reno;
- received six special honors or awards from scientific, technical, and other organizations;
- were interviewed 28 times by television, radio, and print media;
- provided free technical assistance to various consultants, engineers, lawyers, and citizens of Nevada and elsewhere;
- reviewed more than 130 articles for scientific journals and publications of geological surveys; and
- reviewed more than 33 proposals for funding of research by the National Science Foundation, the U.S. Department of Energy, and other agencies.

In recent years, NBMG has made a concerted effort to create special publications for the general public and for users who are pursuing economic development opportunities in Nevada. Significant additions to our offerings for students, teachers, and the general public include new one-day field trips for thhNae general public as part of the annual Earth Science Week (available online as part of the Educational Series at http://www.nbmg.unr.edu/dox/dox.htm) and points of geological interest located by GPS coordinates (EarthCache sites at http://www.nbmg.unr.edu/earthcache/ec.htm). For those interested in exploring for and developing mineral and energy resources, most of our mining-related files, including many one-of-a-kind reports and maps, are now available online at ftp://comstock.nbmg.unr.edu/pub/MD/Start.htm; many of our databases on mineral and energy resources are accessible in interactive maps with useful geographic locators at http://gis2.nbmg.unr.edu/; geothermal information is accessible through http://www.nbmg.unr.edu/geothermal/gthome.htm; and high-quality scans of logs from most oil and gas exploration and production wells drilled in the state are posted at http://www.nbmg.unr.edu/lists/oil/oil.htm. All our Web offerings are linked through www.nbmg.unr.edu.
Several NBMG Special Publications are reaching users in bookstores throughout Nevada and other parts of the country. All publications can be ordered online (www.nbmg.unr.edu), and selected publications, several Educational Series items, NBMG's annual publication, *The Nevada Mineral Industry*, and the joint publication with the Nevada Division of Minerals, *Major Mines of Nevada*, are provided to the public for free on the Web. As costs for data storage have dropped, and as more people have gained access through the Web at home, businesses, schools, and libraries, NBMG now provides most new maps and reports to the professional users and general public for free on the Web.

For more information about the Nevada Bureau of Mines and Geology, or about the geology, resources, and environmental issues in Nevada, please feel free to contact us.

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31 December 2010

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APPENDIX A

Activities of NBMG in 2008 and 2009

This appendix includes citations of publications produced by NBMG and authored by NBMG scientists; grants awarded to principal investigators on the NBMG staff; invited lectures, public presentations, and other professional activities of the NBMG staff; and awards and honors during the past two years.

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Aerojet, Water sampling along Garfield Road to evaluate geothermal potential of the area, 6/22/09-9/30/09, $3,000, Shevenell, L., and Penfield, R.
Applied Research Initiative, University of Nevada, Reno, Operational Support of Research Activities of the Great Basin Center for Geothermal Energy 7/1/07-12/31/08, $121,572, Shevenell, L.
Atna Resources: Gold-silver veins at Jarbidge, 9/1/06 - 12/31/10, $9,986, Muntean, J.L.
Barrick Cortez Gold Mine, Geology of the NE margin of the Caetano caldera and adjacent Paleozoic rocks, Cortez area, Nevada, 4/08-3/09, $26,476, Henry, C.D.
Barrick Gold, Characterization of the time-space relationships between hydrothermal alteration, gold mineralization, and intrusive phases in the RBM Pit, Bald Mountain mining district, White Pine County, Nevada, $17,165, MS thesis, Pace, D.W., and Muntean, J.L.
General Moly Mining Corporation, InSAR study in the Diamond-Kobeh Valley area, 8/08-3/09, $46,443, Bell, J.W.
Hands on Ventures, Shallow temperature survey at Hands on Ventures properties, 11/10/08-12/30/09, $1,000, Shevenell, L. and Sladek, C.
International Lithosphere Program, Temporal and spatial changes of stress and strain, 1/05–12/09, $25,000 ($5,000 awarded for 2005), Heidbach, O., Friedrich, A., and Kreemer, C.W.
Kodali, Inc., Construction of probes for shallow temperature surveys on Kodali Inc. properties, 1/16/09-1/8/10, $5,662, Shevenell, L., and Sladek, C.
Las Vegas Valley Water District, Operation and analysis of subsidence data from continuous GPS station UNR1, 1/06-6/09, $41,200, Bell, J.W.
Las Vegas Valley Water District, Operation and analysis of subsidence data from Las Vegas continuous GPS station, 7/1/09-6/30/10, $15,500, Bell, J.W.
Magma Energy Corporation, Structural study of the Desert Queen geothermal area, Churchill County, Nevada, 1/1/09-3/31/10, $50,384, Faulds, J.E.
National Aeronautics and Space Administration, Jet Propulsion Laboratory, The Global Geodetic Observing System: meeting the requirements of a global society on a changing planet in 2020, 7/06-1/09, $108,843, Plag, H.-P.
National Aeronautics and Space Administration, Synthesis of NASA Data on Earth's Changing Geometrical and Gravitational Shapes to Assess Change in Terrestrial Water Storage and Its Effect on Sea Level, Lithospheric Loading, and Earth Rotation, and to Image Mantle Rheology, 7/04–6/08, $500,100, Blewitt, G.
National Aeronautics and Space Administration, Geodetic Imaging of Earth's Surface Deformation using Integrated InSAR and GPS Observations, 1/09-12/11, $405,647, Hammond, W.C., Blewitt, G., Kreemer, C.W., and Plag, H.-P.
National Aeronautics and Space Administration, A New Technique to Enhance Global GPS Accuracy and Resolution for Earth Science, 7/09-6/12, $181,650, Blewitt, G.
National Aeronautics and Space Administration, Jet Propulsion Lab, Improvements to the GPS Data Analysis System as Implemented at JPL, 1/09-12/09, $109,760.69, Blewitt, G.
National Aeronautics and Space Administration, Jet Propulsion Lab, Improvements to the GPS Data Analysis System as Implemented at JPL, 11/07-12/08, $100,780.99, Blewitt, G.
National Aeronautics and Space Administration, Jet Propulsion Lab, GPS-Based Rapid Earthquake and Tsunami (GREAT) Alert System, 10/08-9/10, $195,000, Blewitt, G., and Plag, H.-P.
National Aeronautics and Space Administration, Jet Propulsion Lab, Surface Mass Loads from GRACE, GPS, and

Earth Rotation, 3/08-9/10, $296,422, Gross, R.J. (JPL), Plag, H.-P., and Blewitt, G.

National Aeronautics and Space Administration, Development of Real-Time Tsunami Warning Systems Using Continuous GPS, 12/07-12/10, $393,920, Blewitt, G., Hammond, W.C., Kreemer, C.W., and Plag, H.-P.

National Aeronautics and Space Administration, Nevada Space Grant Consortium, NASA Geophysical Space Geodesy Course Development, 8/1/09-12/31/09, $9,762, Hammond, W.C.

National Aeronautics and Space Administration, Jet Propulsion Lab, The Global Geodetic Observing System: Meeting the Requirements of a Global Society on a Changing Planet in 2020, 7/08-1/09, $30,583, Plag, H.-P.

National Science Foundation, Revealing the Nature of Contemporary Uplift and Collapse in the Sierra Nevada - Great Basin System. 2/09-3/12, $474,930, Blewitt, G., Hammond, W.C., and Plag, H.-P.

National Science Foundation, Quasi-Block Modeling of Walker Lane Tectonic Deformation, Using Geodetic and Geologic Data to Constrain System Complexity and Time-Variable Behavior, Sponsored by NSF, Federal, 8/06-7/10, $236,776, Hammond, W.C., Kreemer, C.W., and Blewitt, G.

National Science Foundation, An Integrated Geologic and Geodetic Study of Strain Accumulation and Release in the Northern Walker Lane, 1/07-12/09, $334,853, Wesnousky, S.G., Hammond, W.C., and Kreemer, C.W.

National Science Foundation, Collaborative research on fluid pathways, and metal transport and deposition in Carlin-type gold deposits: insights from the Getchell system, 2/1/07 to 1/31/10, $457,544 (of which $162,544 is to UNR), Cline, J.S., and Muntean, J.L.

National Science Foundation: Elucidating physical processes in upper crustal magma systems - Evidence from Miocene intrusive and extrusive sequences in southern Nevada, $85,036, 7/04–6/09, Faulds, J.E.

National Science Foundation, Impact of extrafluvial events on river valley evolution, Owyhee River, Oregon, 9/06-8/09, $117,108, House, P.K., Ely, L, and Safran, L.

National Science Foundation, Improving the Spatial and Temporal Resolution of Strain Rate Models of Continental Deformation, 9/15/09-9/14/12, Federal, $280,580, Kreemer, C.W.

National Science Foundation, Thermal Contraction, Oceanic Intraplate Deformation, and Plate Circuit Closure, 9/1/09-8/31/11, $92,043, Kreemer, C.W.

National Science Foundation, Southern California Earthquake Center, Detecting Transient Deformation Signals in GPS time-series, 2/1/09-1/31/10, $18,951, Kreemer, C.W., and Zaliapin, I.

National Science Foundation, Southern California Earthquake Center, Time-Dependent Modeling of Seismic Moment Release, 2/1/09-1/31/10, $24,967, Zaliapin, I., Kreemer, C.W., Anderson, J.G., and Pancha, A.

National Science Foundation, Southern California Earthquake Center, Modeling Seismic Moment Rate in San Andreas Fault –Great Basin system: Combination of seismological and geodetic approaches, 2/1/08-12/31/09, $20,000, Zaliapin, I., Kreemer, C.W., Anderson, J.G., and Pancha, A.

National Science Foundation, 2008 Gordon Research Conference on Geochemistry of Mineral Deposits, 6/1/08-6/1/09, $20,000, Muntean, J.L., and Gray, N.R.

Nevada Geothermal Power Company, Developing a conceptual structural model for the Blue Mountain geothermal field, Humboldt County, Nevada: 12/07, $2,000, Faulds, J.E.

Nevada Power, UNR participation in the Nevada Geothermal Energy Technical Advisory Panel, 7/11/07-12/31/09, $10,044, Shevenell, L., Faulds, J.E., and Garside, L.J.

Nevada Power, Completion of a Geothermal Resource Location Map, 3rd edition of NBMG Map 141, 3/1/08-12/30/10, $13,894, Shevenell, L.

Nevada Public Agency Insurance Pool: Nevada Earthquake Safety Council Inventory of Buildings, 7/07/09-8/07/12, $7,926 in matching funds for FEMA grant, Price, J.G.

Piedmont Geosciences, Fault Trenching for the Pit River No.3 Dam, California, 11/09-12/09, $19,524, dePolo, C.M.

Piedmont Geosciences, Seismic Hazards Posed by Faults in the Modoc Plateau, California, 4/09-5/09, $10,000, dePolo, C.M.

Queenstake Resources, Jerritt Canyon, 6/1/05 to 6/1/08, $88,000, Muntean, J.L., and Henry, C.D.

Ralph J. Roberts Center for Research in Economic Geology, University of Nevada Reno, Hydrothermal footprint of the Carlin-type deposits of the Jerritt Canyon District: district-scale patterns of trace elements, alteration, and isotopes along the Saval discontinuity, 1/1/07 to 12/31/08, $37,940, gift to fund Lucia Patterson's MS thesis, Muntean, J.L.

Sierra Geothermal Power Corporation Faulds, Structural controls of the Reese River geothermal system, central Nevada, 9/15/09-3/15/10, $45,348, Faulds, J.E., and Hinz, N.H.

Southern Nevada Water Authority, Baseline InSAR study of groundwater basins in southeastern Nevada, 1/1/08-6/1/09, $50,000, Bell, J.W.

State of Nevada: Commission on Mineral Resources, Division of Minerals, Science Sample and Records Library, 09/06/07-09/05/11, $219,243, Price, J.G.

State of Nevada: Mining Cooperative Fund Research, 7/09-6/10, $70,000; 7/08-6/09, $70,000; 7/07-6/08, $70,000,

Price, J.G.

State of Nevada, Nevada Earth/Space Science Initiative (NESSI), 3/07-9/08, $226,000, additional through 9/09, $111,000, Crowther, D., and LaPointe, D.D.

United Nations Educational, Scientific and Cultural Organization – International Union of Geological Sciences, Developing the Global Geodetic Observing System into a Monitoring System for the Global Water Cycle, 3/08-2/13, 47,800, Plag, H.-P.

U.S. Bureau of Land Management: Traveling the Great Basin Highway: A Guide to the Geology and Natural History along U.S. Highway 93 in Nevada and Arizona, 9/23/04 to 9/22/09, $137,574, Price, J.G., and Tingley, J.V.

U.S. Bureau of Land Management, Clark County geologic mapping, 5/9/07 to 5/08/12, $984,883, Faulds, J.E., and House, P.K.

U.S. Bureau of Land Management, Clark County Desert Conservation Program, Ecosystem Indicators, 11/5/08-6/1/11, $229,195, House, P.K.

U.S. Bureau of Reclamation, Walker Lake Task 2-7B, 11/07-3/11, $24,250, House, P.K.

U.S. Department of Defense, Department of Navy, Geothermal assessment of the Fallon Bombing Range 16 and Hawthorne Army Depot for the Geothermal Program Office, 3/2/09-3/31/10, $350,000, Shevenell, L.A., Coolbaugh, M.F., Faulds, J.E., Bell, J.W., and Louie, J.

U.S. Department of Defense, Department of Navy, Geothermal resource assessment of the Hawthorne Army Depot and Fallon (BR16) areas, 11/08-3/31/10, $100,000, Shevenell, L.A., Faulds, J.E., and Coolbaugh, M.F.

U.S. Department of Defense, Department of Navy, Low sun angle Quaternary fault analysis of the Hawthorne Army Weapons Depot, 11/08-10/10, $45,105, Bell, J.W.

U.S. Department of Energy, Geothermal Research and outreach at the Great Basin Center for Geothermal Energy, 9/30/09-12/31/12, $682,778, plus cost share, Shevenell, L., Faulds, J.E, Bell, J.W., and Biasi, G.

U.S. Department of Energy, National geothermal database by the geothermal database consortium, 11/19/09-5/31/14, $698,240, Shevenell, L., and Hastings, J.T.

U.S. Department of Energy, Geodetic Monitoring of the Yucca Mountain Region using Continuous Global Positioning System Measurements, 10/1/03 to 9/30/09, $5,864,226, Price, J.G., and Blewitt, G.

U.S. Department of Energy, Golden Field Office, Expanding geothermal resource utilization in Nevada through directed research and public outreach, 6/05–12/08, $992,133, Shevenell, L., includes: Geochemical sampling of thermal and non-thermal waters in Nevada: Continued evaluation of geothermal resources, $65,685, Shevenell, L., Lechler, P.J., Garside, L.J., and Coolbaugh, M.; Management of the research and outreach programs at the Great Basin Center for Geothermal Energy, $309,258, Shevenell, L.;. Revival of grass-roots geothermal exploration in the Great Basin (where to look for new geothermal fields) -- a new approach to assessing geothermal potential using a geographic information system (GIS): parts IV and V., $299,923, Coolbaugh, M., Zehner, R.E., Kreemer, C.W., Sawatzky, D., Oppliger, G., Blackwell, D., Shevenell, L., Taranik, J., and Raines, G.; Satellite InSAR (interferometric synthetic aperture radar) ground displacement analysis for geothermal reservoir management and development, $258,040, Oppliger, G., Coolbaugh, M., Shevenell, L., Widmer, R.; Geothermal applications of multi-gas geochemistry, $92,226, Lechler, P.J., Garside, L.J., Coolbaugh, M., and Shevenell, L.

