Nevada System of Higher Education
NSF EPSCoR R II

Pre-Proposal Cover Page
2013-2018 Project Period

Name of Project: Shale gas/oil in a Water Challenged State: A Nevada Energy-Water-Environment Nexus Research Project

This project involves human or vertebrate animal subjects: YES__ NO_X_

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Dr. Dev Chidambaran — Faculty name — UNR — Institution — Faculty signature — 12/08/2011 — Date

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Dr. Giles Marion	DRI	Giles M. Marion	8 Dec. 2011
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2. **Project Summary -** We propose to establish a Shale Gas/Oil Center of Excellence that researches the energy, water and environmental aspects of shale gas/oil resources. We will use geologic rock formations that are present over large areas of central Nevada, including the Chainman Shale and other mudrocks, as case studies for this project. These units were deposited over the geologic periods of time known as the Late Devoninan to Early Mississippian (~385-326 million years ago) at a time when marine environments were progressively covering more of the continents (a transgressive event). These units all preserve abundant organic material that was accumulating during the time of their deposition. Similar rocks (same age, same marine transgression, same organic richness) deposited in Texas (the Barnet Shale), North Dakota/ Montana (the Bakken Formation) and in the Appalachian region (the Marcellus Shale) are areas of active exploration and production of natural gas/oil that is driving a major transition in the energy industry. Unlike conventional natural gas and oil exploration, the natural gas/oil in these areas is still trapped within the low permeability rocks that they were generated in. Because of this, hydraulic fracturing (commonly known as "hydro-fracking") of the rock is required in order to free the trapped gas/oil. This process requires 1-8 million barrels of water per well. Once the shale is fractured and the natural gas/oil flows to the well it is recovered and used to fuel societal energy needs. However, in addition to the natural gas/oil that flows to the well, the water that was used to fracture the rock also flows back up the well along with natural byproducts like salts, metals, and radioactive materials. The non-gas/oil components that are recovered in the well must be reclaimed in order to not pollute the environment. Ideally, especially in a state like Nevada that has limited water resources, the flow back water must be recycled so that it can be reused for ongoing fracking. If the mudrocks are amenable to this type of development, the economic impact for the state of Nevada would be tremendous. Unemployment rates in PN, ND and TX where shale gas/oil projects are booming are well below the national average and have been declining in recent years in contrast to Nevada which has the highest unemployment rate in the nation.

A team of UNR/UNLV geoscientists will conduct a detailed study of the Chainman and other mudrocks in order to differentiate them, to understand their tectonic settings, to unravel their structural and thermal evolution, and to test their viability as sources of natural gas/oil. Members of our DRI team will test whether there are adequate natural water resources available in central Nevada in order to support the needs of fracking activities should the viability of these geologic units be established. They will also determine if subsurface aquifers in the study area are available for injecting waste water. Our UNR hydrologic and engineering team will develop and test multiple methods of water treatment in order to recycle flow back water for reuse, and test methods for contaminant cleanup in order to establish environmentally sound practices that can be applied globally for these types of energy resources. They will also continue to research fundamental science questions regarding extracting energy from water sources, as well as how best to use water resources to produce energy.

There are several intellectual merits to this project. Because these types of energy resources are still in their infancy, research like we propose is essential for the advancement of our knowledge and understanding of key aspects of shale gas/oil resources. Our proposed work spans traditional geologic fields of sedimentology, stratigraphy, and structural geology, inorganic and molecular organic geochemistry, hydrogeology, radiochemistry, and environmental engineering solutions to wastewater treatment. Our group is a diverse team (our team has gender, race, ethnicity, first generation college graduate, and physical disability diversity) that consists of both established and new researchers. The expertise of our team covers much of the proposed scope of the project, and proposed new faculty lines would fill in gaps in our team. Our team members supervise physical resources that can address many of the research topics and proposed new hires and facilities would build infrastructure in the state. We know of no group conducting similar research within an academic setting in the U.S. so our proposed research is original, creative and potentially transformative in that our research has the potential to create an entirely new field of research that has global relevance.

3. **Project Description**

3.1 **Status and Overview**

No research directly related to this proposal has been, or is being, conducted in the state of Nevada. However, several research projects that are peripherally related to this topic have been or are currently being conducted. For example, one of Hanson's MS students recently completed a molecular organic geochemistry study of oil in Railroad Valley, NV and showed that much of the oil that has been produced in the state of Nevada thus far is derived from the Chainman Shale (Adhyar, 2011). Another MS student is conducting a study of potential oil/gas source rocks in northern Nye County and is studying the organic geochemistry of other mudrocks. Another MS student is studying the thermal history of the Chainman Shale in east central Nevada. Faculty members Taylor, Cashman and Trexler have studied the Chainman and other mudrocks at localities ranging from the Nevada Test Site to northeastern Nevada. Their research has focused on the tectonic history during the late Devonian/Mississippian (Cashman et al., in press; Cashman et al., 2008; Trexler et al., 2004a; Trexler et al., 2004b).

No current research in Nevada is directly addressing the wastewater treatment and recycling of flow back water because so far none has been produced in Nevada. We are aware of one researcher at UNLV who is conducting research on flow back water treatment for wells in the Williston basin in North Dakota (Fig. 1) where shale oil is being exploited.

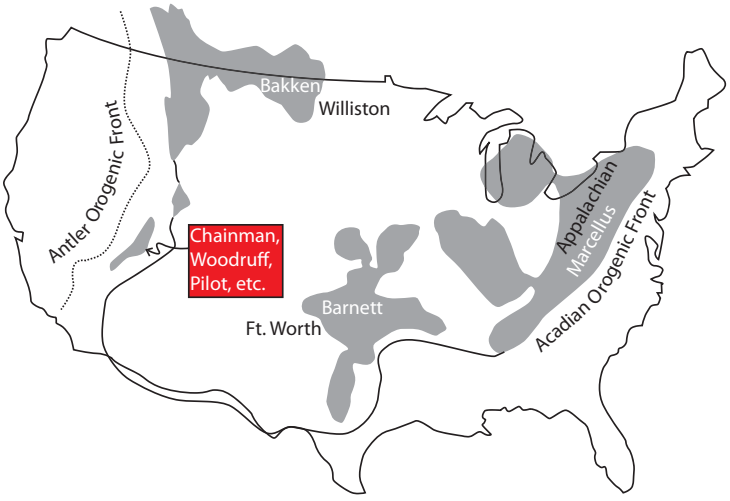

Figure 1. Paleogeographic map of the U.S. during the Late Devonian and Early Mississippian (from Ettensohn, 1995). Successful shale gas/oil exploration and production is currently ongoing in the peripheral basin in the Ft. Worth basin (the Barnett Shale), in the Appalachian basin (the Marcellus Shale) and in the Williston basin (the Bakken Formation). The Woodruff, Pilot, Chainman and other mudrock units occur in the Antler foreland in Nevada and are the focus of this proposal.

Existing Strengths

Current strengths within the state related to this research project are linked to our previous research, plus our personnel and facilities. Our geologic team consists of an organic geochemist who conducts petroleum related research (Hanson), two structural geologists who have worked extensively on the structural and tectonic evolution of eastern Nevada where the mudrocks of interest are located (Cashman and Taylor), and two stratigraphers/sedimentologists who have worked extensively on the Chainman and other mudrocks targeted in this project (Trexler and Hanson). We will utilize the ESAL laboratory that is managed by Dr. Buck (a soil scientist and environmental geologist) for many of our analyses. We have an excellent team of hydrogeologists that have extensive expertise and experience in conducting water resource assessments in Nevada basins (Chapman, Pohlmann and Tyler). One P.I. (Berli) is an expert on 2-phase fluid flow and will deal with phase separation as gas and water are

extracted. Three P.I.'s are experienced engineers who have vast expertise and knowledge of waste water systems (Childress, Marion, Marchand) and we have a stellar group of Assistant Professors (Chidambaran, Kolodziej, Geiger and Park) and one post-doctoral scholar (Achilli), whose research focus is on other aspects of waste water treatment. One of our Assistant Professors (Sudowe) is an expert on radionuclides in water.

From the facilities standpoint, the ESAL is an established, well equipped, and well-staffed environmental science lab. Dr. Sudowe's lab is operational and able to analyze water samples for radionuclides. The UNR Engineering labs have significant existing equipment (see Facilities section elsewhere) but requests included here will expand those capabilities.

Barriers and Opportunities

Minimal organic geochemistry facilities are currently in place in the state of Nevada and up until now our molecular organic geochemistry work has been done at the organic geochem lab at Stanford University. There are two issues related to the Stanford lab: the analyses are costly (about $1000/sample), and the P.I. of that lab just retired and Stanford does not intend to replace him in kind. We plan to address this barrier by purchasing state of the art equipment (Leco TOC, Rock-Eval, GC, GC-MSD, GC-MSMS, organic extraction equipment) and by adding a faculty line whose area of expertise is organic chemistry with specific expertise in hydrocarbons. Although NSHE currently has organic chemists on staff, none of them work on research related to hydrocarbon exploration/exploitation; instead their focus is on environmental contamination/cleanup and their instrumentation can't be used for this type of project.

Although the ESAL lab is very well equipped, it lacks a laser ablation ICP-MS (LA-ICPMS). The planned purchase of an LA-ICPMS would not only support this projects trace elemental analyses needs by providing high precision analyses on very small rock samples and water samples, it would expand the infrastructural needs of several faculty members in the state of Nevada. There are at least five faculty members in the UNLV Geoscience department and another faculty member at UNR who are currently sending samples to the Univ. of Arizona for these types of analyses. The purchase of an LA-ICPMS would greatly improve the analytical capacity of UNLV and UNR and would bring in researchers from other universities outside of the state.

By expanding the infrastructure (both physical and human) pertaining to shale gas/oil, NSHE has the opportunity to become a leader in addressing the multitude of fundamental issues related to shale gas/oil. Even if the Chainman or other mudrocks we propose to study do not turn out to be effective sources of energy, the knowledge gained in the proposed study can be transported around the globe. More and more countries are pursuing shale gas/oil opportunities because they provide relatively clean sources of energy. Currently burning of coal provides about 50 percent of the electricity used in the U.S. and it contributes about 40 percent of all U.S. carbon dioxide emissions, as well as other pollutants. Switching to natural gas would reduce carbon emissions by about 50 percent. Because the occurrences of mudrocks that are potential sources for this type of energy are widespread, the potential of natural gas in enormous (the Energy Information Agency estimates that there is enough shale gas to last 100 years at current consumption rates). Because of the global aspect of shale gas/oil, this project has the potential to significantly improve Nevada's competitiveness for federal and private industry research and development funding. In addition to projects mentioned elsewhere in this proposal, shale gas/oil projects are expanding in Canada and Western Europe. In fact, western Europe sees shale gas as a key way to get around gas supply issues from Russia that have left western Europe without gas resources because of pipeline disagreements between Russia and Ukraine in recent years. If countries like China, India and Australia, which use large quantities of coal for electricity, switched to natural gas the globe would see a dramatic reduction in emissions. Despite the need to move to renewable energy supplies, natural gas is a relatively clean transition energy source and fossil fuels will continue to be vital energy resources until at least mid-century.

Improving Competitiveness

The future of shale gas/oil projects is very bright. The successful establishment of a center of excellence in Nevada focused on this research topic, while these types of projects are still in their infancy, bodes incredibly well upon globally increasing our competitiveness for future collaboration with industry.

A recent Brookings Institution report pointed out the current existence of a "Strong geosciences knowledge base" in Nevada and this project would vastly expand current capabilities.

Advancement of NSHE/NSF goals

Nevada would like to be energy independent and eventually become an energy exporter. As demonstrated in other parts of the U.S., shale gas/oil is a huge area of expansion within the energy industry. The Williston basin in North Dakota is seeing such heightened exploration and production that the state's unemployment rate is approximately 3.5 percent and the state budget has a surplus in excess of a billion dollars. Shale gas exploration and development in the Appalachian basin has resulted in Pittsburg becoming a major center of the energy industry.