U.S. Department of Energy, Golden Field Office, Geothermal research and outreach at the Great Basin Center for Geothermal Energy, 6/15/06-12/31/08, $990,000, Shevenell, L.

U.S. Department of Energy, Golden Field Office, Geothermal research at the Great Basin Center for Geothermal Energy, 11/1/07-12/31/08, $350,000, Shevenell, L.

U.S. Department of Energy, Great Basin Center for Geothermal Energy, Characterizing Controls on Geothermal Systems in the Northern Great Basin through Integrated Structural Analysis and Modeling: 12/01/07 to 9/30/12, $216,568, Faulds, J.E., and Coolbaugh, M.

U.S. Department of Energy, Great Basin Center for Geothermal Energy, Geothermal spring sampling, 3/02-12/08, $189,450, Shevenell, L., Garside, L.J., Coolbaugh, M., and Lechler, P.J.

U.S. Department of Energy, Great Basin Center for Geothermal Energy, Targeting of Potential Geothermal Resources in the Great Basin from Regional to Basin-Scale Relationships between Geodetic Strain and Geological Structures, 7/05–12/08, $236,532, Blewitt, G., Hammond, W.C., and Kreemer, C.W.

U.S. Department of Energy, Great Basin Center for Geothermal Energy, Characterization of active faulting and neotectonics at Nevada geothermal sites—Phase I, 11/30/07-12/31/12, $56,484, Bell, J.W., and Ramelli, A.R.

U.S. Department of Energy, Great Basin Center for Geothermal Energy, Characterization of active faulting and neotectonics at Nevada geothermal sites—Phase II, 9/1/09-12/31/12, $74,456, Bell, J.W., and Ramelli, A.R.

U.S. Department of Energy, Great Basin Center for Geothermal Energy, Comprehensive structural analysis of the Great Basin and adjacent regions for geothermal exploration, 10/09-9/12, $935,505, Faulds, J.E., and Bell, J.W.

U.S. Department of Energy, Great Basin Center for Geothermal Energy, Pattern and timing of active faulting along Nevada geothermal systems, Part 1, 9/1/06–12/31/12, $168,430, Bell, J.W. and Ramelli, A.R.

U.S. Department of Energy: Great Basin Science Sample and Records Library – Phase I, Cooperative Agreement Number DE-FG52-06NA25361, 7/01/06 to 9/30/09, $3,465,000, Price, J.G.

U.S. Department of Energy, Idaho Operations Office, Expanding geothermal resource utilization in Nevada through directed research and public outreach, 5/03–12/08, $963,364, Shevenell, L., and Long, J.C.S.

U.S. Department of Energy, National Renewable Energy Laboratory, Training the Geothermal Workforce, 3/16/09-5/15/11, $256,496, Shevenell, L.

U.S. Department of Energy, National Renewable Energy Laboratory, Research to locate concealed geothermal systems, 3/16/09-5/15/11, $118,503, Coolbaugh, M., Lechler, P.J., and Shevenell, L.

U.S. Department of Energy (passed through the California Energy Commission): Sequestration of CO_2 using Mafic and Ultramafic Rocks and through Enhanced Oil Recovery, 4/04/06 to 3/31/08, $75,000, Price, J.G.

U.S. Department of Homeland Security, FFY05 Pre-Disaster Mitigation HAZUS Data Update, 10/05–10/09, $60,063, Johnson, G.L., and Arritt, C.

U.S. Department of Homeland Security, Federal Emergency Management Agency: Earthquake Hazard Reduction, 8/17/09 to 2/06/11, $63,077, Price, J.G.

U.S. Department of Homeland Security, Federal Emergency Management Agency (passed through the Nevada Division of Emergency Management): Nevada Earthquake Safety Council Inventory of Buildings, 7/07/09 to 8/07/12, $23,777, Price, J.G.

U.S. Department of Homeland Security, Federal Emergency Management Agency (passed through the Nevada Division of Emergency Management): Hazard Mitigation Plan Subcommittee, 7/14/09 to 7/13/12, $150,364.63; 6/2/08 to 6/1/10, $44,000, Price, J.G., and LaPointe, D.D.

U.S. Department of Homeland Security, Federal Emergency Management Agency (passed through the Nevada Division of Emergency Management): Hazard Mitigation Planning Committee, 7/14/09 to 7/13/12, $45,478.73; 11/24/05 to 11/25/09, $42,493.20, Price, J.G.

U.S. Department of Homeland Security, Federal Emergency Management Agency (passed through the Nevada Division of Emergency Management): State Risk Assessment, 8/4/06 to 2/8/09, $53,842, Underwood, S.J., and Price, J.G.

U.S. Department of Homeland Security, Federal Emergency Management Agency (passed through the Nevada Division of Emergency Management): State Hazard Mitigation Risk Assessment, Grant No. 97039HM6, 04/06/07 to 02/06/09, $1,442, Price, J.G.

U.S. Department of Homeland Security, Federal Emergency Management Agency (passed through the Nevada Division of Emergency Management): Earthquake Risk Mitigation in Nevada, 10/1/07 to 1/31/09, $88,973, plus $24,287 supplemental funding, dePolo, C.M., Price, J.G., Anderson, J.A., and dePolo, D.

U. S. Fish and Wildlife Service, Ecosystem Flow Recommendation Study, Bill Williams River, AZ, 8/04-8/09, $36,000, House, P.K.

United State Geological Survey, 2008 Gordon Research Conference on Geochemistry of Mineral Deposits, 6/1/08-6/1/09, $10,000, Muntean, J.L., and Gray, N.R.

U.S. Geological Survey, Inventory of geologic data, 7/07-6/08, $5,000, Davis, D.A.

U.S. Geological Survey, IPA Agreement, 7/1/08-9/1/08, $5000, Ramelli, A.R.

U.S. Geological Survey, Mineral Resources External Research Program, Collaborative research on fluid pathways, and metal transport and deposition in Carlin-type gold deposits: insights from the Getchell system, 6/30/06 to 6/30/08, $151,000 (of which $38,672 is to UNR), Cline, J.S., and Muntean, J.L.

U.S. Geological Survey, Mineral Resources Program, Mineral resource assessment of northern Nye County, Nevada, 8/4/09-5/31/11, $388,312, Muntean, J.L., and Henry, C.D.

U.S. Geological Survey, National Earthquake Hazards Reduction Program, Spatial and temporal patterns of fault slip rates on the Genoa fault, 10/31/08-3/31/10, $35,691, Ramelli, A.R., and Bell, J.W.

U.S. Geological Survey, National Earthquake Hazards Reduction Program, Report on the Wells earthquake, 6/08-1/31/09, $100,000, dePolo, C.M., Price, J.G., and Biasi, G.P.

U.S. Geological Survey, National Earthquake Hazards Reduction Program, Estimating uncertainties of seismic hazard parameters for Nevada faults, formation of a Nevada Quaternary Fault Working Group, and gaining consensus fault parameters, 4/06-5/08, $64,811, dePolo, C.M.

U.S. Geological Survey, National Earthquake Hazards Reduction Program, Geodetic Constraints on the Slip Rate of the Mohawk Valley Fault Zone, California, 1/1/08-12/31/09, $64,222, Kreemer, C.W., and Hammond, W.C.

U.S. Geological Survey, National Geological and Geophysical Data Preservation Program, Nevada metadata and catalog, 8/09-7/10, $14,750, Hess, R.H., and Davis, D.A.

U.S. Geological Survey, STATEMAP portion of the National Cooperative Geologic Mapping Program, Geologic

Mapping in Urban and Rural Nevada, 5/01/09 to 4/30/10, $208,268, Price, J.G. (coordinator of proposal with C.D. Henry, G.L. Johnson, and P.K. House); 5/01/08 to 4/30/09, $193,616, Price, J.G. (coordinator of proposal with J.E. Faulds, A.R. Ramelli, P.K. House, J.W. Bell, and J. Hastings); 5/01/07 to 4/30/08, $214,559, Price, J.G. (coordinator of proposal with J.E. Faulds, A.R. Ramelli, C.D. Henry, P.K. House, E.C. Crouse, and G.L. Johnson). Specific projects include:

- GIS Conversion of published geologic maps, 5/07-10/08, $155,514, Hastings, J.T, Crouse, E.C., and Johnson, G.L.
- GIS conversion of published geologic maps, 5/09-10/10, Hastings, J.T., $63,691.
- Geologic mapping in the north half of the Fernley West Quadrangle, 05/07–10/08, $30,592, Faulds, J.E., Ramelli, A.R., and Henry, C.D.
- Geologic mapping of the north half of the Spirit Mountain NW Quadrangle, 5/1/07-8/31/08, $28,453, House, P.K., and Faulds, J.E.
- Geologic mapping in the Grimes Point quadrangle, 5/08-4/09, $43,500, Bell, J.W.
- Geologic mapping of the Reno area, 5/1/09-4/30/10, $94,832, Henry, C.D., House, P.K., dePolo, C.M., and Bell, J.W.
- Geologic mapping of the west half of the Hazen Quadrangle, 1/08-10/31/09, $32,913, Faulds, J.E.
- Geologic mapping in the Cortez Mine area, 5/09-10/10, $24,576, Henry, C.D.
- Geologic mapping of the lower Walker River, south area, 5/08-10/09, $26,286, House, P.K.
- Geologic mapping of the lower Walker River, north area, 5/09-10/10, $25,169, House, P.K.

Washoe County Department of Water Resources, Truckee Meadows geologic compilation and modeling, 4/1/09-12/31/09, $14,612, Henry, C.D., and Hastings, J.T.

PRESENTATIONS, ABSTRACTS, AND WEBSITES

Amelung, F., and Bell, J.W. (2008). InSAR analysis of the 2008 Wells, Nevada earthquake (53rd ed., vol. 89, pp. S51B-1745). Washington, DC: Eos Transactions, American Geophysical Union.

Anderson, J.G., Price, J.G., Taylor, W.J., Smith, K., Anooshehpoor, R., Biasi, G.P., dePolo, C.M., dePolo, D., Kreemer, C., and Louie, J.N., 2008, Seismic hazards in southern Nevada: the gap between the present and a state-of-the-art evaluation: Geological Society of America Abstracts with Programs, v. 40, no. 1, p. 61.

Bar-Sever, Y., Blewitt, G., Gross, R.S., Hammond, W.C. , Hsu, V., Hudnut, K.W. , Khachikyan, R. , Kreemer, C.W., Meyer, R., Plag, H.-P., Simons, M., Sundstrom, J., Song, Y., and Webb, F., (2009). A GPS real time earthquake and tsunami (GREAT) alert system (Invited). Eos Trans. AGU 90(52), Fall Meet. Suppl., Abstract G21A-02.

Bell, J.W., Status of InSAR studies and data acquisition in the Basin and Range, Workshop on seismic hazards of western Nevada, Academic, National Earthquake Hazards Reduction Program, Reno, NV. (April 10, 2009).

Bell, J.W., Capturing earthquakes across Nevada with InSAR, Association of Engineering Geologists Las Vegas Section Monthly Meeting, (March 21, 2009).

Bell, J.W. and Amelung, F., (2009), InSAR analysis of the 2008 M 4.7 Reno-Mogul earthquake: Evidence for co-seismic and post-seismic ground deformation associated with smaller magnitude earthquakes in the Basin and Range (52nd ed., vol. 90, abstract number G23A-0677). Washington, DC: Eos Transactions, American Geophysical Union.

Bell, J.W., Katzenstein, K., Oppliger, G., and Hammond, W.C., (2008), InSAR search for earthquakes across the Sierra Nevada Basin and Range Transition Zone (53rd ed., vol. 89, pp. S23B-1892). Washington, DC: Eos Transactions, American Geophysical Union.

Bell, J.W., and Ramelli, A.R., Active fault controls at high-temperature geothermal sites: Prospecting for new faults, Geothermal Resource Council Annual Meeting, Reno, NV. (October 5, 2009).

Bell, J.W., and Ramelli, A. R., Geohazards of the Lake Tahoe basin and the eastern front of the Sierra Nevada, Association of Environmental and Engineering Geologists Annual Meeting, South Lake Tahoe, CA. (September 22, 2009). Leaders for guided one-day geological field trip for more than 40 paid participants.

Bird, P., Kreemer, C.W., Holt, W.E., A long-term forecast of shallow seismicity based on the global strain rate map, AGU Fall Meeting, San Francisco, CA (December 17, 2009).

Bird, P., Kreemer, C.W. , Holt, W.E., A long-term forecast of shallow seismicity based on the global strain rate map, SCEC Annual Meeting, Palm Springs, CA (September 15, 2009).

Blewitt, G. (2008), Overview of the SNARF Working Group, its activities and accomplishments, presented at the 9th SNARF Working Group Workshop, March 13, 2008, Boulder, CO.

Blewitt, G. (2008), Ambizap Version 2.1, class presented December 14, 2008, at the GIPSY Users Class, San Francisco, CA.

Blewitt, G., Stable North America Reference Frame Working Group, Web site: http://www.unavco.org/research_science/workinggroups_projects/snarf/snarf.html. (Updated with new material from a workshops that I convened and chaired in 2008).

Blewitt, G., Ambizap2, Gd2p_zap, Ambizap3 and carrier range for GIPSY OASIS II, class presented December 13, 2009, at the GIPSY Users Class, San Francisco, CA.

Blewitt, G., Carrier Range: A new GPS data type. Seminar presented at Jet Propulsion Laboratory, Pasadena, California, June 18, 2009.

Blewitt, G., Carrier Range: A new GPS data type. Seminar presented at Istituto Nazionale di Geofisica e Vulcanologia, Rome, Italy, July 7, 2009.

Blewitt, G., GPS and InSAR monitoring of the Mogul swarm: Evidence for mainly aseismic fault creep. Seminar presented at Istituto Nazionale di Geofisica e Vulcanologia, Rome, Italy, July 8, 2009.

Blewitt, G., Global-scale ambiguity resoultion on high-rate precise point positioning using carrier range, presented at the third GREAT workshop, held in Hawaii, August 12, 2009.

Blewitt, G., Unique global network solutions for all geodetic GPS data, presented at the 2009 EarthScope National Meeting, held in Boise, ID, May 12-15, 2009

Blewitt, G., Bell, J.W., Hammond, W.C. , Kreemer, C.W., Plag, H.-P., and dePolo, C.M., GPS and InSAR monitoring of the mogul swarm: Evidence for mainly aseismic fault creep, with implications for seismic hazard, presented at the Brown Bag Seminar Series, UNR, Feb 4, 2009.

Blewitt G., Bertiger, W., and Weiss, J.P., GPS Carrier Range: A new geodetic data type from Ambizap3 for improved high-rate global positioning and seismo-tectonic applications. Presented at the Fall 2009 AGU Meeting.