Another of NSHE's goals is to produce "trained technicians and professional architects, engineers, scientists, and contractors to provide the workforce needed for a clean energy economy". In the past decade, both the UNLV and UNR Geoscience Departments have seen a dramatic increase in hiring of their graduate students by energy companies. In the past five years ExxonMobil has hired more geology graduate students from UNLV than from any other university that they recruit at in the U.S. (out of approx. 45 universities in the nation). If shale gas/oil can be developed in Nevada then many of these highly trained scientists can stay in the state and contribute more directly to our economy while serving the needs of the industry.

This research project would also directly contribute to Nevada's Water Resources Goals to "accurately assess the total quantity and quality of available water resources in Nevada". Computer modeling would impact the goal to "improve predictive water management tools and develop new visualization tools for both scientific exploration and public education" and would y "Support increased production of trained technicians and professional scientists, engineers, and policy analysts in the field of water resources".

This project also has indirect ties to NSHE's goals to improve and protect the health of Nevada's citizens. The waste water associated with shale gas/oil extraction must be treated effectively. Not only is the waste water portion of this project essential for recycling scarce water resources, best practices must be in place in order to meet NSHE's goal to "Protect and advance public health, safety, and quality of life for all Nevadans as well as visitors to the State."

NSHE's definition of technology as "the application of science and engineering for practical purposes" clearly fits with our proposed research on shale gas/oil, water resources, and environmental issues related to shale gas/oil. Our project connects with each of the NSHE "Common Themes" in concrete ways.

This project meets NSF goals to support frontier research, innovation, and technology infrastructure while providing an educated population that can produce economic growth and social prosperity as alluded to in the previous section. We would use the $1,000,000/year funds in the grant to develop and implement discovery based learning in K-12 classrooms, a process that has been increasing in Nevada school districts. The newness of shale gas/oil means that there are many opportunities to advance our frontiers of knowledge (Discovery). ASTEM workforce must be developed in order to understand shale gas/oil issues (Learning). These advances can only be achieved if adequate instruments and facilities are in place (Research Infrastructure). And finally, Stewardship, gained through excellence in research and education can only be achieved for global problems if national resources are allocated to them. The proposed project is clearly in line with NSF's priority to further U.S. economic competitiveness.

3.2 **Results from Relevant Prior NSF and other Federal Support**

Dr. Andrew Hanson USGS: History and Origin of Mineral Deposits in northern Nye County, Nevada, $140,000. NSF: Orogen Hinterland Evolution: Testing Hypotheses using the Cretaceous to Eocene Stratigraphic Record in Eastern Nevada, USA, $164, 077: Two USGS grants are being used to study oil and gas resources in northern Nye County. Publications are in Hanson's bio sketch.

Dr. James H. Trexler

NSF research grant: "Collaborative proposal: Distribution and kinematics of Late Paleozoic deformation from southeastern California to northeast Nevada"; UNR portion = $241,052; 3 years. NSF research grant "Extent, style and tectonic significance of Pennsylvanian deformation in the Great Basin: a test of late Paleozoic models for the western U.S." $140,134; 2 years

Published results are included in Trexler's biographical sketch.

Jenny Chapman/Karl Pohlmann US DOE funding through contracts DE-AC08-90NV10845, DE-AC08-95NV11508, DE-AC08-00NV13609, DE-AC52-06NA26383, and DE-AC01-02GJ79491 supported field and laboratory investigations and numerical modeling of groundwater resources and contaminant transport in the Central Nevada region of interest in this proposal. Results include three published papers.

Jenny Chapman US DOE funding through DE-AC52-06NA26383 and DE-AC01-02GJ79491 supported numerical modeling of the environmental consequences of natural gas production from hydro-fracked wells in a tight-gas sandstone reservoir in the Piceance Basin, adjacent to a nuclear fractured test site. Results include a paper listed on Chapman's Biographical Sketch

Karl Pohlmann

Flow and Transport Modeling at the Climax Mine Site, Nevada National Security Site, U.S. DOE contract DE-AC52-00NV13609 Groundwater flow modeling incorporating alternative models of hydrogeologic framework and groundwater recharge, development of an averaged regional model, estimation of model and parametric uncertainty, and model calibration. Three peer-reviewed papers resulted from this work.

Dr. Brenda Buck Two grants from BLM ($1,365,000) between 2007-2011 were not directly related to the proposed project but they each enhanced the analytical capabilities of the ESAL Laboratory. 2002-2003, Co-investigator, Migration Properties of Depleted Uranium from Naval Ordnance in Arid Environments, China Lake, CA, U.S. Naval Facilities Engineering Command. $99,984. Two peer-reviewed publications resulted.

Dr. Giles M. Marion Dr. Marion has many projects and published papers over his scientific career that has spanned ≈ 40 years. His results include papers (112), NSF programs (9), NASA programs (11), and DOE programs (3).

Dr. Eric Marchand *BES-0239314 CAREER: Microbial-Based Engineering Approaches for Prevention and Treatment of Acid Mine Drainage; ($400,008)*. This research grant has supported 2 Ph.D. students, 3 M.S. students, and 5 undergraduate students at UNR. This project is relevant to the current submission due to the biological water treatment components of both projects, *EAR- 0838239 Investigating pesticide contamination in small lakes in Khorezm, Uzbekistan; ($139,995)*. This research grant has supported 2 M.S. students and has supported outreach and training efforts for scientists from Uzbekistan. It is relevant to the current submission because both projects focus on the interaction between contaminants and natural systems with a focus on the fate of contaminants during water treatment processes

Dr. Scott Tyler EPS-0447416 (RII); Scaling Environmental Processes in Heterogeneous Arid Soils (SEPHAS). $2,980,000 including cost share from State of Nevada, 05-08. This project was initiated to address the need to focus statewide research efforts on characterizing and quantifying the degree of heterogeneity in arid soil processes and how these heterogeneities can be scaled up and down. Funding also supported three NSF proposals (two Hydrology and one PIRE). Six publications were published from this work, DEB-0816726 Collaborative Research: Root Induced Changes of Soil Physical Properties Using Synchrotron X-ray Microtomography (CMT) and Micromechanical Simulations $121,111. The goal of this research is to quantify rhizosphere physical properties by employing CMT to visualize

physical root-soil structure interactions, using computer models to simulate root-induced structural alterations to the rhizosphere using micro-mechanical approaches, and estimating changes in rhizosphere hydraulic properties based on CMT imaging and inverse modeling. Two publications are published or in review and are listed in the proposal references. EAR-0929638 Collaborative Research: Facility Support: Transformation of Distributed Environmental Sensing $446,906. This project represents the initiation of the CTEMPs effort and has focused on instrument development and instrument support to the community of fiber optic temperature sensing systems. To date instrument users and collaborators have submitted or have prepared 7 published manuscripts and proceedings. Six publications, supported through the UNR component of the center have been published or are in review.

Dr. Markus Berli DOE-UGTA, $28,000, "Stress-Fracture-Permeability – Determining possible relation between current stress tensor and fracture permeability at Pahute Mesa"; EAR-0952272, $29,617, "Fire-Induced Changes of Soil Structure: Implications for Soil Hydraulic Properties and Coupled Erosion by Water and Wind", DEB-0817073, 0816726, $435,791, "Collaborative Research: Root Induced Changes of Soil Physical Properties Using Synchrotron X-ray Microtomography (CMT) and Micromechanical Simulations, EPS-0447416 (RII), $25,000, NSF EPSCoR Seed Grant on "Root induced changes in soil physical properties", EPS-0447416 (RII), $85,000, NSF EPSCoR Equipment Grant on "Secondary structure and its influence on mechanical properties of arid soils", USDA NRI under grant no. 2003-35107-13598, $193,000, "Compaction of Tilled Soils - Microscale Structural Dynamics Affecting Pore Space and Hydraulic Properties".

Dr. Amy Childress CTS-0093617; $375K + REU supplements; 2001-2007; "CAREER: A Comprehensive Experimental and Theoretical Investigation into Membrane Fouling". Four peer-reviewed journal publications resulted; 2) BES-0332432; $232K + REU supplements; 2003-2008; "Resolving the Discontinuity in Experimental and Theoretical Investigation of Nanofiltration Performance Modeling". Three 3 peer-reviewed journal publications resulted. Training of post-docs, graduate students, and undergraduate students resulted. These projects supported outreach or lower socioeconomic status 8th grade girls.

Dr. Wanda Taylor U.S. DOE - Earthquake hazards/seismic risk in Southern Nevada – from the source to the citizen, 2006–2010, $990,000. This funding purchased all of the resources mentioned in the Facilities section that are in the Applied Geophysics Center including the 4WD vehicles. Nine refereed papers were published and four are in progress. Nine graduate students were funded. **NSF**, Collaborative Research: Distribution and kinematics of Late Paleozoic deformation from southeastern California to northeast Nevada, National Science Foundation, 200 –2009, $241,052. We documented evidence in five ranges in northern Nevada that show at least four episodes of contraction during this time that many believe is a tectonically quiet time. Two refereed papers were published and two are in progress. Five graduate students were funded.

Dr. Chanwoo Park DOE: ***Nano-Coating, Structured Porous Surfaces for Evaporation/Boiling Heat Transfer Enhancement.*** Development of advanced nano/micro-scale, structured porous-layer surfaces for high performance two-phase heat exchangers. Structured porous-layer surfaces were used to provide increased area and nucleation sites for the boiling/evaporation heat transfer. A hydrophilic nano-scale oxidation layer was used to enhance surface wetting and two-phase heat transfer. These surfaces could significantly enhance waste water remediation. Three peer-reviewed publications resulted from this study.

Drs. Dev Chidambaran and Emil Geiger– New faculty members with no federal funding to date.

3.3 **Research Program**

Geologic (Tectonic and Stratigraphic) Framework for this Project

The structural and stratigraphic development of the western North American continental margin in Nevada during the Phanerozoic has been a focus of research for decades and is a classic locality for understanding continental margin tectonic processes (Burchfiel et al., 1992). This margin initially developed in the late Precambrian when the western edge of North America underwent rifting, followed by the development of a passive margin. The passive margin was subsequently overprinted and modified by several major deformation events.

The first deformational processes to alter the passive margin were contractional events in east-central Nevada. Late Paleozoic deformation is thought to be dominated by two major periods of deformation: the Late Devonian to Mississippian Antler and Permo-Triassic Sonoma orogenies (Burchfiel et al., 1992). Classic theories suggest that the Antler orogeny thrust the Roberts Mountain allochthon onto the western craton followed by a period of no tectonic activity in the Pennsylvanian and Permian. Following this, the Late Permian to Early Triassic Sonoma orogeny emplaced the Golconda allochthon above the Roberts Mountain allochthon (Burchfiel et al., 1992) (Fig. 2). However, recent studies suggest that deformation took place throughout the Pennsylvanian and Permian. These deformations are recorded as angular unconformities, folds and thrusts throughout Nevada (Fig. 3) (Trexler et al., 2004a; Cashman et al., 2008; Cashman et al., 2010). Unconformities show subjacent strata deformed by an event that is not recorded in the overlying strata and are interpreted as a record of tectonism (Fig. 3) (Trexler et al., 2004; Cashman et al., 2008). It was during late Devonian to Mississippian time when mudrocks that are the central theme of this proposal were deposited.