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Blewitt, G., and Bertiger, W.I., (2009), Carrier Range: A New GPS Data Type for Global Geodynamics (2009), Abstracts of the VII Hotine-Marussi Symposium, held in Rome, July 6-10, 2009.

Blewitt G., Bertiger, W., and Weiss, J.P., (2009), GPS Carrier Range: A new geodetic data type from Ambizap3 for improved high-rate global positioning and seismo-tectonic applications. Eos Trans. AGU 90(52), Fall Meet. Suppl., Abstract G23A-0667.

Blewitt, G., Hammond, W.C., Kreemer, C.W., and Plag, H.-P., GPS geodesy at Yucca Mountain, presented at Great Basin Science Sample and Records Library, August 25, 2009.

Blewitt, G., Hammond, W.C., Kreemer, C.W., and Plag, H.-P., (2009), The 2008 Mogul, Nevada earthquake swarm: Geodetic evidence for largely aseismic afterslip equivalent to ~Mw 5.0, Abstracts of the 2009 EarthScope National Meeting, held in Boise, ID, May 12-15.

Blewitt, G., Kreemer, C.W., Hammond, W.C., and Plag, H.-P., (2008), GPS velocity and strain fields in the Great Basin and California, Eos Trans. *AGU 89*(53), Fall Meet. Suppl., Abstract G21A-0658.

Blewitt, G., Kreemer, C.W., Hammond, W.C., and Plag, H.-P., (2008), Mogul swarm: Preliminary GPS results, presented at NBMG Meeting, April 29, 2008, Reno, NV.

Blewitt, G., Kreemer, C.W., Hammond, W.C., and Plag, H.-P., (2008), GPS monitoring of the Mogul swarm: Evidence for mainly non-seismic fault slip, presented at Nevada Earthquake Safety Council Meeting, August 6, 2008, Reno, NV.

Blewitt, G., Kreemer, C.W., Hammond, W.C. , Plag, H.-P., and dePolo, C.M., (2008), GPS and InSAR monitoring of the Mogul swarm: Evidence for mainly aseismic fault creep, presented at a public information meeting August 2008, at The Joe, UNR, Reno, NV.

Blewitt, G., Kreemer, C.W., Hammond, W.C.,lag, H.-P., Stein, S., Okal, E., Bar-Sever, Y., Gross, R., Hsu, V., Hudnut, K., Simons, M., Song, T., and Webb, F., (2008), Toward real-time GPS for tsunami warning systems and post-earthquake damage assessment and emergency response, invited abstract, presented at the 2008 UNAVCO Science Workshop, March 11-13, 2008, Boulder, CO.

Blewitt, G., Stein, S., Okal, E., Bar-Sever, Y., Gross, R., Song, T., Webb, F., Hsu, V., Hudnut, K., and Simons, M., (2008), Toward real-time GPS for tsunami warning systems and post-earthquake damage assessment and emergency response, abstract in Proc. of the International Symposium on Gravity, Geoid, and Earth Observation, June 23-27, 2008, Chania, Greece.

Boler, F.M., Meertens, C.M., Kreemer, C.W., and Blewitt, G., (2009), Research enabled through eighteen years of geodesy data sharing by the UNAVCO Data Center. Eos Trans. AGU 90(52), Fall Meet. Suppl., Abstract U51C-0023.

Bormann, J.M., Hammond, W.C., Kreemer, C.W., Blewitt, G., and Wesnousky, S.G., (2009), GPS constraints on shear accommodation in the northern Walker Lane, western Nevada, USA. Eos Trans. AGU 90(52), Fall Meeting. Suppl., Abstract G33B-0651.

Bormann, J.M., Kreemer, C.W., Wesnousky, S.G., and Hammond, W.C., Geodetic and geologic constraints on shear accommodation through en-echelon basin development in the Walker Lane, western Nevada, USA, EarthScope National Meeting, NSF EarthScope Program, Boise, ID (May 12, 2009) [Won Best Student Poster Competition].

Brossy, C.C., House, P.K., Ely, LL., Safran, E.B., Champion, D.E., O'Connor, J.E., Bondre, N., and Grant, G.E., (2008), The Role of Late-Cenozoic Lava Flows in the Evolution of the Owyhee River Canyon, Oregon (53rd ed., vol. 89, pp. H53B-1035). EOS Trans, AGU, Fall Meet. Suppl..

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Safran, E.B., Peden, D., Harrity, K., Anderson, S.W., O'Connor, J.E., Wallick, R., House, P.K., and Ely, L.L., (2008). Impact of Landslide Dams on River Profile Evolution (89(53) H54D-03), EOS Trans, AGU, Fall Meet. Suppl.
Sandwell, D., Becker, T.W., Bird, P., Fialko, Y., Freed, A., Holt, W.E., Kreemer, C.W. Loveless, J., Meade, B., McCaffrey, R., Pollitz, F., Konter-Smith, B., and Zeng, Y., Comparison of strain-rate maps of western North America, SCEC Annual Meeting, Palm Springs, CA (September 14, 2009).
Sandwell, D., Bird, P., Freed, A., Kreemer, C.W., Parsons, T., Konter-Smith, B., and Wdowinski, S., Comparison of strain-rate maps of western North America, EarthScope National Meeting, Boise, ID (May 13, 2009).
Scott, B. J. and Plag, H.-P., Final Report, Faculty Senate Task Force on Non-Traditional Faculty, Faculty Senate Meeting, UNR, Reno, NV (June 4, 2009).
Schuh, H., Rothacher, M., Neilan, R., and Plag, H.-P., IAG's Global Geodetic Observing System (GGOS) and its Relation to IAG Commission 3, ETS 2008 New Challenges in Earth's Dynamics, International Association of Geodesy, Jena, Germany (September 1, 2008).
Shevenell, L., The Future of Geothermal Technologies: Conventional Hydrothermal Systems. Presented at the Geothermal Energy Association Project Showcase, Newseum, Washington, DC., May 6, 2009.
Shevenell, L., Perspectives on geothermal in reaction to the "Beyond Coal" video, presented at the Sierra Club monthly meeting, Reno, NV, September 23, 2009.
Shevenell, L., Geothermal data and web applications for the Great Basin, presented at the kick-off meeting of the National Geothermal Data System, Boise, ID, November 2, 2009.

Shevenell, L., Overview of Activities at the Great Basin Center for Geothermal Energy. Presented at the Northwest Mining Association conference, Reno, NV, December 3, 2009.

Shevenell, L., Testified before the Nevada Senate committee on Energy, Infrastructure and Transportation about the Great Basin Center for Geothermal Energy and its geothermal research and educational programs at UNR, and plans for the future and how we can help the state's renewable energy industry. February 5, 2009.

Shevenell, L., Geothermal Energy, Introduction to Renewable Energy Sources, Guest lecturer for ENGR 110/PSC110, UNR, November 3, 2009.

Shevenell, L., Alternative Energy, Guest lecturer for the ChE 301, October 29, 2009.

Shevenell, L., Overview of Geothermal Research at the Great Basin Center for Geothermal Energy, presented at Enel North America, Reno, NV, August 20, 2008.

Shevenell, L., Highlighting Geothermal Energy in Nevada, presented at the Sierra Club monthly meeting, Reno, NV, September 11, 2008.

Shevenell, L., Resource Exploration, Assessment and Research, at the Resources Assessment and Research Panel held by Geothermal Energy Association in the 2008 Geothermal Issues and Outlook Workshop, Geothermal Resources Council pre-meeting workshop, Reno, NV, October 4, 2008.

Shevenell, L., Opening Remarks and Welcome, Geothermal Resources Council Annual Meeting, Reno, NV, October 6, 2008 (800 in audience).

Shevenell, L., Nevada Geothermal Resource Identification, Colorado Geothermal Working Group - Nevada Trade Mission, Reno, NV, October 22, 2008.

Shevenell, L., Geothermal Resources, Power Production and Use, with emphasis on Nevada. Presented to the Northern Nevada Alternative Energy (NNAE) group (part of the Pickens Plan movement), Reno, NV, December 10, 2008. (presentation prepared but date postponed to early 2009)

Shevenell, L., with Bell, Blewitt, Coolbaugh, Faulds, Hammond, Kreemer, Lechler, Louie, Oppliger, Penfield, Plag, and Zehner, Geothermal research at the Great Basin Center for Geothermal Energy. Geothermal Resources Council Annual meeting, Reno, NV, October 4 - October 7, 2009 (poster).

Shevenell, L., with Bell, Blewitt, Coolbaugh, Faulds, Hammond, Kreemer, Lechler, Louie, Oppliger, Penfield, Plag, and Zehner, Geothermal research at the Great Basin Center for Geothermal Energy, Geothermal Resources Council Annual meeting, Reno, NV, October 3 - October 8, 2008 (poster).

Shevenell, L., with Coolbaugh, Sladek, Zehner, Kratt, Faulds, and Penfield, Our Evolving Knowledge of Nevada's Geothermal Resource Potential, Geothermal Resources Council Annual meeting, Reno, NV, October 3 - October 8, 2008.

Shevenell, L., with Coolbaugh, Sladek, Zehner, Kratt, and Morris, Our Evolving Knowledge of Nevada's Geothermal Resource Potential, Geothermal Energy Association's Geothermal Development and Finance Workshop conference, Las Vegas, NV, January 16, 2008 (Co-authors:).

Smith, J.A., Hausback, B.P., Henry, C.D., Noble, D.C., and Hilton, R.P., 2009, The Soldier Meadow Tuff of the High Rock Caldera, Northwestern Nevada, Geological Society of America Abstracts with Programs, 41 7: 140.

Song, Y.T. and G. Blewitt, Real-time GPS detection of tsunamis and requirements, abstract in Proc. of the IGS Analysis Center Workshop 2008, held June 2-6, 2008, in Miami Beach, FL.

Starkel, W.A., Wolff, J.A., Henry, C.D., and Castor, S.B., 2009, Geologic evolution and initial constraints on the petrogenesis of the McDermitt volcanic center, northern NV and southern OR, Geological Society of America Abstracts with Programs, 41 7: 369.

Sturmer, D.M., Price, J.G., and Tempel, R.N., 2008, Maximizing carbon sequestration by modeling rock-CO_2(g) reaction with basalts of varying composition from Nevada: Geological Society of America Abstracts with Programs, v. 40, no. 6, p. 361.

Sturmer, D.M., Price, J.G., and Tempel, R.N., 2009, Maximizing carbon sequestration and minimizing product volume by modeling rock-CO_2(g) reaction with mafic rocks in Nevada: Geological Society of Nevada Newsletter, v. 24, no. 2, p. 3.

Sylvester, A.G., Raines, G.L., Hastings, J.T., and Henry, C.D., 2008, New geologic map of the Sagehen Creek and Independence Lake hydrologic basins, northeastern Sierra Nevada, California, Geological Society of America Abstracts with Programs, 40 1: 54.

Torres, R., Zaliapin, I., Kreemer, C.W., Pancha, A., and Anderson, J.G., Statistics and correlations of seismic and tectonic moment rate in California and the Great Basin, SSA Annual Meeting, Seismological Society of America, Monterrey, CA (April 2009).

Torres, R., Zaliapin, I., Kreemer, C.W., Pancha, A., and Anderson, J.G., Statistics and correlations of seismic and tectonic moment rate in California and the Great Basin, AGU Fall Meeting, American Geophysical Union, San Francisco, CA (December 17, 2008).

Wesnousky, S.G., Bormann, J., Kreemer, C.W., and Hammond, W.C., Neotectonic and geodetic observations bearing

on the structural development of the Walker Lane, western Nevada, Fall Meeting, American Geophysical Union, San Francisco, CA. (December 15, 2008).

Wesnousky, S.G., Bormann, J., Kreemer, C.W., and Hammond, W.C., Structural development of the Walker Lane: Neotectonics and geodesy, Annual Meeting, Geological Society of America, Houston, TX. (October 5, 2008).

Wesnousky, S.G., Bormann, J., Kreemer, C.W., Hammond, W.C., and Brune, J.N., Problems in integrating neotectonics and geodesy to assess seismic hazard in the northern Walker Lane, Annual Meeting, Seismological Society of America, Monterey, CA. (April 8, 2009).

Zaliapin, I., Kreemer, C.W., Transient detection: A multiscale trend analysis approach", (Contributed Talk), Southern California Earthquake Center Workshop on Transient Anomalous Strain Detection: Blind Test Results and Future Planning, SCEC (December 13, 2009).

Zaliapin, I., Kreemer, C.W., Anderson, J.G., and Pancha, A., Modeling seismic moment release: Toward resolving the seismic moment deficit paradox, SCEC Annual Meeting, Palm Springs, CA.. (September 15, 2009).

Zaliapin, I., R. Torres, R., Kreemer, C.W., Pancha, A., and Anderson, J.G., Modeling seismic moment release: A step toward resolving the seismic moment deficit paradox, 6th International Workshop on Statistical Seismology, Lake Tahoe, CA (April 2009).

Zhou, X. and Kreemer, C.W., Are the plates still rigid?: A case study of GPS time-series noise in Australia, AGU Fall Meeting, San Francisco, CA (December 16, 2009).

Zhou, X. and Kreemer, C.W., Statistical analysis of GPS velocities in western U.S. and Asia: Block-like or continuum deformation?, EarthScope National Meeting, Boise, ID (May 2009).

HONORS AND AWARDS

dePolo, C.M.

Award of Excellence from Nevada Earthquake Safety Council (2009) (“recognized for leadership on earthquake response after the 2008 Wells Earthquake and earthquake risk reduction in Nevada”)

Mauldin, J.M.

Second Place Award, “Artographic” Category, Nevada State Geographic Information Society Conference, 2009 (“for cartography and layout of *Quaternary Faults in Nevada*”)

Price, J.G.

Ian Campbell Medal for Superlative Service to the Geosciences, American Geological Institute, 2009 (“for his exceptional commitment, service, and dedication to the geological profession”)

Shevenell, L.

Appointed by State Assembly Speaker Barbara Buckley to serve on the Nevada Renewable Energy Task Force, 2008.

Elected to serve on the Geothermal Resources Council (GRC) Board of Directors and its Executive Committee, 2008.

Invited by Senator Harry Reid to be a member of a Blue Ribbon Panel focusing on the steps Nevada needs to take to realize a clean energy future and its full potential as a net exporter of renewable energy, 2008.

OTHER PROFESSIONAL ACTIVITIES

NBMG scientists are active professionally at local, state, regional, national, and international levels. Many frequently serve as peer reviewers of manuscripts published in refereed journals, of proposals submitted to funding agencies, and of tenure and promotion applications at other universities. NBMG employees also serve on numerous committees and assignments within the University of Nevada, Reno, College of Science, Mackay School of Earth Sciences and Engineering, and NBMG. The latter tasks include review of NBMG publications by other authors. Many NBMG staff members frequently respond to inquiries from consulting geologists, industry geologists, civil engineers, local governments, state agencies, federal agencies, and the general public about Nevada geology. Below is a partial list of additional professional service provided by NBMG staff.

Bell, J.W.

Member, Steering Committee for Las Vegas Fissure Preserve, Association of Engineering Geologists, 2008-09.
UNR institutional representative for the Western North America InSAR (WInSAR) Consortium, overseeing the acquisition of free radar data for all UNR InSAR research provided by funding from NSF and NASA, 2008-09.
Peer reviewer of manuscripts for federal and state geological surveys, international journals (5 in 2008, 5 in 2009)
Peer reviewer of proposals for federal agencies (3 in 2009).

Blewitt, G.

Chair, UNAVCO Inc. Membership Committee (reviewing applications for membership to the UNAVCO scientific community-based organization, and providing recommendations to the Directors of UNAVCO Inc.), 2006-07.
Chair, NSF EarthScope Stable North America Reference Frame Working Group (developing a new geodetic reference frame for scientific and legal purposes in North America (USA and Canada) in collaboration with NSF EarthScope and national survey agencies, NGS and NRCan, and the International Association of Geodesy), 2004-08.
Workshop Organizer, NSF EarthScope workshops on research and development of reference frames for the NSF EarthScope Plate Boundary Observatory, 2004-08.
Member, National Research Council Committee on "National Requirements for Precision Geodetic Infrastructure," 2008-09.
Member, American Geophysical Union Fellows Committee, 2006 – Present.
Member, American Geophysical Union Geodesy Awards Committee, 2006 – Present.
Member, Executive Committee, Board of Directors, International GNSS Service (providing direction and oversight to the IGS collaborative organization as a whole), 2007-2011 (member of Board of Directors, 2003-2011).
Member, International Association of Geodesy Inter-Commission Working Group on "Concepts and Terminology Related to Geodetic Reference Systems," 2007–2010.
Advisor, USGS (Menlo Park) on reference frame realization for their GPS operations in the western US, and on use of my "Ambizap" software. Hosted working visits to UNR of Jerry Schwartz and Jessica Murray.
Peer reviewer of manuscripts for international journals (5 in 2008).
Chair, Search Committee for Director of the Nevada Seismological Laboratory and Professor of Geological Sciences, 2008-2009.
Chair, College of Science Personnel Committee, 2008-2011.
Member, Promotion and Tenure Committee, College of Science, University of Nevada, Reno, 2006-07.

dePolo, C.M.

Co-Chair, Research Committee, Nevada Earthquake Safety Council (presenting regular updates on earthquake research at the quarterly meetings of the Council) 2008-09.
Member, Basin and Range Province Committee, Western States Seismic Policy Council (reviewing policy statements and helping to set the committee's agenda, including a future rural earthquake disaster summit), 2008-09.
Conference Session Organizer, Earthquake Hazard of the Sierra Nevada Range, Annual Meeting of the Association of Environmental and Engineering Geologists, South Lake Tahoe, 2009.
Deployed by the Nevada Division of Emergency Management in response to the 21 February 2008 magnitude 6.0 Wells, Nevada earthquake.
Assisted with press conferences held by NBMG, UNR, the Governor, and the City of Wells regarding recent earthquakes and emergency response.
Guest Speaker, National Geographic Channel, (2009). "Naked Science" special program on the 2008 Mogul seismic swarm (with other NBMG and Seismo lab personnel).
Peer reviewer of manuscripts for federal and state geological surveys, international journals (1 in 2008).

Faulds, J.E.,

Chair, Scholarship Committee, Nevada Petroleum Society, 2009.

Member, College of Science Bylaws Committee, 2009.
Organizer, European Session on Geothermal Energy, annual meeting, Geothermal Resources Council, 2009.
Chair, Session on Geothermal Exploration, annual meeting, Geothermal Resources Council, 2009.
Field Trip Leader, Structural controls of geothermal systems in the western Great Basin, Geothermal Resources Council, 2009.
Assistant to Pyramid Lake Paiute Tribe on evaluating geothermal resources.
Editor for Engine (European Geothermal Consortium), English editing of ENGINE Best Practice Handbook, Chapter 1, 2008.
Field Trip Leader, Boundary between the Colorado Plateau and Basin and Range province at the mouth of the Grand Canyon, Geological Society of America, 2008.
Field Trip Leader, Geothermal fields in western Nevada, HandsOn Ventures, LLC, September 18, 2008.
Field Trip Leader, Structural controls of the Desert Peak geothermal field for evaluation of an enhanced geothermal system project, Ormat Geothermal Company, November 19, 2008.
Peer reviewer of abstracts for the annual meeting of the Geothermal Resources Council, 2009 (20 in 2009).
Peer reviewer of manuscripts for federal and state geological surveys, international journals (2 in 2008, 8 in 2009).
Peer reviewer of proposals for federal agencies (4 in 2008, 4 in 2009).

Garside, T.M.

Secretary, Nevada Hazard Mitigation Planning Committee, 2003-present.
Treasurer, Geological Society of Nevada 2010 Symposium, 2007-2009.
Executive Assistant, Nevada Earthquake Safety Council, 1997-present.
Field Trip Logistics Coordinator, GSA field trip in southern Nevada, 2008.
Field Trip Logistics Coordinator, Nevada Petroleum Society, 2008.
Field Trip Logistics Coordinator, Geothermal Resource Council geothermal field trip, 2009.
Field Trip Logistics Coordinator, Owyhee River research group, May 2009.
Workshop Logistics Coordinator, IGCP 565 San Francisco, CA, December 2008 and 2009.
Organizer, FEMA ATC-20 workshops held in southern and northern Nevada, 2008.
Organizer, FEMA ATC Course on Mitigating Non-Structural Hazards for Hospitals held in southern and northern Nevada, 2008.
Co-Organizer with P.K. House, GSA Pardee Session, Portland, Oregon, October 18, 2009.
Co-Organizer, GSA Pardee Session Volcanoes to Vineyards: Geologists and wine, October 18, 2009.
Peer Reviewer for FEMA's Pre-Disaster Mitigation Grant Review Panel, 2009.

Hammond, W.C.

Chair, EarthScope Plate Boundary Observatory Advisory Committee, 2007-08.
Workshop Program Organizer, Geodetic and Geologic Datasets in the Northern Walker Lane, Organized, with Rich Briggs (USGS) joint USGS/NBMG workshop held at UNR on geodetic and geologic data sets in the Northern Walker Lane.
Conference Chair, American Geophysical Union - Geodesy Section, AGU Joint Assembly Program Committee - Geodesy Section for 2009 meeting in Toronto Canada, and the 2008 meeting in Ft. Lauderdale, FL.
Conference Session Chair, American Geophysical Union - Geodesy Section, organized G12A "Crustal deformation in plate boundary zones: EarthScope and beyond, AGU Joint Assembly, Toronto, Canada, May 24-27, 2009.
Guest Speaker, National Geographic Channel, (2009). Gave extensive TV interviews for inclusion in National Geographic Channel program "Naked Science" special on the 2008 Mogul seismic swarm (with other NBMG and Seismological Laboratory personnel).
Conference Session Chair, American Geophysical Union - Geodesy Section, organized session on "Geodetic Measurement of the Seismic Cycle and Dynamics of the Lithosphere" at AGU Joint Assembly in Ft. Lauderdale, 2008.
Taught UNR graduate-level course in tectonic geodesy, 2009.
Peer reviewer of manuscripts for international journals (7 in 2008, 6 in 2009).
Peer reviewer of proposals for federal agencies (3 in 2008, 4 in 2009).

Hastings, J.T.

Vice President, Nevada Board on Geographic Names, 2008-09.

Henry, C.D.

Member, Editorial Board, Revista Mexicana de Ciencias Geologicas, the publication of all geologic branches of Universidad Nacional Autonoma de Mexico (edited 4 papers in 2009).
Field Trip Co-Leader, Geological Society of Nevada, 2009.
Conference Session Chair, Cenozoic magmatism and metallogeny of the Great Basin, for Geological Society of Nevada Symposium 2010.
Peer reviewer of manuscripts for federal and state geological surveys, international journals (5 in 2008, 5 in 2009).
Peer reviewer of proposals for federal agencies (2 in 2008).

Hess, R.H.

Executive Secretary, State Mapping Advisory Committee, 2008-09.
Nevada Representative, National States Geographic Information Council, 2008-09.
Nevada Representative, Geographic Information System Council, Western Governors' Association, 2008-09.

Hinz, N.H.

Field Trip Co-Leader, Structural controls of geothermal systems in the western Great Basin, Geothermal Resources Council, 2009.
Field Trip Co-Leader, University of Nevada, Reno Mackay Rockhounds (undergraduate geology club) field trip to Lassen National Park, 2008.
Peer reviewer of manuscripts for federal and state geological surveys, international journals (1 in 2009).

House, P.K.

Vice Chair, Quaternary Geology and Geomorphology Division, Geological Society of America, 2008-09.
Member, Steering Committee for the Geoscience Information Network, 2009.
Representative for the Geological Society of America on the Selection Committee for the John C. Frye Memorial Award in Environmental Geology, presented by the Geological Society of America and the Association of American State Geologists, 2008-09.
Conference Session Chair, Keynote session at the Geological Society of America annual meeting, 2009.
Conference Session Chair, Technical session at the Geological Society of America annual meeting, 2009.
Guest speaker, High Desert Montessori School, Reno, 2008.
Visiting Scientist, University of New Mexico, Department of Earth and Planetary Sciences (2-week field trip along the Colorado River in 2008).
Co-taught UNR capstone undergraduate course, summer field course, 2009.
Peer reviewer of manuscripts for federal and state geological surveys, international journals (5 in 2008, 3 in 2009).
Peer reviewer of proposals for federal agencies (3 in 2008).

Hursh, J.P.

Executive Secretary, Nevada Board on Geographic Names, 2008-09.

Johnson, G.L.

Treasurer, Nevada Geographic Information Society, 2008-09.
Treasurer, Nevada Geographic Information Foundation, 2009.
Instructor, UNR Geography Department (2 undergraduate courses in 2008).

Kreemer, C.W.

Organizer, Seminars on topics concerning Great Basin tectonics, UNR, Nevada Bureau of Mines and Geology, 2006-09.
Member, UNAVCO Facility Advisory Committee, 2009-11.
Member, EarthScope Crustal Strain and Deformation Working Group, 2008-11.

Member, Regional Dense Velocity Fields Working Group, International Association of Geodesy, 2008-11.
Guest Speaker, National Geographic Channel, (2009). "Naked Science" special program on the 2008 Mogul seismic swarm (with other NBMG and Seismo lab personnel).
Speaker, St. Willibrordus Elementary School, The Netherlands, 2009.
Member, PBO Data Working Group, National Science Foundation, 2007-09.
Peer reviewer of manuscripts for international journals (7 in 2009).
Peer reviewer of proposals for federal agencies (3 in 2009).

LaPointe, D.D.

Editor and peer reviewer of manuscripts for federal and state geological surveys, international journals (4 NBMG publications in 2008, 8 in 2009).
Peer reviewer of manuscripts for Nevada Press (1 in 2008).
Presenter, two sessions on soil science, Clark County Math-Science T3 conference, a K-12 teacher in-service workshop, Spring Valley High School, Las Vegas, February 8-9, 2008.
Coordinator and presenter, six sessions at the annual southern Nevada three-day K-12 teacher workshop sponsored by the Nevada Mining Association and Nevada Division of Minerals in Las Vegas in March 2008.
Field Trip Co-Leader, two field trips to mines and geological sites associated with this workshop (Valley of Fire, Death Valley), Nevada Mining Association and Nevada Division of Minerals in Las Vegas, March 2008.
Instructor, Nevada Earth / Space Science Initiative (NESSI) workshop and field trips, Reno, Lassen Volcanic National Park, Winnemucca, and Phoenix Mine, June 8 –June 28, August 26, and September 9, 2008.
Coordinator and presenter, six sessions at the annual northern Nevada three-day K-12 teacher workshop sponsored by the Nevada Mining Association and Nevada Division of Minerals, Tonopah, July 19-24, 2008.
Field Trip Co-Leader, two field trips to mines and geological sites associated with this workshop (Round Mountain Gold Mine, Foote Lithium Minerals plant, Clayton Valley, Monte Cristo Range), July 2008.
Field Trip Leader, Earth Science Week, October 19 & 20, 2008 (two one-day trips for the general public).
Field Trip Coordinator and Participant, National EarthScope Educational Outreach Interpretive Workshop for the Basin and Range Province held at University of Nevada, Reno, October 19-22, 2008.
Field Trip Co-Leader, Geothermal Energy 2008 Conference, Peppermill Hotel, Reno, Nevada, October 4-8, 2008.
Coordinator, EarthCache and GeoCache sites maintained by NBMG, 2008-09.
Informational resource for field trips, University of Nevada, Reno Mackay Rockhounds (geology club), 2008-09.
Presenter, Science Fairs, Westergard and Elizabeth Lenz Elementary Schools.
Tour Guide, Mackay School of Earth Sciences and Engineering, University of Nevada, Reno, 2008-09.
Member, Education Committee, Nevada Mining Association.
Coordinator, Earth Science Field Trip Grant Program, Geological Society of Nevada (providing more than $6,000 in grants in 2008 to Nevada K-12 teachers for transportation on Earth science-related field trips).
Director, Geological Society of Nevada Foundation, 2008-09.
Secretary, and Member of the Board of Directors, Geological Society of Nevada, 2008.
Organizer, NBMG booth at Reno Gem and Mineral Society Jackpot of Gems Mineral Show, May 5-11, 2008.
Collaborator, W. M. Keck Museum (week-long Mackay Centennial Celebration in May, 2008).
Chair, Scholarship Committee, Mackay School of Earth Sciences and Engineering, UNR, 2008.
Chair, Scholarship-Loan Committee, NV-Reno Section of the Women's Auxiliary of the American Institute of Mining, Metallurgical, and Petroleum Engineers, 2008-09.
Co-Organizer, Geological Society of Nevada Foundation fundraising events, Rock Raffle and Silent Auction, which raise funds for the Foundation's educational projects and its Earth Science Field Trip Grant Program.

Lechler, P.J.,

Chair, Space Recommendation Committee, Mackay School of Earth Science and Engineering, UNR, 2008-09.
Chair, Analytical Equipment Committee, Mackay School of Earth Science and Engineering, UNR, 2008-09.
Participant, Project on Sustainable use of Platinum Group Elements in the 21st Century, International Geological Correlation Program.
Member, Abandoned Mine Lands Task Force, U.S. Bureau of Land Management, 2006-07.
Adjunct Professor, Western Carolina University, 2006-07.

Mauldin, J.M.

Member, Web Subcommittee, Nevada Geographic Information Society.
Instructor, Western Nevada College, Graphic Communications (2 courses in 2009).

Muntean, J.L.

Associate Editor of the journal *Economic Geology*, 2008-09 (reviewed and edited 5 manuscripts in 2008, 5 in 2009).
Councilor, Society of Economic Geologists, 2008.
Chair, Medal Committee, Society of Economic Geologists, 2008.
Mentor, Society of Economic Geologists on-line mentoring program, 2008-09.
Advisor, UNR Student Chapter, Society of Economic Geologists, 2008-09.
Chair, 2012 Gordon Research Conference on Geochemistry of Ore Deposits, 2008-09.
Vice Chair, 2008 Gordon Research Conference on Geochemistry of Ore Deposits, 2008.
Participated in filming and production of "America's Gold," and episode for the History Channel's "How the Earth was Made" television series, 2009.