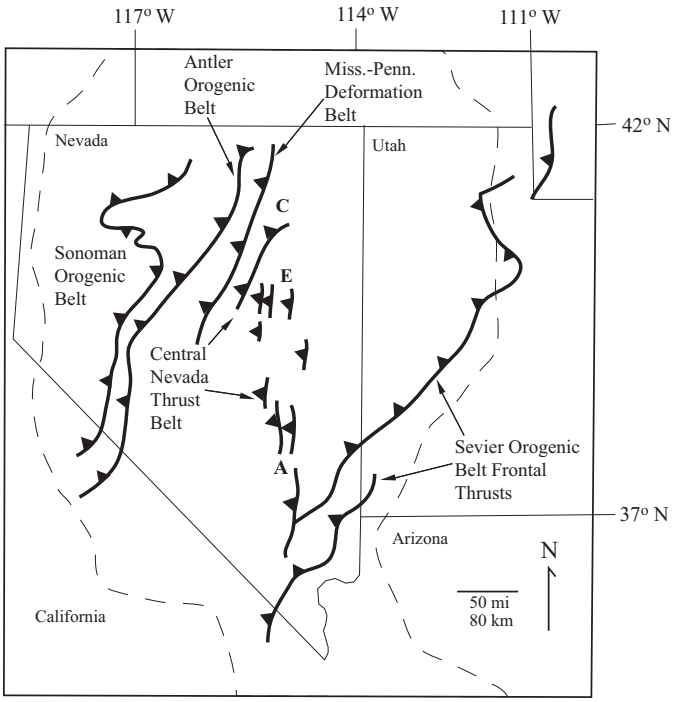

Figure 2. Map showing the locations of major belts of deformation in central Nevada. The study area for this project is adjacent to the Central Nevada Thrust Belt and extends to the west to the Antler Orogenic Belt. Limits of the Basin and Range province are shown by dashed line. A - Alamo, C - Carlin, E - Eureka (modified from Burchfiel et al., 1992; Taylor et al., 1993; Trexler et al., 2003).

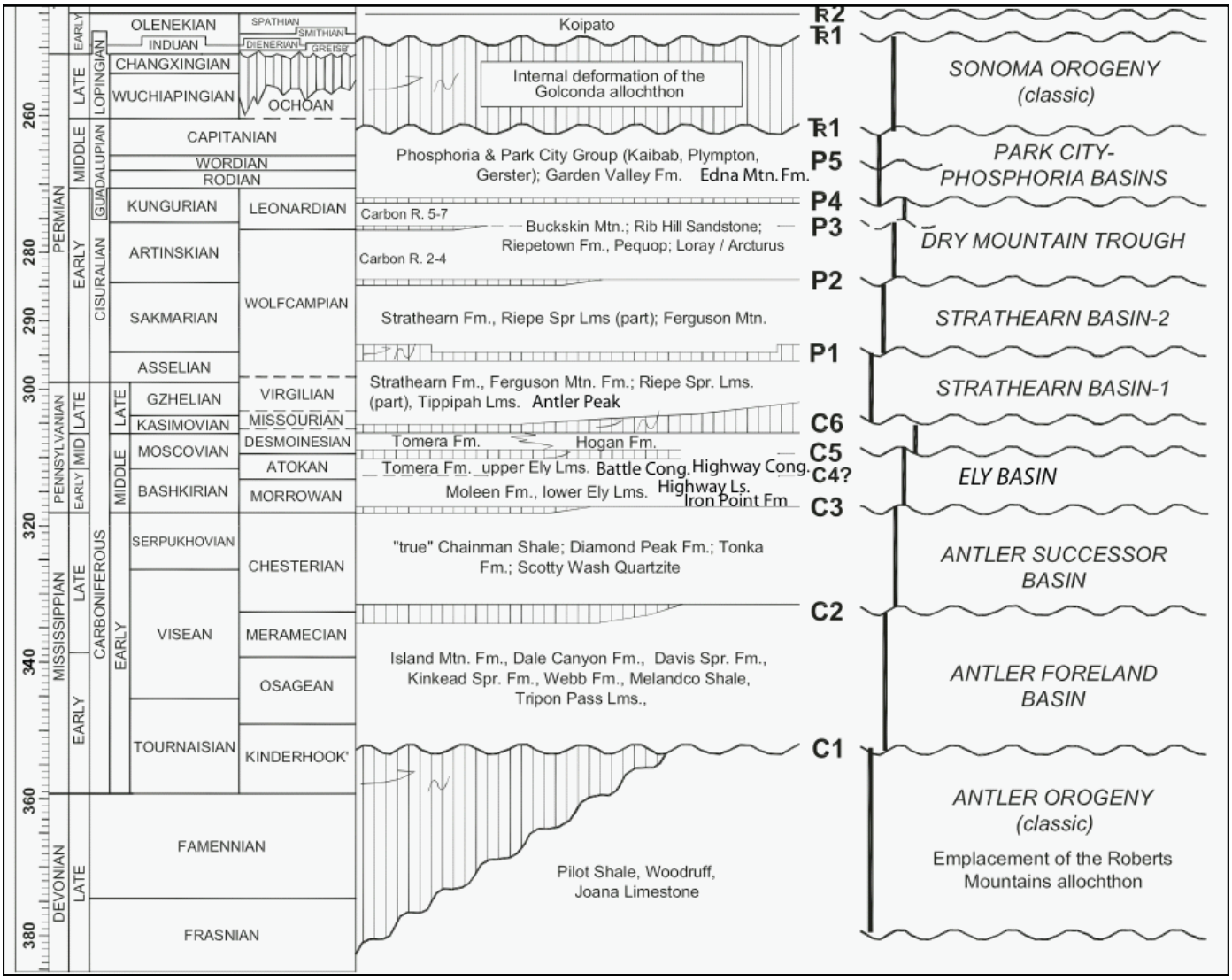

Fig. 3 Revised stratigraphic chart of Late Devonian to Earliest Triassic strata in east central Nevada (Cashman et al., 2008). The Pilot, Woodruff, Dale Canyon, Davis Spring, Webb, Melandco, "true" Chainman, Diamond Peak and two other units not shown here (the Gap Wash and Eleana) are the targets of this study.

Contractile deformation also occurred in the Mesozoic and altered the earlier structures and stratigraphic units. Armstrong (1968) proposed that the folds and thrusts in the White Pine Range represent the hinterland of the Sevier orogen. More recent studies suggest that the contractile structures are part of the central Nevada thrust belt (CNTB), which may represent a hinterland branch of the Sevier orogenic belt (Fig. 2) (Armstrong and Bartley, 1993; Taylor et al., 2000). The CNTB is bracketed between Late Permian and Cretaceous in age as seen by the deformation of Paleozoic to Cretaceous age strata (Taylor et al., 2000). This time frame allows the CNTB to be temporally associated with the formation of the Sevier orogenic belt. The CNTB is a north trending belt of contractional structures, continuous except where interrupted by Cenozoic normal faults, that can be traced for > 400 km

northward from the Pahranagat shear zone (~37°14'N) in southern Nevada to the northern Adobe Range (~41°19'N) (Taylor et al., 2000). At its southern end the CNTB projects toward thrusts and folds of the Sevier orogenic belt in southern Nevada (Fig. 2) (Armstrong, 1968). Part of the CNTB was previously identified as part of the Eureka belt in the area north and northwest of Railroad Valley (Speed, 1983; Speed et al., 1988) and the Garden Valley thrust system to the southeast of Railroad Valley (Bartley and Gleason, 1990; Armstrong and Bartley, 1993). Although no specific structure has been correlated across Railroad Valley, contractional structures located northwest and southeast of Railroad Valley lie approximately along strike of each other and have comparable styles and compatible timing brackets. Therefore the existence of a single, once-continuous fold-thrust belt seems clear. Although comprehensive stratigraphic descriptions lie outside the scope of this work (see Kellogg, 1963; Reso, 1963; Tschanz and Pampeyan, 1970; Best and Grant, 1987; Best et al., 1989; Taylor, 1990; Best and Christiansen, 1991; Hurtubise and du Bray, 1992), differences in stratigraphic relations of Paleozoic and Cenozoic rocks from one thrust plate to the next are important to structural correlation and in several instances are controversial because of a lack of good paleontological and geochronological control. The contractional features play a vital role in the burial and maturational history of the organic rich mudrocks that are the focus of this project. Thermal histories vary dramatically from one part of a basin to another because of structural overprinting as shown in the geologic map included as Fig. 4.

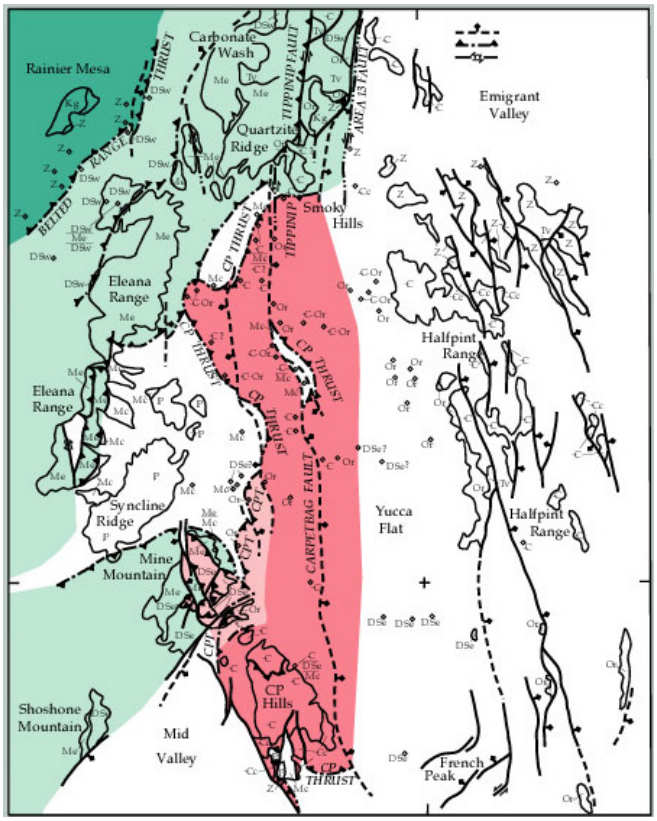

Figure 4. Geologic map of a portion of the Nevada Test Site showing complex structures that have significantly impacted the thermal history of the Chainman Shale (from Trexler et al., 2004a). Rocks shaded in green are in the hanging wall of thrusts that verge to the east and override the Syncline Ridge region. Rocks in shades of pink are in the hanging wall of a different thrust system that verges to the west and also overrides the Syncline Ridge region(lower middle-left side of figure). Conodont alteration index (CAI) data that constrain the burial history of the Chainman yielded results that are 3-4 in the green areas and 4-5 in the pink areas whereas at Syncline Ridge CAI values are about 1(i.e., significantly less thermally mature).

Extension in much of the Great Basin occurred episodically since the Cretaceous or late Eocene until today (e.g., Axen et al., 1993; Sonder and Jones, 1999; Henry and Ressel, 2000). In much of the northern Basin and Range province, normal faults occur in the Cretaceous to mid to late Eocene, and others occur in late Eocene to Oligocene time (e.g., Fryxell, 1988; Jayko, 1990; Taylor and Bartley, 1992; Hodges and Walker, 1992; Wells et al., 1998; Axen et al., 1993; Page, 1995; Camilleri, 1996). Cretaceous to mid to late Eocene extension is documented in north-central Nevada, northwestern Utah, and southeastern Idaho and is interpreted to be a product of extensional collapse of over-thickened crust that resulted from Mesozoic thrusting (e.g., Vandervoort and Schmitt, 1990; Wells et al., 1990, 1998; Camilleri, 1996). Recent studies in east central Nevada have documented extensional events that produced surface-breaking high angle normal faults (Druschke et al., 2009a, 2009b, 2011) beginning in the late Cretaceous.

In Nevada and Utah, evidence of late Eocene to Oligocene extension is the Snake – Stampede extensional system, which is interpreted to consist of the Seaman (breakaway) fault and the Snake Range and Stampede detachments (Taylor and Bartley, 1992; Axen et al., 1993). However, the largest amounts of extension typically occurred during the Miocene (Wawrzyniec et al., 2001). The latest episode of extension continues today (e.g., Caskey and Wesnousky, 1997; Lund and Black, 1998; Mattson and Bruhn, 2001; Taylor and Switzer, 2001). These Pliocene to Quaternary faults control the present topography in many areas (e.g., Stewart and Carlson, 1978). The uneven distribution of times of extension across the region suggests that transverse faults may be the along strike boundaries between areas with different ages of extensional fault systems. These temporal differences also impact timing of exhumation, and thus further complicate the thermal evolution of the Devonian-Mississippian mudrocks of interest.

The key time interval with respect to this proposal is the Late Devonian and Mississippian because several black, organic-rich mudrock units were deposited during that time. These include the Pilot, Woodruff, Dale Canyon, Davis Spring, Webb, Melandco, "true" Chainman, Diamond Peak, Gap Wash and Eleana (Fig. 3). Several studies have documented the organic rich nature of the Chainman Shale in Nevada (Poole and Claypool, 1984; French 1989) and the Chainman has been linked to oils produced in Railroad Valley and other parts of eastern Nevada using organic geochemical methods (French, 1989 Adhyar, 2011). The Pilot and Woodruff have also been shown to be organic rich but have not been geochemically linked to known hydrocarbons (Poole and Claypool, 1984) The Chainman is a proven oil generating unit; depending on the thermal maturity of the Chainman it can also be gas prone (at higher temperatures crude oil breaks down into natural gas). Most drilling that has penetrated the Chainman has not encountered significant gas. The Meridian #32-29 Spencer-Federal well (29-9N-57E, Permit 446, Railroad Valley, Nye County) drilled the Chainman in the deep part of Railroad Valley, had good oil shows, and produced a small amount of oil from a vertical, non-fracked well in the Chainman during testing (French, 1994). In other cases, drilling that penetrated the Chainman has shown that it can be gas prone; the Plains #27-1 Pluto well, 27-18N-61E, Permit 888, Robinson Summit, White Pine County, flared a significant amount of gas while drilling in the Chainman. However, the well was abandoned without testing because the well was planned as an oil well, not a gas well (pers. comm., J. Walker, 2011).

This simplified geologic history of central Nevada leads to the postulation of numerous hypotheses that we intend to test. Specific hypotheses are spelled out in the following section.

Hypotheses to be tested/Questions to be addressed

1. Several upper Devonian-Mississippian mudrocks in central Nevada may be shale gas/oil source rocks. These include the Chainman, Pilot, Woodford, Eleana, Diamond Peak, Dale Canyon, Davis Spring, Webb, Melandco and the Gap Wash. We will test this hypothesis by analyzing samples from these units for their total organic content (TOC), testing the quality of the organic material (using Rock-Eval) and by testing their thermal maturity (Tmax data derived from Rock-Eval).
2. The maturity of the mudrocks controls their viability as a shale gas/oil source rock.

In successful shale gas plays, the "sweet spot" for productivity is strongly linked to areas that are slightly overmature with regards to the oil window. Shale oil plays are strongly linked to thermal maturities that

are in the oil window. The regional distribution of thermal maturity indicators within the Chainman Shale are generally known but significant local variability also occurs (Fig. 4) and could strongly influence the distribution of where the Chainman is an effective source rock. The other mudrocks are not nearly as well constrained. We will test this hypothesis by continuing to analyze the maturity of the Chainman and by analyzing the maturity of the other mudrocks in greater detail. We will also import previously collected thermal data into our proposed GIS database and into the Petra computer software.

3. The distribution of hydrocarbon maturity in the Chainman Shale is controlled in part by three types of structural elements: Mesozoic thrust faults, Oligocene to Miocene low-angle normal faults, and Pliocene to Quaternary normal faults. The Jurassic to Cretaceous ~E-W thrust faults and folds of the variously named CNTB / Eureka belt / hinterland part of the Sevier orogenic belt cut through the region in which the Chainman Shale is exposed. The related thrust loading and/or exhumation likely influenced hydrocarbon maturity. These thrust faults and folds are locally structurally overprinted by Oligocene to Miocene Low-angle normal faults which are also generally directed E-W. Consequently these faults moved some of the Chainman Shale and the thrusts that cut it some km off strike of correlative structures. These faults are cut, in-turn, by Pliocene to Quaternary faults that in the region of the Chainman Shale are dominantly high-angle normal faults. These faults generated small and large basins, but some basins, such as Railroad Valley (the deepest in Nevada at ~ 10 km deep) also bury Chainman Shale, and thus, influenced it thermal maturity. This hypothesis will be tested by using new (proposed) and existing geologic maps to construct regional retrodeformable cross sections across the region of interest. These cross sections will constrain current depths of the Chainman Shale. In addition, through stepwise retrodeformation / reconstruction to Oligocene – Miocene (pre-low-angle normal faults) and to pre-thrust fault, the burial history of the Chainman Shale can be evaluated. These cross sections will also be useful to predict the present locations of aquifers at depth that are potential sources of water for hydro-fracking. The structural results will be incorporated with the existing and new thermal data.

4. The facies/internal stratigraphy of the Chainman Shale and locations of thrust faults are related.

In many fold and thrust belts throughout the world, the locations of steeper positions of thrust faults are controlled by the changes in geometries of a sedimentary basin. Where a basin floor steepens, the thrusts will steepen and where the floor becomes more gently inclined, so will the faults. Different depths of the thrust faults are commonly controlled by different parts of the stratigraphy. We suspect that the Chainman Shale influences the geometry of the thrusts faults at its level because areas to the east of the CNTB, the eastern and western parts of that belt, and areas to the west all have different internal stratigraphies in the Chainman (and lateral equivalents) interval. This hypothesis will be tested by using new (proposed) and existing geologic maps to construct regional retrodeformable cross sections across the region of interest. In this case, it will be critical to overlay stratigraphic information about the Mississippian units.

5. Prospective parts of the mudrocks will be identifiable based on an “Isotopic rollover”.

In other successful shale gas/oil plays, an unexplained “rollover” occurs in the ethane carbon isotope values when plotted against gas wetness. Under normal conditions the carbon isotopes of ethane become progressively less negative as gas wetness decreases (and as thermal maturity increases). However, the most prospective parts of shale gas basins are those in which the normal trend reverses itself and you see more negative carbon isotopic signatures of the gas as it becomes less wet. We will test this hypothesis by analyzing ethane carbon isotopic values along E-W and N-S sections that span the Chainman and other mudrocks.

6. We hypothesis that we will be able to distinguish different mudrocks from each other based on their inorganic trace element geochemistry. The mudrocks of interest in the study area have not yielded rich paleontological data. Fossils are sparse and the mudrocks are not reliably distinguished in the field even after decades of research. Past paleontological research has failed to produce reliable results that allow detailed stratigraphic resolution. This problem is compounded by the multitude of faults that cut the Chainman and other mudrocks; cross-fault correlations have been especially hard to constrain. However, recent studies in other shale gas/oil basins have successfully used trace element geochemistry in

mudrocks to allow correlations, to recognize previously undetected unconformities, and to determine sequence stratigraphic relationships (Fig. 5A-C).
We will test this hypothesis by analyzing surface transects of the mudrocks as well as vertical transects taken from cores and cuttings from wells in the basin. This will allow us to distinguish different mudrocks from each other.

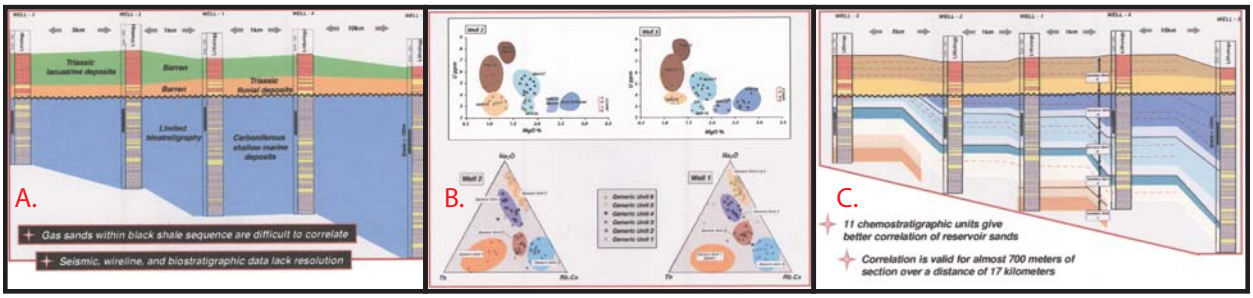

Fig. 5A-C. Strata from a poorly constrained Carboniferous section (the blue section in A) were analyzed using inorganic geochemistry. The results allowed identification of several different stratal sections that became correlatable based on their major and trace element geochemistry (B). This resulted in dramatically improve resolution of the section (C) (from Dix, 2011).

7. We hypothesis that trace element geochemistry can be used to distinguish different internal facies within the mudrocks as well as to distinguish different mudrocks. Recent research has beautifully illustrated the value of using inorganic geochemistry to correlate mudrocks that previously were not correlatable. In a study of Carboniferous mudrocks in Algeria that had limited fossils, seismic data, well log data and biostratigraphic control did not allow resolution of internal aspects of the black shale sequence of interest (Fig. 5A). By analyzing major and trace element inorganic content (Fig. 5B) the authors were able to dramatically improve correlations within an otherwise non-correlatable sequence (Fig. 5C). Being able to correlate mudrocks and constrain their internal geometries as illustrated in Fig. 5 is essential for successful hydro-fracking. We will test this hypothesis by analyzing surface transects of the mudrocks as well as vertical transects taken from cores and cuttings from wells in the basin. This will allow us to establish correlative relationships within an individual mudrock.
8. We hypothesize that only certain members of the Chainman Shale can be effectively fracked. Previous studies conducted within industry have suggested that only shales with a minor quartz silt content or a small amount of carbonate cement can effectively be fracked because those that lack these constituents are not brittle and cannot be artificially fractured (pers. comm. Dan Jarvie, 2010). We will analyze quartz and carbonate content throughout the Chainman in order to address this issue. We will mechanically test samples using equipment already available in Dr. Berli's lab at DRI. Once we have compiled all structural, thermal, pre-existing and proposed new seismic data, we will select the best site for a test well.
9. We hypothesis that the chemistry of expelled fluids from shale gas/oil wells will compositionally evolve over time. We will test this hypothesis by analyzing the chemistry of fluids through time. We will employ models developed by Dr. Marion such as FREZCHEM, CALGYP, and CHEMCHAU in order to test this hypothesis and to understand how the fluids change through time.
10. We hypothesis that the chemistry of pore fluids recovered from fracked mudrocks will differ from the chemistry of pore fluids within porous/permeable conventional reservoirs that are juxtaposed against the shales. We will test this hypothesis by analyzing the chemistry of fluids from the fracked shale and adjacent reservoir fluids. We are not aware of this type of analyses ever having been performed but want to understand the related chemistries in order to be predictive about what types of pore fluid chemistries future shale gas projects might incur based on pre-drill testing of nearby conventional reservoir fluids.
11. We hypothesize that biological and physicochemical treatments of wastewater can effectively be developed. Dr. Marchand employs these treatment processes for water or wastewater and for identifying

strategies to optimize water reuse/resource recovery systems (Achilli et al., 2011). Some of the pressing questions/issues that will be tested in this project are: (1) identifying the optimum treatment process(es) for contaminated gas recovery wastewater; (2) assessing the suitability of treated water for various reuse purposes; and (3) developing low-energy use treatment processes that are synergistic with existing operations at shale gas/oil recovery operations.

12. We hypothesize that developing engineered solutions, such as salinity gradient technology, plus forward and reverse osmosis membrane processes used in novel ways can be developed for water/wastewater treatment. Dr. Childress and Achilli have been working with these membrane processes (MD, FO, PRO) for water/wastewater treatment (with consideration of energy) (Achilli et al., 2010). They will also test which treatment systems are best for these processing shale gas/oil water. Their research will test whether the best system can be predicted based simply on chemical, physical, and biological analyses of the process waters. At a basic level, the membrane serves as the interface between the process water and the treated water and will play a critical role. But most likely, more important will be the role of the driving force (temperature, concentration, or pressure) for the various membrane processes and the engineering of a pre-treatment process as well as the final process itself.