Plag, H.-P.

Co-Editor-in-Chief, Physics and Chemistry of the Earth, 2008-09.
Member, Editorial Board, Journal of Geodynamics, 2008-09.
Co-Convener, "Severe Storms and Sea Level Rise: A challenge to Science and Society" (Sessions NH11A, NH13B), "The Global Geodetic Observing System: Scientific Requirements and Applications" (Sessions G23C, G33E), "Science and Technology in GEO and GEOSS" (Sessions U43B, U51B), "Extreme Natural Hazards: Risk Assessments, Forecasting, and Decision Support" (Sessions NH43A, NH52A, NH51D), all at AGU Fall Meeting, December 2009, San Francisco, CA.
Co-Chair, GEO Geohazards Community of Practice, 2009.
Member, GGOS ad hoc Working Group on an ITRS ISO Standard, 2008-09.
Chair, Program Committee for Annual Workshops of the IGCP 565 Project, 2008-09.
Co-Convener, "The Global Geodetic Observing System: Science and Applications", Session at the IAG Assembly, August 31-September 4, 2009, Buenos Aires, Argentina.
Co-Convener, "The Global Geodetic Observing System: Ground and Space-based Infrastructure for Earth Science", Session G8, EGU General Assembly, April 2009, Vienna, Austria.
Workshop Organizer, Coastal Zone Community of Practice WS Steering Committee, 2008-09.
Co-Chair, GEO Coastal Zone Community of Practice, 2008-09.
Member of the Science Advisory Group for the Delta Commission of the Dutch Parliament on future sea level changes, 2008-09.
Project Leader of the IGCP 565 Project, 2008-09.
Member, GEO Architecture and Data Committee, 2008-09.
Member, GEO Science and Technology Committee, 2008-09.
Chair, GEO Work Plan Task AR-07-03, 2008-09.
Member, IAG's Inter-Commission Working Group 2 "Concepts and terminology related to Geodetic Reference Systems," 2008-09.
Chair, Working Group on GEO Relations, International Association of Geodesy, Global Geodetic Observing System, 2008-09.
Member, GEO User Interface Committee, 2008-09.
Member, Geological Applications of Remote Sensing (GARS) and IGOS-P Geohazards Joint Steering Committee, 2008-09.
Vice-Chair, Steering Committee, International Association of Geodesy, Global Geodetic Observing System, 2008-09.
Co-Convener, "Global Geodetic Observing System: Science and Instrumentation", Sessions G31C and G33A, AGU Fall Meeting, December 2008, San Francisco. CA.
Co-Convener, "Earth observation and the Global Geodetic Observing System (GGOS)", Session at the IAG Symposium "Gravity, Geoid and Earth Observation GGEO 2008", June 23-27, 2008, Chania, Crete, Greece.
Panel member, "Climate Change and Transportation Panel", Water Canada, May 14, 2008.
Co-Convener, "GGOS: Observing and Interpreting Earth's Mass Transports", Session G12, EGU General Assembly, April 2008, Vienna, Austria.
Peer reviewer of manuscripts for international journals (15 in 2008, 12 in 2009).

Peer reviewer of proposals for federal agencies (4 in 2008, 3 in 2009).

Price, J.G.

Treasurer, Chair of the Finance Committee, and Member of the Executive, Investment, Audit, and Programmatic Overview Committees, Geological Society of America, 2009-present.
Secretary, Nevada Earthquake Safety Council, 1995-present.
Chair, State Hazard Mitigation Planning Committee, State of Nevada, Division of Emergency Management, 2003-present.
Representative from the Society for Mining, Metallurgy, and Exploration to the American Geological Institute, 2008-present.
Member, Action Committee, Mining and Metallurgical Society of America, 2009-2010.
Program Chair, Symposium on Minerals for a Green Society, Mining and Metallurgical Society of America (February 4, 2010, Washington, DC), 2009-2010.
Judge for the U.S. Bureau of Land Management's Reclamation and Sustainable Mineral Development Awards, 2007-present.
Chair, Nevada Section of the Mining and Metallurgical Society of America, 2008-2010.
Co-Chair, Critical Elements for New Energy Technologies Study Committee, Panel on Public Affairs, American Physical Society, 2009-2010.
Member, Plan Subcommittee, State Hazard Mitigation Planning Committee, 2003-present.
Chair, State Mapping Advisory Committee, 1995-present.
Administrator, Mining Cooperative Fund, State of Nevada, 1988-1993, 1995-present.
Chair, Honorary Members Committee, Association of American State Geologists, 2006-present.
Chair, Mineral Resources Committee, Association of American State Geologists, 2008-present.
Member, Hazards Committee, Association of American State Geologists, 2006-present.
Member, Annual Program Committee, Geological Society of America, 2005-2009.
Chair, Intermountain West Regional Advisory Committee for the Advanced National Seismic System, 2008-2009.
Field Trip Co-Leader, Earth Science Week, October 10 & 11, 2009.
Substitute for the Administrator of the Nevada Division of Minerals on the Corporate Guarantee Panel, Nevada Division of Environmental Protection, Carson City, May 5, 2009.
Instructor and Field Trip Co-Leader, Nevada Mining Association Teachers' Workshops, Las Vegas, April 5-9, 2009.
Instructor and Field Trip Co-Leader, Nevada Mining Association Teachers' Workshops, Reno, July 13-16, 2009.
Special Awards Judge (for the American Geological Institute), Intel International Science and Engineering Fair, Reno, May 12-13, 2009.
Reviewer, Institute of Medicine-National Research Council report on "Evaluating Occupational Health and Safety Research Programs: Framework and next Steps."
President, Association of American State Geologists Foundation, 2007-2008.
Past-President, Nevada Petroleum Society, 2007-2008.
Secretary-Treasurer, Society for Mining, Metallurgy, and Exploration (SME) Foundation, 2004-2008; Trustee, 2001-2008.
Councilor, Geological Society of America, 2004-2008.
Chair, Audit Committee, Geological Society of America, 2007-2008; Member, 2005-2008.
Chair, Panel on Energy and Mineral Resources Position Statement, Geology and Public Policy Committee, Geological Society of America, 2006-2008.
Member, Working Group on Fugitive Mercury from Mining Operations, Nevada Division of Environmental Protection, 2007-08.
Member, Review Panel, U.S. Bureau of Land Management Reclamation and Sustainable Mineral Development Awards Program, 2007-2008.
Field Trip Co-Leader, Earth Science Week, October 18 & 19, 2008.
Co-taught UNR graduate-level course in ore petrology, 2008.
Interviewed by Reno and Las Vegas media on earthquake hazards in Nevada (November 3 and 4, 2009) and by Jack Bowe for local TV show on radon in Nevada.
Interviewed by John Seelmeyer, Nevada Business Weekly, for article on CO_2 (January 31, 2008).
Interviewed on Living with Earth, through KUNR public radio, regarding gold in Nevada (February 11, 2008).
Interviewed by local TV stations during a press conference organized by the Nevada Seismological Laboratory, regarding earthquakes in Nevada (March 2008).
Interviewed by local TV stations during a press conference organized by Governor Jim Gibbons, regarding

earthquakes in Nevada (April 29, 2008).
Interviewed by CNN regarding earthquakes in Nevada (April 30, 2008).
Interviewed by the Los Angeles Times regarding earthquakes in Nevada (April 30, 2008).
Interviewed by local TV Channel 8 regarding earthquakes in Nevada (April 30, 2008).
Interviewed by Winnemucca, Nevada radio station regarding earthquakes in Nevada (May 12, 2008).
Interviewed by local TV stations and print media during a press conference with Governor Jim Gibbons, regarding the Vigilant Guard earthquake response and recovery exercise (June 12, 2008).

Ramelli, A.R.

Peer reviewer of manuscripts for federal and state geological surveys, international journals (1 in 2008, 3 in 2009).
Technical reviewer, fault trenches (4 in 2009).

Shevenell, L.

Director, Great Basin Center for Geothermal Energy, 2008-09.
Member, Board of Directors, Executive Committee, 2008 Annual Meeting Planning Committee, and Public Outreach Committee of the Geothermal Resources Council.
Member, Nevada Geothermal Technical Advisory Panel to NV Energy, 2008.
Member, Nevada Renewable Energy Task Force, 2008.
General Program Chair for the 2008 Annual Geothermal Resources Council Meeting held in Reno, NV, September 30-October 3, 2008.
Member, Geothermal Energy Association Technical Advisory Committee, 2008.
Member, Senator Harry Reid's Blue Ribbon Panel on Renewable Energy, 2008.
Panelist on the "State of Nevada" program by Brian Bahouth, KUNR, about the future for alternative power generation in Nevada, February 15, 2008; http://www.knpr.org/son/archive/detail.cfm?ProgramID=1268.
Guest on the Corey Farley show (1270 The Buzz) discussing the role of faults and earthquakes in geothermal systems and the role geothermal will play in America's energy future, June 16, 2008.
Interviewed by James Yearling at High Country News about geothermal development in Nevada, January 31, 2008. http://www.hcn.org/issues/364/17517
Interviewed by Erik Stabile of Reno News and Review for an article his was writing on geothermal in Nevada, April 2, 2008 (cover story published April 17, 2008).
Interviewed by Karen Broyles, Senior News Editor at ODS Petradata, a Houston based offshore energy company who have a web-based Energy Currents newsletter, April 24, 2008 (kboman@ods-petrodata.com). http://www.energycurrent.com/index.php?id=3&storyid=10318
Interviewed by Kent Garber, US News & World Report concerning the fact that geothermal was left off the list of renewables in both McCain & Obama's energy plans.
Interviewed by Julian Smith, New Scientist Magazine, August 4, 2008. Interviewed by Paul Tolme who was preparing an article on geothermal energy for climate.edu (a National Wildlife Federation publication, August 22, 2008. (ptolme@aol.com)
Interviewed by Don Cox who is writing magazine articles on behalf of the Nevada Commission on Economic Development, September 23, 2008 (355-8436).
Interviewed by Tom Hinkinius of KTVN TV 2 about geothermal in general and the Annual Geothermal Resources Council meeting, Reno, NV, October 6, 2008.
Interviewed by KRNV TV 4 about geothermal in general and the Annual Geothermal Resources Council meeting, Reno, NV, October 6, 2008.
Interviewed by Marla Dickerson of the LA Times on the annual GRC meeting and geothermal in Nevada, Reno, NV, October 7, 2008. http://www.latimes.com/business/la-fi-geothermal3-2008nov03,0,3620633.story
Interviewed by Geralda Miller of the Reno Gazette Journal on the hot springs in Nevada and soaking. October 21, 2008.
Interviewed by Scott Sonner, Associated Press regarding geothermal resources and the Annual Geothermal Resources Council meeting, October 7, 2008.
Peer reviewer of manuscripts for federal and state geological surveys, international journals (6 in 2008, 15 in 2009).
Peer reviewer of proposals for federal agencies (12 in 2009).

APPENDIX B

STATUTORY MANDATES OF THE NEVADA BUREAU OF MINES AND GEOLOGY

Nevada Revised Statutes related to the Nevada Bureau of Mines and Geology

CHAPTER 514 - BUREAU OF MINES AND GEOLOGY

NRS 514.002 Definitions. As used in this chapter, unless the context otherwise requires, the words and terms defined in NRS 514.005 and 514.007 have the meanings ascribed to them in those sections.
(Added to NRS by 1997, 2977)

NRS 514.005 "Professional geologist" defined. "Professional geologist" means a person who:
1. Possesses a baccalaureate or higher degree from an accredited college or university with at least 30 semester hours or 45 quarter hours of course work in the science of geology and has at least 5 years of experience in the science of geology, which may include no more than 2 years of postgraduate course work in the science of geology;
2. Has at least 12 years of experience in the science of geology, at least 3 years of which must have been completed under the supervision of a professional geologist; or
3. Is currently licensed or certified as a professional geologist:
(a) In another state; or
(b) By a national nonprofit geological organization with members in at least 10 states who are licensed or certified, if the requirements for his current licensure or certification included requirements at least equal to those set forth in either subsection 1 or 2.
(Added to NRS by 1997, 2978)

NRS 514.007 "Science of geology" defined. "Science of geology" means the:
1. General study of the earth, including its origin, processes and history;
2. Collection and investigation of specimens of the constituent rocks, minerals, fossils, solids, mineralizing fluids, gasses and other materials of the earth that are located from the center of the core of the earth to the surface of the earth; and
3. Application of the knowledge set forth in subsections 1 and 2 for the benefit of the general public and the general welfare of this state.
(Added to NRS by 1997, 2978)

NRS 514.010 Establishment. There is hereby established a Bureau of Mines and Geology of the State of Nevada which shall be in the Public Service Division of the Nevada System of Higher Education.
[Part 1:127:1935; 1931 NCL § 4311.01]-(NRS A 1971, 368; 1993, 411)

NRS 514.020 Compensation and expenses of Board of Regents. Members of the Board of Regents shall serve without compensation, but shall be reimbursed for the actual expenses incurred in the performance of their official duties.
[Part 1:127:1935; 1931 NCL § 4311.01]

NRS 514.030 Employment and compensation of Director and other employees.
1. The Board of Regents of the University of Nevada shall appoint as Director a competent scientist or engineer, to be known as the Director of the Bureau of Mines and Geology, who must be a:
(a) Graduate of a recognized college or university with a degree in some branch of earth science or mineral engineering; and
(b) Professional geologist with expertise in the science of geology.
2. Upon the Director's nomination, the Board of Regents of the University of Nevada shall employ such assistants and employees as the Board deems necessary.
3. The Board of Regents of the University of Nevada may also determine the compensation of all persons employed by the Bureau of Mines and Geology and may remove them at will.
[Part 1:127:1935; 1931 NCL § 4311.01]-(NRS A 1971, 369; 1993, 411; 1997, 2978)

NRS 514.040 Duties. The Bureau of Mines and Geology shall:
1. Serve as a bureau of information and exchange on Nevada mineral industry, mineral resources and geology.

2. By questionnaire, field investigations, laboratory studies or otherwise, conduct a thorough survey of the mineral resources and geology of the State.
3. Apply geologic engineering principles to problems of conservation, environment, construction, mineral industry and other scientific matters that may be of importance to the welfare of the State.
4. Make studies of mineral materials to determine the most economical and practical methods of concentrating and processing these resources and to promote their conservation.
5. Collect, in collaboration with the Mackay School of Mines, a library and bibliography of all literature pertaining to Nevada mineral industry, geology and mineral resources.
6. Collect, in collaboration with the Mackay School of Mines, typical geological and mineralogical specimens and models, drawings and descriptions of appliances used in the mineral industry and earth science. Collections of these materials may be maintained and displayed elsewhere within or without the State.
7. Provide for the dissemination of information on the mineral industry, geology and mineral resources of the State through lectures and publications.
8. Consult with, advise, and assist state and local governmental agencies on geological problems of importance to the citizens of Nevada.
9. Consider such other kindred scientific and economic questions as in the judgment of the Board of Regents shall be deemed of value to the people of the State.