13. Anaerobic bioremediation of contaminants can be effective in ground water.
Dr. Chidambaram's research focuses on contaminant treatment and energy recovery (Chidambaran et al., in press). He will test the viability of addressing remediation of inorganics and organics in the ground water using bio-nano-catalytic methods (microbial). His research also benefits from synchrotron based microspectroscopic techniques that characterize the samples.

14. Effective treatment systems based on contaminant classes and contaminant properties specific to shale gas/oil operations can be developed. Dr. Kolodziej works on contaminant identification – particularly contaminants of emerging concern (Kolodziej et al., 2004). Given the widespread public concern about the environmental effects of natural gas recovery, and the observed adverse effects on water quality associated with natural gas recovery, it is clear that efficient, yet cost-effective, solutions to hydro-fracking impacts on water quality are not currently available. Dr. Kolodziej is interested in approaching this water quality problem, using a mechanistic approach, to design systems that are effective for the specific contaminant classes and their properties. Dr. Kolodziej will address the challenge of maintaining water quality through all aspects of the natural gas recovery and production process by investigating the following key research questions:

1) What contaminants are most problematic for natural gas recovery? What compounds are largely responsible for observations of water quality degradation? He proposes to better characterize and understand contaminant occurrence, concentrations, and predicted environmental fate in hydro-fracking fluids and production water. This is a necessary first step to design an efficient treatment process. We collectively need to understand the contaminants and their chemical properties to build appropriate treatment barriers for them.

2) What are the potential treatment systems we could implement to improve water quality and mitigate adverse impacts of natural gas production? We hypothesize that once we have focused our efforts on specific classes of contaminant, we can evaluate a range of treatment technologies at laboratory and pilot scales for contaminant removal. We propose to focus on the development or use of sustainable, low infrastructure, low energy and chemical footprint treatment technologies as much as possible, though these criteria cannot always be met given the range of economic and technological solutions currently available.

15. Heat transfer is water treatment facilities is a major control on their viability as well as on the economics of these structured systems. Dr. Park is an expert on heat exchanger technology for the collection of waste heat and high efficiency cooling systems. He will work on new methods to improve heat transfer technology.

16. Considering the large quantities of water that may be required for extraction of shale gas/oil, it will be critical that the amount of water successfully reclaimed through treatment for other uses be maximized. This is particularly important in an arid region like the Great Basin where water resources are currently limited and future demands are only going to increase as the population of the southwestern

U.S. continues to grow. Whether process water is reused for further production, returned to groundwater reservoirs (fresh or saline), or reclaimed for other uses on the surface will hinge on the successful development of cutting edge treatment technologies that minimize energy consumption and treatment byproducts. Computer modeling by our groundwater team (Chapmann, Pohlmann, and Tyler) will assess the availability of water supplies but can also be used to address other important water related issues. Specific examples include: 1) Management of water supplies and estimation of sustainable yield. What are the impacts on existing supplies of different approaches to providing large quantities of water? For example, how do alternative pumping regimes and/or local verses inter-basin transfer impact availability? Yield estimates are an important challenge in the Great Basin where subsurface data are scarce. Addressing this issue requires integration of knowledge about regional stratigraphy and structure, lithology, tectonics, geochemistry and hydrology. Quantifying the uncertainty in sustainable yield will be an integral part of this analysis, as it is an important contributor to the analysis economic/environmental costs and sustainability. 2) Characterization of impacts. Precise monitoring of groundwater conditions, including pressure changes, hydraulic head, and flow will be needed to characterize impacts of groundwater production and water reinjection, as well as to evaluate estimates of sustainable yield. An assessment of these monitoring systems would provide information for applications for related purposes in other settings.

Long-Term Research Goals and Intellectual Focus: As mentioned elsewhere, the newness and importance of hydraulic fracking and shale gas/oil projects naturally lend themselves to important new study. Our goal is to study how/why certain resource targets work, to understand the essential geologic constraints upon them, to establish best practices for their development (especially in regions where water resources are scarce), and to develop and test new engineering solutions for treatment and use of water in these systems while maintaining a sustainable environment.

Planned Research Activities: Our first efforts will be to constrain the stratigraphic and thermal evolution of the mudrocks of interest in this project. We will conduct extensive geologic (field and laboratory) research in order to 1) distinguish different mudrock units, 2) determine the structural history of the basins these strata were deposited in and determine their burial histories, 3) measure the quartz and carbonate content of the mudstones because these factors control whether the shales can be fracked, and 4) to understand the organic characteristics of these rocks. A second effort will be aimed at determining the availability of water resources in the region in order to determine if sufficient quantities are present for hydro-fracking activities. This effort will consist of two parts: 1) determining the quantity of groundwater in the region, and 2) assessing the viability of using water being excavated from gold mines in northern Nevada as a source of water for fracking. Our third efforts will be aimed at developing and testing new and innovative ways to address water contamination, remediation, and energy generation.

Integration with Education: All senior participants will be involved in supervising post-docs, graduate students and undergraduate students enrolled at UNLV, UNR and DRI. The UNLV Geoscience Department has been working with the West Career Technical Academy (a magnet science and technology high school in Clark County) and Summerlin High School faculty in the past and we anticipate partnering with them in order to involve high school science students in this project. Dr. Childress has a history of incorporating high school girls into engineering projects and we anticipate that to occur with this project as well. All UNR and UNLV faculty will be able to incorporate new results and concepts into undergraduate and graduate classes that they teach at their respective institutions.

Role and Intellectual Contribution of Lead Participants: Drs. Hanson and Trexler will lead the geologic efforts to distinguish the different mudrocks. Drs. Cashman and Taylor will study the structural evolution of the basins. Hanson will work on the thermal maturity of the strata as well as on the molecular organic make-up of the mudrocks. Hanson, Trexler, Cashman and Taylor will all be involved in putting all geologic information into a GIS database and manipulating the data within Petra software. Drs. Buck and Sudowe will help interpret analytical results.

Investigators Chapmann, Pohlmann and Tyler will lead the hydrogeologic efforts to determine the availability of groundwater within the study area. They will collect data that already exist and model groundwater flow, volumes, and aquifer geometries using computer facilities currently available at DRI.

Pohlmann, Chapmann and Tyler will also supervise any well testing that takes place using hydrologic tools currently available at DRI. Buck and Sudowe's labs will be utilized to test the chemistry of the water to determine if the available water is of high enough quality to be used for hydro-fracking.

Drs. Childress, Chidambaran, Kolodziej, Marchand, Achilli, Marion, Geiger, and Park will all work on engineered solutions to water remediation. They will also continue fundamental research on developing membranes and processes focused on using waste water to generate electricity (Childress, Achilli), maximizing the most effective heat transfer technology in waste water systems (Park), understanding the fate and transport of contaminants (Kolodziej and Tyler), developing new analytical methods for detecting trace compounds that are harmful to humans (Kolodziej), developing new in-situ sensors for monitoring purposes (Geiger), using computer models to understand organics in the waste water effluent (Marion), and testing methods of anaerobic remediation and use of nanomaterials as catalysts to remove contaminants (Chidambaran). Drs. Tyler and Berli will study processes that control reactive transport and phase evolution during fracking.

Major Challenges, Novelty/Originality of this Project: Although there may be more, we are only aware of one peripherally related research program (at Penn State where the focus is on shale fractures and environmental monitoring). Because shale gas and shale oil resources are new, they provide a fertile ground for new/novel research. As with any new research arena, we expect that challenges and opportunities will arise that we do not foresee at this time.

Organization and Administration of this Project: This project will be headed by Dr. Hanson who is the P.I. on the project; he will oversee all of the geologic components of the project. Dr. Childress is serving as the co-P.I. and will oversee all of the engineering aspects of the project. Dr. Berli has agreed to be the key contact person at DRI. We have budgeted one position for a Project Manager and that person will coordinate all of the administrative responsibilities for the project.

Resources: Available and Planned: A full list of available facilities is provided elsewhere in this proposal. Current expertise exists in the following fields: structural geology, sedimentology/stratigraphy, organic geochemistry, thermal assessment of strata, groundwater hydrogeology, geochemical modeling, engineering solutions for wastewater treatment, radionuclides in water, and fluid flow through fractured porous media.

This proposal seeks to hire faculty members, post-docs and contractors that would fill in gaps in expertise in organic chemistry, geophysics, petrophysics (microporosity/micropermeability), GIS database development, and use of 3D software for linked complex surface and subsurface data sets.

Means of Developing an Interactive, Collaborative Approach Involving Investigators:

Almost all of the investigators for this project have met each other and many of us have worked with several members of this team on past projects. This proposal would link all of us together in ways that have not occurred in the past but if the collegiality and helpfulness that characterized the assembly of this proposal is any indicator, then we have good reason to believe that this team will work interactively and collaboratively. We fully expect the geoscientist to bring knowledge and understanding of the mudrocks and their attributes to the engineers who will deal with the waste waters that will be produced and studied. The hydrogeologists and the structural geologists will work together to produce an integrated model of the 3D geometries of the geologic units of interest in this project.

Articulate the Contribution of Partners and How Their Participation is Essential: Our plan is to intensively concentrate on the geologic components of this project during the first two years. This will enable us to conduct field work, to test rocks in the lab, to generate new seismic data and integrate it with existing data, and to plan and execute a stratigraphic test well. The hydrogeological team will also be actively engaged in researching the availability of ground water resources during the early stages of the project. The engineering team will continue to work on new methods and tools for treatment schemes and will begin testing pore waters from existing petroleum reservoirs in Nevada. During the later years, the engineering group will work directly with waste water produced from the test well that is planned in year 3.

Strategy for Future Research and Innovation: We envision this project as being the impetus for a new Center of Excellence related to shale gas and shale oil resources. Best practices developed here can be

translated to similar projects around the globe. We anticipate future funding from industry that will allow us to continue to test rocks and fluids from other shale gas/oil projects in order to understand if variability occurs from one project area to another. If so, we expect to be able to research new problems and concepts as they arise using the infrastructure developed as part of this project.

Estimated Numbers of Postdoctoral, Graduate, and Undergraduate Research Participants: Our budget includes funding for a total of 6 post-doctoral scholars, 9 Ph.D. students, and funds to pay undergraduate students. These positions will be at all three institutions.

How Infrastructure Will Enable Future Success: Requested equipment and personnel will continue to bring value to NSHE long after this project is completed. A state of the art molecular organic geochemistry lab will remain in place at UNLV and can take the place of the lab that is being closed due to retirement at Stanford University. The only other universities with comparable facilities are at the University of Oklahoma, North Carolina State University, and Indiana University. The addition of an LA-ICP-MS will benefit a multitude of researchers in the Geoscience and Engineering departments at UNLV and other universities and will be an important component of the ESAL recharge center. We expect that such a facility would draw in researchers from numerous universities, which would raise the research visibility of the university.

The addition of Micro-CT capacity at DRI will dramatically improve research capabilities focused on very small features. The equipment will be available for a multitude of research projects that range from the study of fractured media to pores in crop-growing soils.

The LC/MS, GC, ion chromatograph, potentiostat, surface tension analyzer, computers, sensors, and membrane treatment systems can all be used for other non-shale gas/oil water related research. These will continue to add value to the UNR engineering departments in the future. Although NSF has not traditionally funded petroleum linked research, the support of the Penn State's Sustainability Research Coordination Network (related to the Marcellus Shale), and the new GOALI program at NSF that jointly funds research in collaboration with industry (the American Association of Petroleum Geologists is one such group) are signs that NSF is expanding its support into these types of research projects.

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Speed, R.C., Elison, M.W., and Heck, R.R., 1988, Phanerozoic tectonic evolution of the Great Basin, *in* Ernst, W.G., ed., Metamorphism and crustal evolution of the western United States, Rubey Volume 7: Englewood Cliffs, New Jersey, Prentice-Hall, p. 572-605.

Stewart, J.H., and Carlson, J.E., 1978, Geologic map of Nevada: U.S. Geological Survey, scale 1:500,000.

Taylor, W.J., 1990, Spatial and temporal relations of Cenozoic volcanism and extension in the North Pahroc and Seaman Ranges, eastern Nevada, *in* Wernicke, B.P., ed., Basin and Range extensional tectonics near the latitude of Las Vegas, Nevada: Geological Society of America Memoir 176, p. 181-194.

Taylor, W.J., Bartley, J.M., Fryxell, J.E., Schmitt, J.G., and Vandervoort, D.S., 1993, Tectonic style and regional relations of the central Nevada thrust belt, *in* Lahren, M.M., Trexler, J.H., Jr., and Spinosa., C, eds., Crustal Evolution of the Great Basin and Sierra Nevada: Cordilleran/Rocky Mountain Section, Geological Society of America Guidebook, 1993, Reno, Nevada, p. 57-96.

Taylor, W.J., Bartley, J.M., Martin, M.W., Geissman, J.W., Walker, J.D., Armstrong, P.A., and Fryxell, J. E., 2000, Relations between hinterland and foreland shortening: Sevier orogeny, central North American Cordillera: Tectonics, v. 19, p. 1124-1143.

Taylor, W.J.**,** and Bartley, J.M., 1992, Prevolcanic extensional breakaway fault, White River Valley, Nevada, and regional implications: Geological Society of America Bulletin, v. 104, p. 255-266.

Trexler, J. H., Jr., Cashman, P. H., Cole, J. C., Snyder, W. S., Tosdal, R. M., and Davydov, V. I., 2003, Widespread Effects of Mid-Mississippian Deformation in the Great Basin of western North America: Geological Society of America Bulletin, v. 115, no. 10, p. 1278-1288.

Trexler, J.H., Jr., Cashman, P.H., Snyder, W.S., and Davydov, V.I., 2004a, Late Paleozoic tectonism in Nevada; timing, kinematics, and tectonic significance: Geological Society of America Bulletin, v. 116, p. 525-538.

Trexler, J.H., Jr., Cashman, P.H., Snyder, W.S., and Davydov, V.I., 2004b, The western margin of North America after the Antler orogeny: Mississippian through Late Permian history in the Basin and Range, Nevada, in Haller, K., and Wood, S., eds., Geological Field Trips in Southern Idaho, Eastern Oregon, and Northern Nevada, Volume USGS Open File Report: Boise, Boise State University, p. 18-35.

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Vandervoort, D.S., and Schmitt, J.G., 1990, Cretaceous to early Tertiary paleogeography in the hinterland of the Sevier thrust belt, east-central Nevada: Geology, v. 18, p. 567- 570.

Wawrzyniec, T.F. Geissman, J.W., Anderson, R.E., Harlan, S.S., and Faulds, J., 2001, Paleomagnetic data bearing on style of Miocene deformation in the Lake Mead area, southern Nevada: Journal of Structural Geology, v. 23, no. 8, p. 1255-1280.

Wells, M.L., Dallmeyer, R.D., and Allmendinger, R.W., 1990, Late Cretaceous extension in the hinterland of the Sevier thrust belt, northwestern Utah: Geology, v. 18, p. 929- 933.

Wells, M.L., Hoisch, T.D., Peters, M.T., Miller, D.M., Wolff, E.D. and Hanson, L.M., 1998, The Mahogany Peaks fault, a Late Cretaceous-Paleocene normal fault in the hinterland of the Sevier orogen: Journal of Geology, v. 106, p. 623-634.

5. **Biographical Sketches**
DR. ANDREW D. HANSON

Professional Preparation

Ph.D., Geological & Environmental Sciences, Stanford University (4/99)
M.S., Geological Sciences, San Diego State University (6/93)
B.S., Nursing, Montana State University (6/79)

Appointments

University of Nevada Las Vegas, Department of Geosciences, Associate Professor; effective 7/1/2006
University of Nevada Las Vegas, Department of Geosciences, Assistant Professor; 8/00 – 7/06
Texaco International Exploration Division, Bellaire, TX, Exploration Geoscientist; 12/98 - 5/00

Publications (*indicates Hanson graduate advisee)
(five most closely related)

1. Hudson, Samuel M.*, and **Hanson, Andrew D.**, 2010, Hydrocarbon migration within La Popa basin, NE Mexico and implications for hydrocarbon migration adjacent to other salt structures; American Association of Petroleum Geologists Bulletin, v. 94, p. 273-291.
2. Ludington, Steve, John, D.A., Muntean, J.L., **Hanson, A.D.,** Castor, S.B., Henry, C.D., Wintzer, Niki, Cline, J.S., and Simon, A.C., 2009, Mineral-resource assessment of northern Nye County, Nevada; a progress report: U.S. Geological Survey Open-File Report 2009-1217, 13 p.
3. **Hanson, Andrew D.**, Ritts, Bradley D., and Moldowan, J. Michael, 2007, Organic geochemistry and thermal maturity of oils and Upper Paleozoic and Mesozoic potential source rocks in the Ordos basin, north-central China; American Association of Petroleum Geologists Bulletin, v. 91, p. 1273-1293.
4. Fildani, Andrea, **Hanson Andrew D.,** Chen, ZhengZheng, Moldowan, Michael, Graham, Stephan A., and Arriola, Pedro Raul, 2005, Geochemical characteristics of oil and source rocks and implications for petroleum systems, Talara basin, northwest Peru; American Association of Petroleum Geologists Bulletin, v. 89, p. 1519-1545.
5. **Andrew D. Hanson**, Bradley D. Ritts, David Zinniker, J. Michael Moldowan, and Ulderico Biffi, 2001, Upper Oligocene lacustrine source rocks and petroleum system of the northern Qaidam Basin, NW China, American Association of Petroleum Geologists Bulletin, v. 85, p. 601-619.

(five other significant publications)

1. P. Druschke*, **A.D. Hanson**, M.L. Wells, G.E. Gehrels, D. Stöckli, 2011, Paleogeographic isolation of the Cretaceous to Eocene Sevier hinterland, east-central Nevada: Insights from U-Pb and (U-Th)/He detrital zircon ages of hinterland strata; GSA Bulletin, v. 123, p. 1141-1160.
2. Druschke P.*, **Hanson, A.D.**, and Wells, M.L., 2009, Structural, stratigraphic, and geochronologic evidence for extension predating Palaeogene volcanism in the Sevier hinterland, east-central Nevada, *in* Ernst, W.G. ed. International Geology Review Special Issue: Rise and Fall of the Nevadaplano – Part 1, v. 51, p. 743-775.
3. Druschke, Peter*, **Hanson, Andrew D.**, Wells Michael L., Rasbury, Troy, Stockli, Daniel F., and Gehrels, George, 2009, Synconvergent surface-breaking normal faults of Late Cretaceous age within the Sevier hinterland, east-central Nevada; Geology, v. 37, p. 447-450.
4. Druschke, Peter A.*, Jiang, Ganqing, Anderson, Thomas B. and **Hanson, Andrew D.**, 2009, Stromatolites in the Late Ordovician Eureka Quartzite: implication for microbial growth and preservation in siliciclastic settings: Sedimentology, v. 56, p. 1275-1291.

5. Graham, Stephan A., Chamberlain, C. Page, Yue, Yongjun, Ritts, Bradley D., **Hanson, Andrew D.,** Horton, Travis W., Waldbauer, Jacob R., Poage, Michael A., and Feng, X., 2005, Stable isotope records of Cenozoic climate and topography, Tibetan Plateau and Tarim basin; American Journal of Science, v. 305, p. 101-118.

Synergistic Activities

1) Participant/presenter at "Teaching Sedimentary Geology in the 21st Century" NSF sponsored workshop; 2) Supervisor of 6 female graduate students and 3 female undergraduate students; supervisor of first-generation college students; supervisor of African-American female; supervisor of two Latina students; 3) Teach and conduct research at an EPSCoR university that is one of the 10 top most-diverse universities (US News and World ranking); 4) Serve as Associate Editor for "Journal of Marine and Petroleum Geology, 2008-present); 5) Established and lead research consortium with industry (Director of "Thermal Anomalies around Salt" industry consortium).

Collaborators and Co-Editors

Dr. Tom Anderson, retired; Dr. Octavian Catuneanu, Univ. of Alberta; Dr. Steve Castor, Nevada Bureau of Mines and Geology (NBMG); Dr. Jean Cline, UNLV; Dr. Peter Druschke, ExxonMobil; Dr. Chris Henry, NBMG; Dr. Sam Hudson, ConocoPhillips; Dr. George Gehrels, Univ. of Ariz.; Dr. Kate Giles, Dr. Ganqing Jiang, UNLV; New Mexico State Univ., Dr. Tim Lawton, New Mexico State Univ.; Dr. Steve Ludington, USGS; Dr. Mike Moldowan, Stanford Univ.; Dr. John Muntean, NBMG; Dr. Troy Rasbury, Stony Brook Univ.; Dr. Bradley D. Ritts, Chevron Corp.; Dr. Adam Simon, UNLV; Dr. Daniel Stockli, UT Austin; Dr. Quanren Yan, Chinese Academy of Science (CAGS); Dr. Zhongqi Wang, CAGS; Dr. Michael Wells (UNLV); Niki Wintzer, USGS

Graduate and Postdoctoral Advisors

Dr. Stephan A. Graham (Stanford University, PhD advisor); Dr. Gary H. Girty (San Diego St., MS advisor)

Thesis and Postgraduate-Scholar Sponsor

Current: PhD - Sarah Evans; MS - Ines Yurchenko, Nick Downs, Carl Swenberg, Yuki Agulia BS – Brett Perry, Margarita Rodriquez.

Past: Postdoctoral Scholar - Dr. Brett McLaurin (Asst. Prof, Bloomsburg University, PA); PhD - Dr. Tom Muntean (Asst. Prof, Adrian College), Dr. Peter Druschke (ExxonMobil, Houston);
MS -Laura Eaton (PhD student, Univ. of Minnesota), LaOde Ahdyar (ExxonMobil, Jakarta), Steven Forrester (Providence Engineering, Baton Rouge), Nate Suurmeyer (Shell Oil, Houston), Kati Gibler (female, minority owner, Gibler Geotechnical Consulting); BS – Nick Miller (MS student, Colorado School of Mines), Corrine Griffing (PhD student, Univ. of British Columbia), Rochelle Jackson.

AMY E. CHILDRESS

Professional Preparation

B.S. Civil Engineering, 1992, University of Maryland, College Park
M.S. Environmental Engineering, 1993, University of California, Los Angeles
Ph.D. Environmental Engineering, 1997, University of California, Los Angeles

Appointments

2008-present	Chair, Dept Civil and Environmental Eng, Univ Nevada, Reno
2008-present	Professor, Dept Civil and Environmental Eng, Univ Nevada, Reno
2008	Visiting Professor, National University of Costa Rica
2004-2008	Director, Environmental Engineering Program, Univ Nevada, Reno
2002-2008	Associate Professor, Dept Civil and Environmental Eng, Univ Nevada, Reno
2004	Visiting Associate Professor, University of New South Wales, Sydney, Australia
1997-2002	Assistant Professor, Dept Civil and Environmental Eng, Univ Nevada, Reno

Publications **(selected from >35 peer reviewed)** *indicates Childress advisee
(five most closely related)

1) Antony, A., Low, J.H., Gray, S., **Childress, A.E**., Le-Clech, P., Leslie, G., "Scale Formation and Control in High Pressure Membrane Water Treatment Systems: A Review", Journal of Membrane Science, in press.
2) A. Achilli*, A., Marchand E. A., and **Childress, A.E.**, "A Performance Evaluation of Three Membrane Bioreactor Systems: Aerobic, Anaerobic, and Attached-Growth", Water Science and Technology, Vol. 63 (12) June 2011, pages 2999-3005.
3) Suárez, F., Aravena, J., Hausner, M.B., **Childress, A. E.**, and Tyler, S. W., "Assessment of a Vertical High-Resolution Distributed Temperature-Sensing System in a Shallow Thermohaline Environment", Hydrology and Earth System Sciences, Vol. 15 (3) March 2011, pages 1081-1093.
4) Suárez, F., **Childress, A. E.,** and Tyler, S. W., "Temperature Evolution of an Experimental Salt-Gradient Solar Pond", Journal of Water and Climate Change, Vol. 1 (4) 2010, pages 246-250.
5) Achilli, A.*, Cath, T.Y., and **Childress, A.E.**, "Selection of Inorganic Based Draw Solutions for Osmotically Driven Membrane Processes", Journal of Membrane Science, Vol. 364 (1-2) November 2010, pages 233-241.