[2:127:1935; 1931 NCL § 4311.02]-(NRS A 1971, 369)

NRS 514.050 Cooperation of state departments. All departments of the State Government shall render full cooperation to the Bureau of Mines and Geology in the acquisition and compilation of all data required by NRS 514.040

[3:127:1935; 1931 NCL § 4311.03]-(NRS A 1971, 370)

NRS 514.060 Agreements with United States Geological Survey.

1. The Director of the Bureau of Mines and Geology, for and on behalf of the State of Nevada, with the approval of the Governor, is authorized to enter into agreements with the United States Geological Survey for cooperation in investigating mineral and geological conditions within the State and in the topographic and geologic mapping of Nevada. The expenses of such work must be divided between the parties upon a basis whereby the State of Nevada will not pay more than 50 percent of such expenses.
2. Money necessary to carry out the provisions of this section must be provided pursuant to NRS 519A.260.
3. All claims against such money must be approved by the Director of the Bureau of Mines and Geology, and, when thereafter approved by the State Board of Examiners, must be paid in the same manner as other claims against the State.

[1:40:1953] + [2:40:1953] + [3:40:1953]-(NRS A 1971, 370; 1995, 828)

NRS 514.070 Reports: Distribution and sale.

1. The Board of Regents shall cause to be prepared before September 1 of each even-numbered year a report covering the biennium ending June 30 of such year, showing the progress and condition of the Bureau of Mines and Geology, together with such other information as the Board may deem necessary or useful, or as the Board may require.
2. The regular and special reports of the Bureau of Mines and Geology shall be printed as the Board of Regents may direct, and the reports may be distributed or sold by the Board as the interest of the State or science may demand. All moneys obtained by the sale of such reports shall be retained by the Bureau of Mines and Geology to be used for costs of printing and distribution as the Board of Regents may direct.

[5:127:1935; 1931 NCL § 4311.05] + [6:127:1935; 1931 NCL § 4311.06]-(NRS A 1969, 1458; 1971, 370)

NRS 514.080 Unlawful acts. It shall be unlawful for the Director or any attaché of the Bureau of Mines and Geology:

1. To receive a commission or to act as agent or broker of or for any purchaser, owner, or his or their agents, of a mining property.
2. To act in any other than a wholly impartial way while so employed.

[4:127:1935; 1931 NCL § 4311.04]-(NRS A 1971, 370)

CHAPTER 396 - UNIVERSITY AND COMMUNITY COLLEGE SYSTEM OF NEVADA

PUBLIC SERVICE DIVISION

In General

NRS 396.600 Composition. The Public Service Division of the System consists of the following public service departments:

1. Agricultural Extension.
2. Agricultural Experiment station.
3. Bureau of Mines and Geology.
4. Such other departments as the Board of Regents may designate.

[1:98:1915; 1919 RL p. 3209; NCL § 7765] + [Part 2:98:1915; 1919 RL p. 3210; NCL § 7766] + [3:98:1915; 1919 RL p. 3210; NCL § 7767] + [5:98:1915; 1919 RL p. 3210; NCL § 7769]-(NRS A 1957, 766; 1959, 618; 1969, 1437; 1971, 368; 1985, 1125; 1993, 352)

NRS 396.610 Rules and regulations. All rules and regulations necessary for the proper administration and enforcement of the Public Service Division of the System must be made by the presidents, the chancellor and the Board of Regents.

[4:98:1915; 1919 RL p. 3210; NCL § 7768]-(NRS A 1969, 1438; 1993, 352)

BUREAU OF MINES AND GEOLOGY

NRS 396.620 Analyses of ores, minerals, soil and water: Submission of samples by residents of this state; fee; maintenance of records and samples.

1. Subject to the limitations specified in NRS 396.620 to 396.660, inclusive, the Chancellor shall cause to be analyzed by an appropriate employee of the System any ores, minerals, soil or water taken from within the boundaries of the State of Nevada and sent by any resident of the State for that purpose. Persons sending samples from post offices in states bordering Nevada may be required to furnish evidence that their samples are taken in Nevada and that they are Nevada residents. Any resident of the State may send any such substance for analysis. The report of the results of the analysis must be mailed to him within 10 working days after it has been received if he has supplied the information for the maintenance of records as provided in this section. The report sent to him must also contain as nearly as possible an explanation of the uses and market value of the substance.
2. For each sample sent for analysis, the System shall charge a fee of $5 which must be used to defray the expense of conducting the analysis and storing the sample.
3. The System shall keep a record, open for inspection, under such rules as may be made by the Board of Regents, of all minerals, ores or other matters so sent, with a history of the minerals or other matters, stating the name and residence of the person from whom received, as nearly as possible the location from which the material was taken, including the district and county, and any other relevant information. This information for the records may be required to be filed with the System before any work is done on the material sent, and the 10-day limit for reports will count from the time the information is received by the System. The System shall cause the preparation and printing of forms for providing the information and shall distribute the forms at no charge.
4. A portion of the sample analyzed must be kept by the System for 3 months after the report is sent out, in case any question should arise in relation to the report or additional information be desired. After that time expires, samples may be destroyed or used for any desirable purpose.

[1:84:1895; A 1931, 229; 1933, 147; 1931 NCL § 7754]-(NRS A 1969, 1526; 1981, 1715; 1985, 466; 1993, 352, 1597; 1995, 579; 1997, 20)

NRS 396.630 Assay to be run when same material sent from same district. If the same general kind of matter for analysis is sent from the same district and previous analyses have shown its character and values, it shall not be necessary to analyze the same, but an assay shall be run to determine the value thereof, and shall be sent by mail to the person desiring the same.

[2:84:1895; A 1933, 147; 1931 NCL § 7755]

NRS 396.640 Analyses of samples in order received. Samples for analysis shall be analyzed in the order received, as far as possible.

[3:84:1895; A 1933, 147; 1931 NCL § 7756]

NRS 396.650 Limitations on number of samples and quantitative analyses.

1. Gold and silver samples requiring assays and exact quantitative determinations are limited to two in any 30-day period; and of the so-called strategic or war minerals, such as antimony, arsenic, beryllium, manganese, magnesium, tungsten, molybdenum, quicksilver, zinc, lead, copper, tin, chromium, cadmium, or other strategic minerals for the assaying of which the average assay office is not equipped, there shall be run up to five assays or

quantitative determinations for any single person or associated group of persons. Samples sent for ordinary rock and mineral determinations are limited to 10 in any 30-day period.

2. In order to save the State unnecessary expense, if preliminary examinations by microscope and qualitative tests indicate material of no economic value, exact quantitative analyses are not to be run on such samples, and reports on such material will indicate why such material has no commercial value.

[Part 4:84:1895; A 1897, 91; 1925, 29; 1931, 229; 1933, 147; 1943, 180; 1943 NCL § 7757]

NRS 396.660 Purpose and applicability of NRS 396.620 to 396.660 inclusive.

1. The main object of NRS 396.620 to 396.660, inclusive, as it relates to ore samples, is to aid the prospector in the discovery of new mineral deposits.

2. NRS 396.620 to 396.660, inclusive, shall not apply in the following cases:

(a) To operating mines. The term "operating mines" as used in this subsection means those properties milling or shipping ore or being worked by hired labor.

(b) To engineers sampling mines or prospects for purposes of valuation.

(c) To so-called "control assays" to check other assayers on ore known to be of value.

[Part 4:84:1895; A 1897, 91; 1925, 29; 1931, 229; 1933, 147; 1943, 180; 1943 NCL § 7757]

CHAPTER 327 - NEVADA COORDINATE SYSTEM; GEOGRAPHIC NAMES

NRS 327.100 "Board" defined. As used in NRS 327.110 to 327.150, inclusive, unless the context otherwise requires, the term "board" means the Nevada State Board on Geographic Names.

(Added to NRS by 1985, 588)

NRS 327.110 Nevada State Board on Geographic Names: Creation; purpose. The Nevada State Board on Geographic Names is hereby created to coordinate and approve geographic names within the State for official recommendation to the United States Board on Geographic Names.

(Added to NRS by 1985, 588)

NRS 327.120 Nevada State Board on Geographic Names: Composition. The Board consists of:

1. One representative of each of the following agencies or organizations:

(a) **Bureau of Mines and Geology of the State of Nevada.**

(b) Faculty of the University of Nevada, Reno.

(c) Faculty of the University of Nevada, Las Vegas.

(d) State Library and Archives.

(e) Department of Transportation of the State.

(f) State Department of Conservation and Natural Resources.

(g) Nevada Historical Society.

(h) United States Bureau of Land Management.

(i) United States Forest Service.

(j) Inter-Tribal Council of Nevada, Inc.

Each agency or organization shall designate a representative and one alternative representative for this purpose.

2. An Executive Secretary who is a nonvoting member of the Board. The State Resident Cartographer shall serve in this position. If there is not such a cartographer, the voting members of the Board shall select the Executive Secretary.

(Added to NRS by 1985, 588; A 1993, 507)

NRS 327.130 Nevada State Board on Geographic Names: Officers; rules; quorum; meetings; compensation.

1. The Board shall designate from among its members a Chairman and a Vice Chairman and shall adopt rules for its own management.

2. A majority of the voting members of the Board constitutes a quorum for the transaction of business.

3. The Board shall meet at such times and places as are specified by the Chairman, but may not hold more than four meetings in any 1 year.

4. Members of the Board shall serve without compensation, travel expenses or subsistence allowances except as they may be provided by the members' respective agencies and organizations.

(Added to NRS by 1985, 588)

NRS 327.140 Nevada State Board on Geographic Names: Powers and duties.
1. The Board shall:
(a) Receive and evaluate all proposals for changes in or additions to names of geographic features and places in the State to determine the most appropriate and acceptable names for use in maps and official documents of all levels of government.
(b) Make official recommendations on behalf of the State with respect to each proposal.
(c) Assist and cooperate with the United States Board on Geographic Names in matters relating to names of geographic features and places in Nevada.
(d) Maintain a list of advisers who have special knowledge of or expertise in Nevada history, geography or culture and consult with those advisers on a regular basis in the course of its work.
2. The Board may:
(a) Adopt regulations to assist in carrying out the functions and duties assigned to it by law.
(b) Initiate proposals for changes in or additions to geographic names in the State. Any proposal initiated by the Board must be evaluated in accordance with the same procedures prescribed for the consideration of other proposals.
(Added to NRS by 1985, 588)

NRS 327.150 Changes in or additions of geographic names: Submission of proposal; preliminary consideration; final action and notice.
1. Any person, group or agency of federal, state or local government may propose a change in or the addition of any geographic name within the State by submitting it to the Board for evaluation and recommendation.
2. Upon receipt of any such proposal, together with sufficient supporting information, the Board shall:
(a) Place the proposal on the agenda for preliminary consideration at its next meeting.
(b) Give appropriate notice to persons and groups who are affected by the proposal or might have an interest in it.
(c) Provide opportunities for public comment.
(d) Conduct such research and field investigations as it deems necessary.
3. The Board may not take final action on any proposal until it has been given preliminary consideration at one or more previous meetings.
4. Whenever the Board takes final action on a proposal, it shall notify the person, group or agency who submitted the proposal and shall transmit the official recommendation to the United States Board on Geographic Names.
(Added to NRS by 1985, 589)

CHAPTER 519A - RECLAMATION OF LAND SUBJECT TO MINING OPERATIONS OR EXPLORATION PROJECTS (under the Division of Environmental Protection of the Department of Conservation and Natural Resources)

NRS 519A.260 Annual submission of reports and payment of fees by operator; disposition of money received.

1. Each operator shall, on or before April 15 of each year, submit to the Administrator a report relating to the status and production of all mining operations and exploration projects in which he has engaged and identifying each acre of land affected and land reclaimed by that mining operation or exploration project through the preceding calendar year, and shall pay to the division a fee of:

(a) One dollar and fifty cents for each acre of public land administered by a federal agency; and

(b) Five dollars and fifty cents for each acre of privately owned land, which has been disturbed by mining operations or exploration projects engaged in by the operator and not reclaimed.

2. **All money received by the State Treasurer pursuant to paragraph (a) of subsection 1 together with three-elevenths of all money received by the State Treasurer pursuant to paragraph (b) of subsection 1, up to a maximum of $100,000 annually, must be distributed directly to the Bureau of Mines and Geology of the State of Nevada to be used to carry out the provisions of NRS 514.060.** Any money in excess of the maximum and the balance collected pursuant to paragraph (b) of subsection 1 must be credited to the appropriate account for the division and used to administer the provisions of this chapter.

(Added to NRS by 1989, 1287; A 1991, 201)

Nevada Administrative Code related to the Nevada Bureau of Mines and Geology

CHAPTER 522 - OIL AND GAS (under the Division of Minerals, Commission on Mineral Resources)

NAC 522.215 Cuttings: Requirements for permit; availability and use; notification of shortage. The taking of cuttings and the filing thereof is a condition for approval of the drilling permit, and this condition will be stated on the permit. **A minimum of two 15-milliliter sets of cuttings per sampling interval must be cleaned, dried and placed in sample envelopes, and the cuttings and a split of any core submitted to the bureau of mines and geology as soon as the drilling of the well is complete. The bureau shall remove a 15-milliliter set and place the set in permanent storage. The rest of the cuttings must be made available for public inspection and testing at that time or, if the records concerning the well are to be kept confidential pursuant to NAC 522.540, upon the expiration of the period of confidentiality. Destructive tests may be performed on the cuttings made available for public inspection and testing. The administrator of the division must be notified by the bureau of any sample envelopes containing less than 5 milliliters of cuttings.**

[Div. of Mineral Res., § 204, eff. 12-20-79]—(NAC A by Dep't of Minerals, 9-16-92)

NAC 522.510 Form 5: Well completion report.

1. Form 5, the well completion report, must be filed for all wells drilled in Nevada. In the case of a dry hole, this report may accompany Form 4. In the case of a well placed in commercial production, Form 5 must be filed with the division within 30 days after the well is placed in production. Only one Form 5 is required for each well. A second Form 5 is not required upon the abandonment of any producing well.
2. Two copies of all logging surveys run in the wellbore by the operator must be filed with the division. **The division will file one of the sets with the bureau of mines and geology. The copy at the bureau will be available for public inspection when the records are no longer confidential.**

[Div. of Mineral Res., § 707, eff. 12-20-79]—(NAC A by Dep't of Minerals, 7-22-87)

NAC 522.540 Confidentiality of well records.

1. Records concerning a well will not be kept confidential by the division unless the owner of the well requests confidentiality in writing or marks "confidential" on the logs of an exploratory well. Upon receiving such a request or log, the division will keep the records confidential for 6 months after their receipt unless the owner provides a written authorization for an earlier release.
2. An operator who plans to drill a series of exploratory wells within a given region or area may apply to the division to have the records for all his exploratory wells kept confidential. Such an application must specifically describe the area to be explored and the number and location of exploratory wells contemplated. Upon approval of the application, the administrator will keep all records of the project confidential for 6 months after receipt of the record. The operator may amend the plan of the project with the written approval of the administrator.