Five other significant publications

6) Achilli, A.* and **Childress, A.E**., "Pressure Retarded Osmosis: from the Vision of Sidney Loeb to the First Prototype Installation", Desalination, Vol. 261 (3), October 2010, pages 205-211.
7) Suárez, F., Tyler, S. W., **Childress, A. E.**, "A Theoretical Study of a Direct Contact Membrane Distillation System Coupled to a Salt-Gradient Solar Pond for Terminal Lakes Reclamation", Water Research, Vol. 44 (15), August 2010, pages 4601-4615.
8) Suárez, F., Tyler, S. W., and **Childress, A. E.**, "A Fully Coupled, Transient Double-Diffusive Convection Model for Salt-Gradient Solar Ponds", International Journal of Heat and Mass Transfer, Vol. 53 (9-10), April 2010, pages 1718-1730.
9) Achilli, A.*, Cath, T.Y.*, and **Childress, A.E**., "Power Generation with Pressure-Retarded Osmosis: Influence of Operating Conditions", Journal of Membrane Science, Vol. 343 (1-2), November 2009, pages 42-52.
10) Martinetti, C.R.*, **Childress, A.E.**, and Cath, T.Y., "Advanced Membrane Processes for Desalination of Concentrated Reverse Osmosis Brines", Journal of Membrane Science, Vol. 331 (1-2), April 2009, pages 31-39.

Synergistic Activities

Past President (2009), President-Elect (2008), Vice-President (2007), Board Member (2006) and Newsletter Editor (2001-2006) of the Association of Environmental Engineering and Science Professors (AEESP). This is an association of over 800 professors, mostly from the U.S., in the field of environmental engineering and science. The Association assists its members in improving education and research programs, encourages graduate education, and serves the profession by providing information to government agencies and the public, and provides direct benefits to its members.

Served as visiting professor at National Univ. of Costa Rica through the University Studies Abroad Consortium – taught Environmental Sustainability: The Issues, the Science, and the Politics, 5-7/2008

Lead 5-year engineering and science outreach program for 8th grade lower SES girls as part of NSF CAREER grant (6/01-5/06)

Acquired several undergraduate research and instructional development grants including: Research Experiences for Undergraduates supplement to NSF CAREER grant, Instructional Enhancement Grant for "Colloid and Surface Chemistry", Faculty-Directed Undergraduate Research Project, Undergraduate Initiated Research, "Water Environment Education in the Mobile Engineering Lab"

Environmental Engineering Foundation (EEF) Board of Directors; Advisory Board of Desalination and Water Treatment

Collaborators and Co-Editors

Ed Beaudry (Hydration Technology Innovations), Robert Cheng (Long Beach Water Department), Shane Cox (UNSW), Keith Dennett (UNR), Michael Flynn (NASA), Miles Greiner (UNR), Stephen Gray (UNSW), Ken Hunter (UNR), Kwang Kim (UNR), Ed Kolodziej (UNR), Pierre Le-Clech (UNSW) Greg Leslie (UNSW), Eric Marchand (UNR), Giles Marion (DRI), Glenn Miller (UNR), Chanwoo Park (UNR), Don Phipps (Orange County Water District), Scott Tyler (UNR), Rich Wirtz (UNR)

Graduate Advisor:

Menachem Elimelech, Yale University

Thesis Advisor and Postgraduate Scholar Sponsor (19 total):

Andrea Achilli, completed Ph.D. student in August 2009, currently post-doctoral associate
Katie Bowden, Kerri Hickenbottom, Jeff Ruskowitz; current M.S. students
Jonathan Brant completed Ph.D. in December 2003, currently Asst. Prof. Univ. Wyoming
Josh Cartinella, Catie Harrison, Ryan Holloway, Mirinda Hutton, Riz Martinetti; completed M.S. students
Tzahi Cath completed Ph.D. in December 2003, currently Asst. Prof. CSM
Joanne Daugherty, completed M.S. in August 2002
Tali Harif, Eric Orset; completed post-doctoral associate
Sarah McCormick, current B.S. student
Eric Mortensen, completed M.S. in December 2004
Serife Ozger, current Ph.D. student
Pawel Rempala, current research scientist
Francisco Suarez, completed Ph.D. student in May 2010 with Scott Tyler

JENNY B. CHAPMAN

Professional Preparation

M.A., 1984, University of Texas at Austin, Geology/Hydrogeology

B.S., 1981, Sul Ross State University, Alpine Texas, Geology/Chemistry

Appointments

2008-Present	DRI Program Manager, Technical Research and Engineering Services Contract with the U.S. Department of Energy National Nuclear Security Administration.
1997-Present	Associate Research Hydrogeologist, Desert Research Institute, Division of Hydrologic Sciences, Las Vegas, Nevada.
1990-1996	Assistant Research Hydrogeologist, Desert Research Institute, Water Resources Center, Las Vegas, Nevada.
1988-1990	Hydrogeologist, Desert Research Institute, Water Resources Center, Las Vegas, Nevada.
1985-1988	Hydrogeologist, Environmental Evaluation Group, State of New Mexico, Santa Fe, New Mexico.
1984-1985	Hydrogeologist, Radian Corporation, Austin, Texas.

Publications
(five most closely related)

1. Reeves, D.M., K. Pohlmann, G. Pohll, M. Ye, and **J. Chapman**, 2010, Incorporation of Conceptual and Parametric Uncertainty into Radionuclide Flux Estimates from a Fractured Granite Rock Mass. *Stochastic Environmental Research and Risk Assessment*, published online DOI 10.1007/s00477-010-0385-0.
2. Ye, M.; Cooper, C.A.; **Chapman, J.B.;** Gillespie, D.; Zhang, Y.; 2009. A geologically based Markov chain model for simulating tritium transport with uncertain conditions in a nuclear-stimulated natural gas reservoir, *SPE Reservoir Evaluation & Engineering*, 12(6), 974-984. SPE-114920-PA. doi: 10.2118/114920-PA.
3. Reimus, P., G. Pohll, T. Mihevc, **J. Chapman**, M. Haga, B. Lyles, S. Kosinski, R. Niswonger, and P. Sanders, 2003. Testing and Parameterizing a Conceptual Model for Solute Transport in a Fractured Granite using Multiple Tracers in a Forced-Gradient Test. *Water Resources Research* 39(12):1356-1370.
4. Hassan, A., K. Pohlmann, and **J. Chapman**, 2001. Uncertainty Analysis of Radionuclide Transport in a Fractured Coastal Aquifer with Geothermal Effects. *Transport in Porous Media*, V. 43, pp.107-136.
5. Pohll, G., A.E. Hassan, **J.B. Chapman,** C. Papelis, and R. Andricevic, 1999. Modeling Ground Water Flow and Radioactive Transport in a Fractured Aquifer. *Ground Water*, V.37 (5), pp.770-784.

(five other significant publications)

1. Zhu, Julian; Pohlmann, Karl; **Chapman, Jenny**; Russell, Charles; Carroll, Rosemary; Shafer, David; 2010. Sensitivity of Solute Advective Travel Time to Porosities of Hydrogeologic Units. *Ground Water*, v.48. doi:10.1111/j.1745-6584.2009.00664.x

2. Hassan, A.E., Bekhit, H.M., and **Chapman, J.B.,** 2009. Using Markov Chain Monte Carlo to quantify parameter uncertainty and its effect on predictions of a groundwater flow model. *Environmental Modeling and Software,* 24(6):149-163.
3. **Chapman, J**., B. Lewis, and G. Litus, 2003. Chemical and isotopic evaluation of water sources to the fens of South Park, Colorado. *Environmental Geology* 43(5).
4. Pohlmann, K., A. Hassan, and **J. Chapman**, 2000. Description of Hydrogeologic Heterogeneity and Evaluation of Radionuclide Transport at an Underground Nuclear Test. *Journal of Contaminant Hydrology*, V. 44, pp.353-386.
5. Tyler, S.W., **J.B. Chapman**, S.H. Conrad, D.P. Hammermeister, D. Blout, J. Miller, M.J. Sully, and J.M. Ginanni, 1996. Soil Water Flux on the Nevada Test Site: Temporal and Spatial Variations Over the Last 120,000 Years. *Water Resources Research*, V.32, No.6, pp.1481-1499.

Synergistic Activities 1) Author or co-author on sixty technical reports, over fifty of which are published as DOE Nevada Site Office or Office of Legacy Management technical reports available on OSTI, 2) Author or co-author on forty-four presentations to national and international professional meetings, such as AGU, GSA, and Waste Management. Publication of six reviewed papers in conference proceeding volumes, 3) Reviewer for Journal of Hydrology, Water Resources Research, Ground Water, NSF.

Collaborators and Co-Editors
Clay Cooper, Rishi Parashar, Greg Pohll, Karl Pohlmann Matt Reeves, Chuck Russell, Yong Zhang, Julian Zhu, (Desert Research Institute), Ed Kwicklis, Paul Reimus (Los Alamos National Laboratory), Andy Tompson, Mavrik Zavarin (Lawrence Livermore National Lab), Wayne Belcher (USGS), Ahmed Hassan (University of Cairo), Rex Hodges (Stoller Corp.).

Thesis and Postgraduate-Scholar Sponsor
n/a

DR. CHANWOO PARK

Professional Preparation

The University of Michigan, Ann Arbor, Michigan	Mechanical Engineering	Ph.D.	2000
Korea Advanced Institute of Science and Technology (KAIST), Taejon, South Korea	Mechanical Engineering	M.S.	1992
Hanyang University, Seoul, South Korea	Mechanical Engineering	B.S.	1989

Appointments

01/08 – Present	Assistant Professor, The Mechanical Eng. Dept., University of Nevada, Reno, Reno, NV.
11/06 – 12/07	Group Leader, Advanced Cooling Technologies, Inc., Lancaster, Pennsylvania.
01/04 – 11/06	Senior Engineer, Advanced Cooling Technologies, Inc., Lancaster, Pennsylvania.
02/01 – 10/03	Research Specialist, Hybrid Electric Vehicle Development Team, Ford Research and Advanced Engineering Laboratory, Ford Motor Company, Dearborn, Michigan.
09/00 – 02/01	Research Fellow, Laboratory for Research in Transport, Reaction and Phase Change in Porous Media, University of Michigan, Ann Arbor, Michigan.
09/97 – 08/00	Graduate Research Assistant, Laboratory for Research in Transport, Reaction and Phase Change in Porous Media, University of Michigan, Ann Arbor, Michigan.
06/93 – 07/93	Visiting Research Scientist, The Luikov Heat and Mass Transfer Institute, Minsk, Republic of Belarus.
03/92 – 08/96	Research Scientist, Air Conditioning and Environmental Control Laboratory, Korea Institute of Science and Technology, Seoul, South Korea.