(Added to NAC by Dep't of Minerals, eff. 7-22-87)

CHAPTER 534A - GEOTHERMAL RESOURCES (under the Division of Minerals, Commission on Mineral Resources)

NAC 534A.310 Taking of cuttings is condition for approval; submission to bureau of mines and geology. The taking of cuttings at least every 30 feet, and filing thereof, is a condition for approval of the drilling permit. The cuttings must be cleaned, dried, marked for location and depth and placed in envelopes. **The cuttings and a split of any core must be submitted to the bureau of mines and geology of the State of Nevada within 30 days after the well is completed.**

(Added to NAC by Comm'n on Mineral Resources, eff. 11-12-85)

NAC 534A.550 Filing of report of completion and well logs.

1. Within 30 days after the completion of the construction of a well, the owner of the geothermal resource or the operator shall file with the division:

(a) A report setting forth the manner in which the well was completed.
(b) Two sets of all well logs.

2. **The division shall file one set of the well logs with the bureau of mines and geology of the State of Nevada.**

(Added to NAC by Comm'n on Mineral Resources, eff. 11-12-85; A 12-16-92)

NAC 534A.140 Hole logs: Subsurface information; confidentiality. Information about the subsurface obtained as a result of exploration drilling disclosed on hole logs as required by NAC 534A.130 must be filed with the state engineer within 30 days after it is acquired. **Such information together with other information concerning the exploration appearing on the logs and the cards containing the notice of intent to drill is confidential for a period of 5 years from the date of filing the cards or logs and must not be disclosed during that time without the express written consent of the driller's client.**

[St. Engineer, Exploration Drilling Reg. Art. VIII, eff. 12-13-77]

United States Code (Federal Laws) related to the Nevada Bureau of Mines and Geology

43 USC Sec. 31c 01/26/98

TITLE 43 - PUBLIC LANDS

CHAPTER 2 - UNITED STATES GEOLOGICAL SURVEY

Sec. 31c. **Geologic mapping program**

STATUTE

(a) Establishment

(1) In general

There is established a national cooperative geologic mapping program between the United States Geological Survey and the State geological surveys, acting through the Association.

(2) Design, development, and administration

The cooperative geologic mapping program shall be -

(A) designed and administered to achieve the objectives set forth in subsection (c) of this section;

(B) developed in consultation with the advisory committee;

and

(C) administered through the Survey.

(b) Responsibilities of the Survey

(1) Lead agency

The Survey shall be the lead Federal agency responsible for planning, developing national priorities and standards for, coordinating, and managing the geologic mapping program. In carrying out this paragraph, the Secretary, acting through the Director, shall -

(A) develop a 5-year strategic plan for the geologic mapping program in accordance with section 31e of this title, which plan shall be submitted to the Committee on Resources of the House of Representatives and the Committee on Energy and Natural Resources of the Senate not later than 1 year after December 9, 1999;

(B) appoint, with the advice and consultation of the Association, the advisory committee not later than 1 year after December 9, 1999, in accordance with section 31d of this title; and

(C) not later than 3 years after December 9, 1999, and biennially thereafter, submit a report to the Committee on Energy and Natural Resources of the United States Senate and to the Committee on Resources of the House of Representatives identifying -

(i) how the Survey and the Association are coordinating the development and implementation of the geologic mapping program;

(ii) how the Survey and the Association establish goals, mapping priorities, and target dates for implementation of the geologic mapping program; and

(iii) how long-term staffing plans for the various components of the geologic mapping program affect successful implementation of the geologic mapping program.

(2) Responsibilities of the Secretary

In addition to paragraph (1), the Secretary, acting through the Director, shall be responsible for developing, as soon as practicable -

(A) in cooperation with the Association, other Federal and State agencies, public and private sector organizations and academia, the geologic-map data base; and

(B) maps and mapping techniques which achieve the objectives specified in subsection (c) of this section.

(C) Program objectives

The objectives of the geologic mapping program shall include -

(1) determining the Nation's geologic framework through systematic development of geologic maps at scales appropriate to the geologic setting and the perceived applications, such maps to be contributed to the national geologic map data base;

(2) development of a complementary national geophysical-map data base, geochemical-map data base, and a geochronologic and paleontologic data base that provide value-added descriptive and interpretative information to the geologic-map data base;

(3) application of cost-effective mapping techniques that assemble, produce, translate and disseminate geologic-map information and that render such information of greater application and benefit to the public; and

(4) development of public awareness of the role and application of geologic-map information to the resolution of national issues of land use management.

(d) Program components

(1) Federal component

(A) In general

The geologic mapping program shall include a Federal geologic mapping component, the objective of which shall be to determine the geologic framework of areas determined to be vital to the economic, social, environmental, or scientific welfare of the United States.

(B) Mapping priorities

For the Federal component, mapping priorities -

(i) shall be described in the 5-year plan under section 31e of this title; and

(ii) shall be based on -

(I) national requirements for geologic map information in areas of multiple-issue need or areas of compelling single- issue need; and

(II) national requirements for geologic map information in areas where mapping is required to solve critical earth science problems.

(C) Interdisciplinary studies

(i) In general

The Federal component shall include interdisciplinary studies that add value to geologic mapping.

(ii) Representative categories

Interdisciplinary studies under clause (i) may include -

(I) establishment of a national geologic map database under section 31f of this title;
(II) studies that lead to the implementation of cost- effective digital methods for the acquisition, compilation, analysis, cartographic production, and dissemination of geologic map information;
(III) paleontologic, geochronologic, and isotopic investigations that provide information critical to understanding the age and history of geologic map units;
(IV) geophysical investigations that assist in delineating and mapping the physical characteristics and 3-dimensional distribution of geologic materials and geologic structures; and
(V) geochemical investigations and analytical operations that characterize the composition of geologic map units.
(iii) Use of results
The results of investigations under clause (ii) shall be contributed to national databases.
(2) State component
(A) In general
The geologic mapping program shall include a State geologic mapping component, the objective of which shall be to establish the geologic framework of areas determined to be vital to the economic, social, environmental, or scientific welfare of individual States.
(B) Mapping priorities
For the State component, mapping priorities -
(i) shall be determined by State panels representing a broad range of users of geologic maps; and
(ii) shall be based on -
(I) State requirements for geologic map information in areas of multiple-issue need or areas of compelling single- issue need; and
(II) State requirements for geologic map information in areas where mapping is required to solve critical earth science problems.
(C) Integration of Federal and State priorities
A national panel including representatives of the Survey shall integrate the State mapping priorities under this paragraph with the Federal mapping priorities under paragraph
(1).
(D) Use of funds
The Survey and recipients of grants under the State component shall not use more than 15.25 percent of the Federal funds made available under the State component for any fiscal year to pay indirect, servicing, or program management charges.
(E) Federal share
The Federal share of the cost of activities under the State component for any fiscal year shall not exceed 50 percent.
(3) Education component
(A) In general
The geologic mapping program shall include a geologic mapping education component for the training of geologic mappers, the objectives of which shall be -
(i) to provide for broad education in geologic mapping and field analysis through support of field studies; and
(ii) to develop academic programs that teach students of earth science the fundamental principles of geologic mapping and field analysis.
(B) Investigations
The education component may include the conduct of investigations, which -
(i) shall be integrated with the Federal component and the State component; and
(ii) shall respond to mapping priorities identified for the Federal component and the State component.
(C) Use of funds
The Survey and recipients of grants under the education component shall not use more than 15.25 percent of the Federal funds made available under the education component for any fiscal year to pay indirect, servicing, or program management charges.
(D) Federal share
The Federal share of the cost of activities under the education component for any fiscal year shall not exceed 50 percent.
-SOURCE-
(Pub. L. 102-285, Sec. 4, May 18, 1992, 106 Stat. 167; Pub. L. 103- 437, Sec. 16(a)(1), Nov. 2, 1994, 108 Stat. 4594; Pub. L. 105-36, Sec. 3(b), Aug. 5, 1997, 111 Stat. 1108; Pub. L. 106-148, Sec. 4,Dec. 9, 1999, 113 Stat. 1720.)

APPENDIX C

Customer Service Questionnaire

Dear patron of the Nevada Bureau of Mines and Geology (NBMG),

We've been asked by the University of Nevada, Reno's administration, for reporting to the Nevada Legislature, to provide performance measures on our products and service. In order to provide quantitative results, we've designed the following questionnaire. Please take a couple of seconds to answer the first question only or a few minutes to complete most or all of the form. Your participation will also allow us to serve you better by addressing any suggestions or concerns you may have. Thank you for your help.

Jon Price
State Geologist and Director

Please return the survey to:
Terri Garside
Executive Assistant
Nevada Bureau of Mines and Geology
University of Nevada, Reno/MS 0178
Reno, NV 89557
or submit it by email to tgarside@unr.edu,
or fill out the questionnaire on the Web (www.nbmg.unr.edu).

Please rate the following items on a scale of A through F: A = outstanding, B = commendable, C = satisfactory, D = poor, and F = terrible. N/A = not applicable or don't know.

Overall Performance of the Nevada Bureau of Mines and Geology

How well is the Nevada Bureau of Mines and Geology serving you? **A B C D F N/A**

NBMG Publications and Information Office (Please see www.nbmg.unr.edu/sales/pbs.htm for a list of publications, www.nbmg.unr.edu/dox/dox.htm for free, on-line publications, and www.nbmg.unr.edu/infof.htm for other free information on the Web.)

Quality of NBMG publications:	**A**	**B**	**C**	**D**	**F**	**N/A**
Usefulness of the publications:	**A**	**B**	**C**	**D**	**F**	**N/A**
Number and variety of publications:	**A**	**B**	**C**	**D**	**F**	**N/A**
Quality of NBMG geologic maps:	**A**	**B**	**C**	**D**	**F**	**N/A**
Detail of NBMG geologic maps:	**A**	**B**	**C**	**D**	**F**	**N/A**
Current coverage of geologic maps:	**A**	**B**	**C**	**D**	**F**	**N/A**
Free publications on the Web:	**A**	**B**	**C**	**D**	**F**	**N/A**
Cost of publications for sale:	**A**	**B**	**C**	**D**	**F**	**N/A**
Customer service for sales:	**A**	**B**	**C**	**D**	**F**	**N/A**

Ease of Web sales:	**A**	**B**	**C**	**D**	**F**	**N/A**
Timeliness of receiving Web, mail, and fax orders:	**A**	**B**	**C**	**D**	**F**	**N/A**
Service from the Information Office:	**A**	**B**	**C**	**D**	**F**	**N/A**
Air photo coverage:	**A**	**B**	**C**	**D**	**F**	**N/A**
Content of mining district files:	**A**	**B**	**C**	**D**	**F**	**N/A**
Free mining-district, geothermal, and other information on the Web	**A**	**B**	**C**	**D**	**F**	**N/A**
Hours of operation: (currently M-F, 8:00 a.m. to 4 p.m)	**A**	**B**	**C**	**D**	**F**	**N/A**

External Publications and Professional Service (Please refer to NBMG's Biennial Reports for information on publications in other venues, including scientific journals, Geological Society of Nevada, Geothermal Resources Council, and Nevada Petroleum Society publications, and for information about professional service to geoscience organizations and the community by NBMG staff, www.nbmg.unr.edu/about.htm.)

External publications:	**A**	**B**	**C**	**D**	**F**	**N/A**
Professional service:	**A**	**B**	**C**	**D**	**F**	**N/A**

Outreach to the General Public, K-12 Teachers, and Students (Please rate our publications for the general public, including the road guides, earthquake information, and other items in the Special Publication Series, www.nbmg.unr.edu/sales/pbs.htm, and items in our Educational Series, www.nbmg.unr.edu/dox/dox.htm; let us know how you like the Earth Science Week field trips; and tell us how well we answer your questions.)

Publications for the general public:	**A**	**B**	**C**	**D**	**F**	**N/A**
Earth Science Week field trips:	**A**	**B**	**C**	**D**	**F**	**N/A**
Helpfulness in answering questions:	**A**	**B**	**C**	**D**	**F**	**N/A**

Analytical Laboratory

Quality of assays:	**A**	**B**	**C**	**D**	**F**	**N/A**
Cost of assays:	**A**	**B**	**C**	**D**	**F**	**N/A**
Turnaround time:	**A**	**B**	**C**	**D**	**F**	**N/A**

Suggestions to help us serve you better (Feel free to answer any of these or other questions):

Are there any publications (maps, bulletins, reports, special publications, databases) that you would like to see NBMG prepare?

Are there any areas you'd like to see geologically mapped?

Are there any publications by publishers other than NBMG and the USGS that you would like us to sell?

What are your preferences for media for NBMG publications, including maps (paper only – purchased from us; paper – printed with customized GIS layers added; free on the Web – print your own; CD-ROM version)?

What other types of information and databases would you like to see in digital format free on the Web?

In what specific formats would you like digital information placed on the Web (e.g., pdf files, shapefiles, Access databases, spreadsheets)?

How would you prefer to see digital data organized on the NBMG Website?

If we were able to extend or change our office hours for the Publication Sales and Information Office, during which hours would you most likely visit or call?

Other suggestions or concerns?

_____

_____

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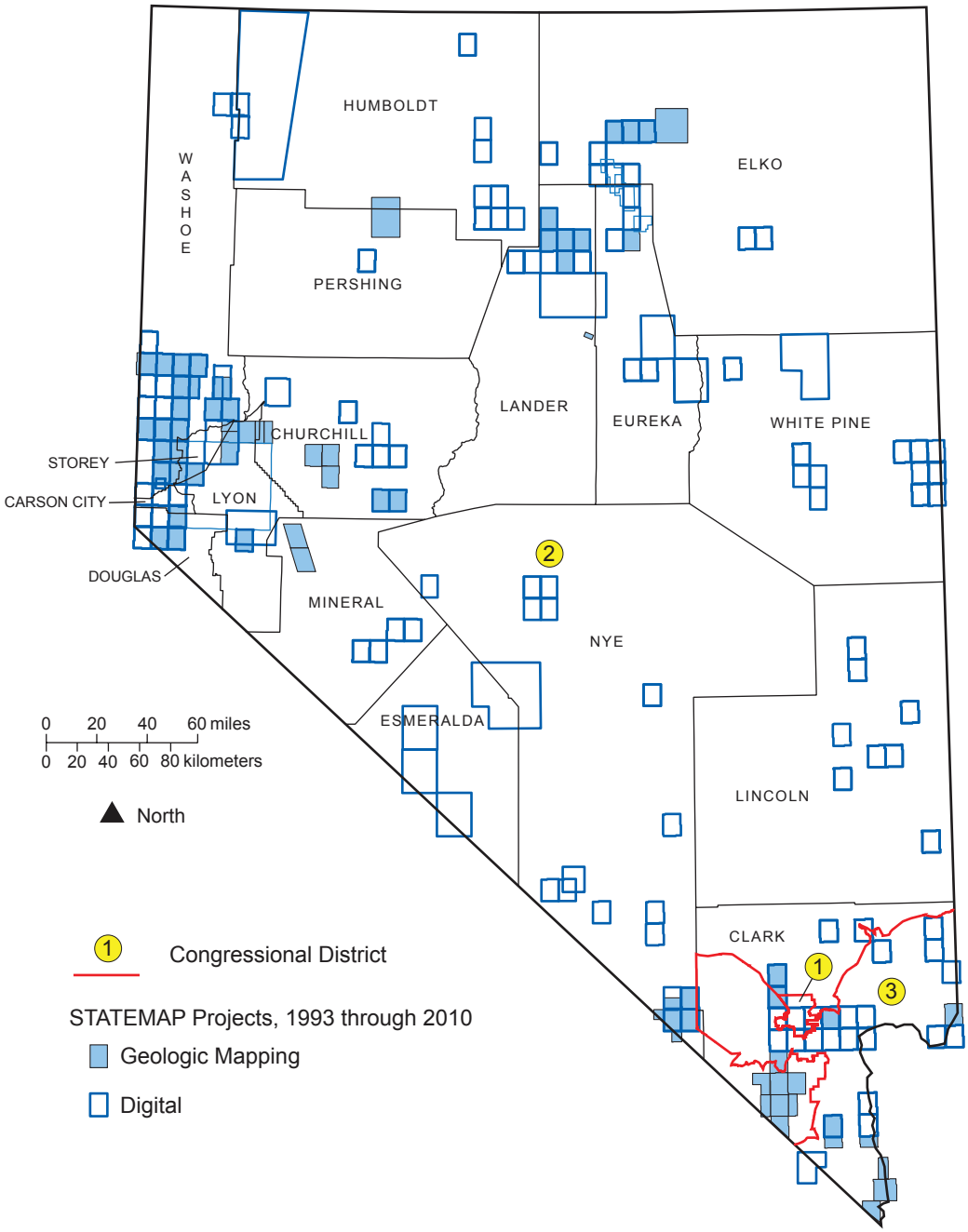
Thank you.

Association of American State Geologists

United States Geological Survey

National Cooperative Geologic Mapping Program

NEVADA



Contact information

Nevada Bureau of Mines and Geology
State Geologist: Jonathan G. Price (775-784-6691)
STATEMAP Contact: Christopher D. Henry (775-682-8753)
http://www.nbmg.unr.edu

USGS Geologic Mapping Program Office
Program Coordinator: Peter T. Lyttle (703-648-6943)
http://ncgmp.usgs.gov/

SUMMARY OF STATEMAP GEOLOGIC MAPPING PROGRAM IN NEVADA

Las Vegas Area

New geologic maps at 1:24,000 scale

1994 - 1 Map 1996 - 1 Map 1997 - 2 Maps 1998 - 2 Maps 1999 - 1 Map 2000 - 2 Maps 2001 - 3 Maps 2002 - 6 Maps 2003 - 5 Maps 2004 - 4 Maps

N ½ Searchlight (2005) N ½ Spirit Mtn. NW (2007)

Digital versions of previously published geologic maps at 1:24,000 scale

2000 - 7 Maps 2001 - 5 Maps 2002 - 2 Maps

Arrow Canyon NW (2007)
Callville Bay (2006)
Castle Mountains (2006)
Fire Mountain (2008)
Government Wash (2006)
Hiller Mountains (2006)
Horse Springs (2008)
Last Chance Range (2009)
Meadview North (2007)
Moapa West (2008)
Pahrump (2008)
Riverside (2008)
Nelson SW (2006)
Skull Mountain (2010)
Sixmile Spring (2008)
Specter Range NW (2010)
Weiser Ridge (2007)
Whitney Pocket (2008)

Reno Area

New geologic maps at 1:24,000 scale

1993 - 2 Maps 1996 - 1 Map 1997 - 1 Map 1998 - 1 Map 1999 - 2 Maps 2000 - 4 Maps 2001 - 4 Maps 2002 - 1 Map 2003 - 1 Map 2004 - 3 Maps

Bunejug Mtns (2010)
N ½ Fernley West (2005)
Fernley West (2007)
Flowery Peak (2005)
Grimes Point (2008)
E ½ Hazen (2010)
W ½ Hazen (2008)
Lahontan Mountains (2006)
N ½ Lower Walker River (2009)
S ½ Lower Walker River (2008)
Mount Rose NE (2010)
Reno (2009)
Seven Lakes Mountain (2005)
Steamboat (2010)
Stockton Flat Well (2006)
Verdi (2009)
Vista (2009)
Washoe City (2010)

*Digital versions of previously published geologic maps at 1:24,000 scale (** maps at 1:48,000 scale)*

2000 - 5 Maps 2001 - 8 Maps

Bedell Flat (2007)
Carson City (2007)
Desert Peak/Brady Area (2008)
Dogskin Mountain (2007)
Fraser Flat and W ½ Moses Rock (2006)
Flowery Peak (2009)
Gardnerville (2008)
Genoa (2007)
Glenbrook (2007)
Griffith Canyon (2009)
Granite Peak (2008)
Marlette Lake (2007)
McTarnahan Hill (2009)
Minden (2008)
Mount Rose NE (2007)
New Empire (2007)
Nine Hill Paleovalley (2010)
Nixon Area (2009)
Olinghouse (2008)
E ½ Pah Rah Mtn (2010)
South Lake Tahoe (2007)
State Line Peak (2007)
Steamboat (2007)
Sutcliffe (2008)
Tule Peak (2009)
Wadsworth (2009)
Parts of Wadsworth and Churchill Butte (2007)**
Washoe City (2007)
Yerington (2009)
Yerington District (2009)

Rural Nevada Area

New geologic maps at 1:24,000 scale (# map at 1:6,000 scale)

1995 - 2 Maps 1996 - 1 Map 1997 - 3 Maps 1998 - 2 Maps 1999 - 2 Maps 2002 - 1 Map

N ½ Jerritt Canyon Mining District (2006) Jerritt Canyon Mining District (2007) Cortez Mine Area (2009)#

Digital versions of previously published geologic maps at 1:24,000 scale (maps at 1:62,500 scale, ** maps at 1:48,000 scale)*

2001 - 18 Maps 2002 - 9 Maps

Antler Peak (2007)
Antler Peak (2010)
Argenta (2009)
Bateman Spring (2008)
Beaver Peak (2006)
Bell Canyon (2007)
Bell Mountain (2007)
Belmont West (2010)
Bettles Well (2007)
Big Bald Mountain (2006)
Bobs Flat (2007)
Brooks Spring (2007)
Buckskin Mountain (2007)
NE ¼ Bullfrog (2010)*
NW ¼ Bullfrog (2010)*
Camp Douglas (2007)
Cherry Creek and Egan Ranges (2010)
Chief Mountain (2007)
Cooper Peak (2008)
Crater Flat (2007)
Deadman Spring SE (2008)
Delvada Spring (2009)
Diamond Springs (2007)*
Ely (2010)
Frazier Creek (2006)
Galena Canyon (2010)
Golconda (2009)
Goldyke (2010)
Goldrun Creek (2007)
High Rock Lake (2009)
Hot Springs Peak (2010)
Indian Cove (2007)
Iron Point (2007)
Jake Creek Mountain (2007)
Jefferson (2010)
Job Peak (2009)
LaPlata Canyon (2008)
Little Horse Canyon (2006)
Magruder Mountain (2008)*
Manhattan (2010)
Mina (2007)
Mineral Hill (2007)**
Moho Mountain (2007)
Mormon Jack Pass (2006)
Mule Canyon (2006)
Northern Shoshone Range (2010)
Oak Spring Butte (2010)
Old Mans Canyon (2006)
Pahroc Spring SE (2008)
Pintail Bay (2008)
Piper Peak (2007)*
Pirouette Mountain (2008)
Reveille (2006)
Rhyolite Ridge (2007)*
Riepetown (2010)
Robinson Summit (2007)
Rodeo Creek NE (2010)
Rose Valley (2008)
Round Mountain (2007)
Ruth (2010)
Russells (2009)
Rye Patch Reservoir S. (2007)
Santa Renia Fields (2008)
Third Butte East (2006)
Tonopah Area (2007)**
Valmy (2010)
Verdi Peak (2006)
Welches Canyon (2009)
Western Humboldt County (2009)
Willow Creek Reservoir (2006)
Willow Creek Reservoir SE (2006)
Wonder Mountain (2006)
Yellow Hills East (2009)
Yellow Hills West (2009)

Digital versions of Carlin Trend maps

B111, 2 maps (2003), 1:24,0000 scale OFR03-1, 7 maps, 1:6,000 scale

The STATEMAP part of the National Cooperative Geologic Mapping Program has helped Nevadans by significantly increasing the geographic coverage of detailed maps produced by the Nevada Bureau of Mines and Geology. Geologic mapping in the Las Vegas and Reno urban areas is focused primarily on issues related to growth and land management, including earthquake and flood hazards, land subsidence due to ground-water withdrawal, collapsing and expanding soils, landslides, ground-water protection, air quality, and raw materials for construction. Mapping in rural Nevada provides key information on the origin of its precious metal deposits, which make Nevada the leading gold producer in the U.S., and on the environmental and economic impacts of mining and climatic change. Planners, scientists, engineers, managers, policy makers, teachers, students, and members of the general public who are interested in the world around them use geologic maps. Only about 20% of Nevada's 1,980 7.5-minute quadrangles are adequately mapped with the detail that is needed for most applications.

STATEMAP FUNDING

Federal Fiscal Year	State Dollars	Federal Dollars	Total Project Dollars
1993	20,519	20,000	40,519
1994	21,746	20,000	41,746
1995	15,113	10,000	25,113
1996	126,444	123,780	250,224
1997	261,357	152,410	413,767
1998	258,917	139,424	398,341
1999	175,175	115,500	290,675
2000	135,520	111,210	246,730
2001	216,702	196,289	412,991
2002	220,825	213,597	434,422
2003	184,860	183,231	368,091
2004	203,225	171,583	374,808
2005	172,489	135,032	307,521
2006	234,966	205,172	440,138
2007	215,122	214,559	429,681
2008	267,245	193,616	460,861
2009	298,948	208,268	507,216
2010	317,806	228,665	546,471
	$3,346,979	$2,642,336	$5,989,315

July 2010

Mackay School of Earth Sciences and Engineering
College of Science
University of Nevada, Reno

Nevada Bureau of Mines and Geology

Advisory Committee Members

Alan Coyner, *Administrator, Nevada Division of Minerals*, Chair of the Advisory Committee
David Donovan, *Hydrologist, Southern Nevada Water Authority*
Del Fortner, *Western Resources Group, LLC, Reno*
Shawn Gooch, *Civil Engineer, Nevada Division of Environmental Protection*
Lew Gustafson, *Mineral Exploration Consultant, Reno*
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Liang-Chi Hsu, *Research Mineralogist* – mineralogy and experimental petrology
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Susan L. Tingley, *Publications Manager & Chief Cartographer* – cartography & geography

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(Morgan State University, Baltimore, Maryland)
P. Kyle House, *Adjunct Research Geologist* – fluvial geomorphology and paleohydrology
(U.S. Geological Survey, Flagstaff, Arizona)

For more information about NBMG, please check the Web (www.nbmg.unr.edu) or contact us by mail, fax, or e-mail.

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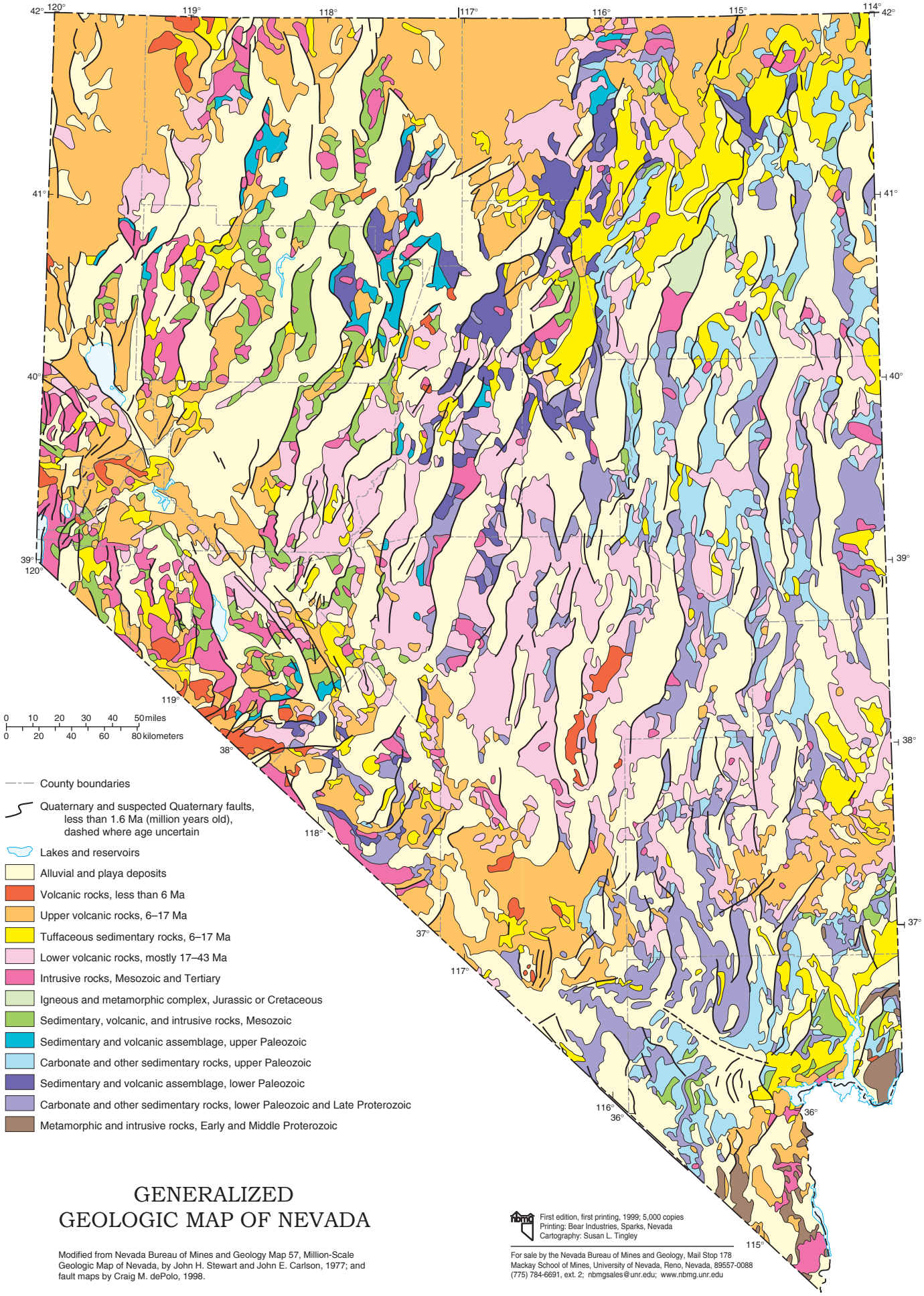

GENERALIZED GEOLOGIC MAP OF NEVADA

Modified from Nevada Bureau of Mines and Geology Map 57, Million-Scale Geologic Map of Nevada, by John H. Stewart and John E. Carlson, 1977; and fault maps by Craig M. dePolo, 1998.

First edition, first printing, 1999; 5,000 copies
Printing: Bear Industries, Sparks, Nevada
Cartography: Susan L. Tingley

For sale by the Nevada Bureau of Mines and Geology, Mail Stop 178
Mackay School of Mines, University of Nevada, Reno, Nevada, 89557-0088
(775) 784-6691, ext. 2; nbmgsales@unr.edu; www.nbmg.unr.edu