Publications

(five most closely related)

1. Lee, S., Koroglu, B., **Park, C**., 2011, "Experimental Investigation of Capillary-Assisted Solution Wetting and Heat Transfer Using a Micro-Scale, Porous-Layer Coating on Horizontal-Tube, Falling-Film Heat Exchanger," International Journal of Refrigeration, 10.1016/j.ijrefrig.2011.11.015.
2. Le, E., **Park, C.**, Hiibel, S., 2011, "Investigation of the Effect of Growth from Low to High Biomass Concentration inside a Photobioreactor on Hydrodynamic Properties of Scenedesmus Obliquus," ASME Journal of Energy Resources Technology, In Press.
3. **Park C.**, Vallury, A., Zuo, J., 2009, "Performance Evaluation of Pump-Assisted Capillary Two-Phase Loop," ASME Journal of Thermal Science and Engineering Applications, Vol.1, pp.022004-1-8.
4. Park, I.-S., Kim, J.-K., Kim, K.J., Zhang, J., **Park, C.**, Gawlik, K., 2009, "Investigation of Coupled AB_5 Type High-Power Metal Hydride Reactors," International Journal of Hydrogen Energy, Vol.34, pp.5770-5777.
5. Crepinsek M., **Park**, **C.**, 2011, "Effect of Operational Conditions on Cooling Performance of Pump-Assisted and Capillary-Driven Two-Phase Loop," AIAA Journal of Thermophysics and Heat Transfer, Vol.25, No.4, pp.572-580.

(five other significant publications)

6. Lee, S., **Park, C.**, 2011, "Experiment-Based Thermal Model for Permeable Clothing Systems under Hot Air Jet Impingement Conditions," International Journal of Thermal Sciences, Vol.51, pp.102-111.
7. Mahamud R., **Park C.**, 2011, "Reciprocating Cooling Flow for Battery Thermal Management to Improve Temperature Uniformity," Journal of Power Sources, Vol.196, pp.5685-5696.
8. **Park, C.-W.**, Kaviany, M., 2002, "Evaporation-Combustion Affected by In-cylinder, Reciprocating Porous-Regenerator," ASME Journal of Heat Transfer, Vol.124, pp.184-194.
9. **Park, C.-W.**, Kaviany, M., 2000, "Combustion-Thermoelectric Tube," ASME Journal of Heat Transfer, Vol.122, pp.721-729.
10. **Park, C.**, Jaura A., United State Patent 7,172,831, Battery System for Automotive Vehicle.

Synergistic Activities

1. Member of ASME/Heat Transfer Division Technical Committee (K-13, Heat Transfer in Multiphase Systems) and AIAA Thermophysics Technical Committee
2. Session Co-Chairs of 2012 ASME Summer Heat Transfer Conference (Track 6: Multi-phase Systems, Topic 4: Boiling Heat Transfer, Topic 6: Heat Pipes); Session Chair of 2010 International Heat Transfer Conference (Session #15-1: Single-Phase Jets); Session co-chair of 2009 ASME Summer Heat Transfer Conference (Track 7: Heat Transfer in Multiphase Systems, Session 4: Heat Pipes); 2009 ASME International Mechanical Engineering Congress & Exposition (Track 7: Heat Transfer in Multiphase Systems, Session 4: Multiphase Heat Transfer in Energy Systems)
3. Manuscript reviewer: Journal of Heat Transfer, Progress in Energy and Combustion Science, International Journal of Hydrogen Energy, International Journal of Multiphase Flow, Applied Mathematical Modeling, International Journal of Energy Research, conferences and publishers
4. Reviewer of NSF Proposal Review Panel (ENG/CBET/Thermal Transport Processes, May, 2011); Reviewer of NV NASA Space Grant Scholarship and Fellowship Applications (Fall 2010; Spring, 2011); Proposal reviewer and member of the site-visit-committee of Automotive Partnership Canada (APC) of Natural Sciences and Engineering Research Council of Canada (NSERC) and U.S. DOD agencies
5. Instructor of newly started minor on renewable energy teaching a graduate course (Heat Transfer in Renewable Energy Systems) (2008 – present)

Collaborators And Co-Editors

Universities: Bevan Matthew (Johns Hopkins University-APL), Christian Fritsen (Desert Research Institute), Amy Childress, Edward Kolodziej, Eric Marchand, Kwang Kim, John Cushman, Mano Misra, Miles Greiner, Qizhen Li, Richard Wirtz (University of Nevada, Reno), Reynolds David (Wright State University), Yitung Chen (University of Nevada, Las Vegas), Uddin Nasir (NIST), Massoud Kaviany (University of Michigan, Ann Arbor), Jonghwan Suhr (University of Delaware)

National Laboratories and Government Agencies: Abraham Thomas (National Renewable Energy Laboratory), Eric Sunada (Jet Propulsion Laboratory, Pasadena), Jeffrey Perez (Army RDECOM), Joseph Gottschlich (Air Force Research Laboratory), Karl Yee (JPL, Pasadena), Quinn Leland (Air Force Research Laboratory), Suresh Govindappa (Army RDECOM), Tony Paris (Jet Propulsion Laboratory, Pasadena), Chol-Bum Kweon (US Army Research Laboratory)

Industries: Aparna Vallury (IBM), Chendong Huang (Ford Motor Company), Dave Sarraf, Devdatta Kulkani, William Anderson, Sanjida Tamanna, Xudong Tang Jon Zuo (Advanced Cooling Technologies, Inc.), Fred Phillips (Thermacore), Gail Baker (Hamilton Sundstrand), Gayton Liter (GE Global Research), Joanna Szydlo-Moore (Boeing), Jon Stanley (SAIC), Karl Apel (Northrop Grumman Space Technology), Warran Todd (Universal Technology Corporation)

Graduate Advisors

Ph.D.: Massoud Kaviany (The University of Michigan, Ann Arbor)

M.S.: Tae-Ho Song (Korea Advanced Institute of Science and Technology, Taejon, South Korea)

Thesis and Postgraduate-Scholar Sponsor

Current: Ph.D. Student: Dick Bogan, Master Students: Batikan Koroglu, Undergraduates: Kunah Lee

Past: Postdoctoral: Dr. Sangsoo Lee, Master Students: Michael Crepinsek, Rajib Mahamud, Charles Carpenter, Rajeev Gunda, Undergraduates: Chris Glover, Ben Baxter, Evans Le, Shigeki Kobayashi

JAMES HUGH TREXLER, JR.

Professional Preparation

Ph.D. in Geology, 1984, University of Washington, Seattle; advisor: Joanne Bourgeois
M.S. in Geology, 1976, University of Oklahoma, Norman; advisor: Patrick Southerland
B.S. in Geology, 1974, University of Maryland, College Park

Appointments

1995 – present: Professor of Geology, University of Nevada, Reno
1991- 1995: Associate Professor of Geology, University of Nevada, Reno
1986-1991: Asst. Professor of Geology, University of Nevada-Reno

Publications

(five most closely related)

Trexler, J.H., Cashman, P., and Cosca, M.A., in press, Constraints on the History and Topography of the Northeastern Sierra Nevada from a Neogene Sedimentary Basin in the Reno---Verdi area, Western Nevada: Geosphere.

Cashman, P.H., Villa, D.E., Taylor, W.J., Davydov, V.I., and **Trexler, J.H., Jr**., in press, Late Paleozoic Contractional and Extensional Deformation at Edna Mountain, Nevada: Geological Society of America Bulletin.

Cashman, P., **Trexler, J.H.J.**, Snyder, W.S., Davydov, V.I., and Taylor, W.J., 2008, Late Paleozoic Deformation in Central Nevada, in Dubendorfer, E., and Smith, G., eds., Field Guide to Plutons, Volcanoes, Faults, Reefs, Dinosaurs and Possible Glaciation of Selected Areas of Arizona, California and Nevada: GSA Field Guide, Volume 11: Boulder, CO, Geological Society of America, p. 21-42.

Trexler, J.H., Jr., Cashman, P.H., Snyder, W.S., and Davydov, V.I., 2004, The western margin of North America after the Antler orogeny: Mississippian through Late Permian history in the Basin and Range, Nevada, in Haller, K., and Wood, S., eds., Geological Field Trips in Southern Idaho, Eastern Oregon, and Northern Nevada, Volume USGS Open File Report: Boise, Boise State University, p. 18-35.

Trexler, J.H., Jr., Cashman, P.H., Snyder, W.S., and Davydov, V.I., 2004, Late Paleozoic tectonism in Nevada; timing, kinematics, and tectonic significance: Geological Society of America Bulletin, v. 116, p. 525-538.

(five other significant publications)

Trexler, J.H.J., Park, H., Cashman, P., and Mass, K.B., 2009, Late Neogene basin history at Honey lake, northeastern California: implications for regional tectonics at 3 to 4 Ma, in Oldow, J.S., and Cashman, P.H., eds., Late Cenozoic Structure and Evolution of the Great Basin - Sierra Nevada Transition: Geological Society of America Special Paper, Volume 447: Boulder CO, Geological Society of America, p. 83-100.

Cashman, P., **Trexler, J.H.J**., Muntean, T.W., Faulds, J.E., Louie, J.N., and Oppliger, G., 2009, Neogene tectonic evolution of the Sierra Nevada - Basin and Range transition zone at the latitude of Carson City, Nevada, in Oldow, J.S., and Cashman, P., eds., Late Cenozoic Structure and Evolution of the Great Basin - Sierra Nevada Transition: Geological Society of America Special Paper, Volume 447: Boulder CO, Geological Society of America, p. 171-188.

Trexler, J.H.J., and Cashman, P.H., 2007, Neogene Basins of Northwestern Nevada, in Limerick, S.H., ed., Geology, Geothermal Resources and Petroleum Exploration of Neogene Basins in the Reno, Nevada Area: Reno, NV, Nevada Petroleum Society, p. 29-50.

Cashman, P., **Trexler, J.H.J.,** Muntean, T.W., Faulds, J.E., Louie, J.N., and Oppliger, G., 2009, Neogene tectonic evolution of the Sierra Nevada - Basin and Range transition zone at the latitude of Carson City, Nevada, in Oldow, J.S., and Cashman, P., eds., Late Cenozoic Structure and Evolution of the Great Basin - Sierra Nevada Transition: Geological Society of America Special Paper, Volume 447: Boulder CO, Geological Society of America, p. 171-188.

Trexler, J.H., Jr., Cashman, P.H., Cole, J.C., Snyder, W.S., Tosdal, R.M., and Davydov, V.I., 2003, Widespread Effects of Mid-Mississippian Deformation in the Great Basin of western North America: Geological

Society of America Bulletin, v. 115, p. 1278-1288.

Synergistic Activities 1) Ecosystems Indicators project for Clark County Nevada, multidiscipline approach to characterizing bio-zones and their controlling parameters; 2) President and member of the Nevada Petroleum Society (AAPG affiliate) and active member of the Geological Society of America, and American Association of Petroleum Geologists, review papers; 3) Active with a local, informal consortium of water regulators and planers in the Reno, NV area, including county water managers, for subsurface water modeling and geologic basin mapping; 4) Attended MGE@MSA workshop on mentoring underrepresented minority PhD students, and volunteered to accept graduate students in this category (graduated two women-geoscientists in the last 5 years); 5) Assisted with outreach education in Earth sciences for local educational groups (most recently the Temple Sinai Men's Club).

Collaborators And Co-Editors

Patricia Cashman, University of Nevada, Reno
James Cole, United States Geological Survey
Vladimir Davydov, Boise State University, Idaho
Jill Heaton, University of Nevada, Reno
John Louie, University of Nevada, Reno
Gary Oppliger, University of Nevada, Reno
Walter Snyder, Boise State University, Idaho
Wanda Taylor, University of Nevada, Las Vegas

Thesis and Postgraduate-Scholar Sponsor

Tristan Ashcroft, University of Nevada, Reno
Nicole Buckhouse, University of Nevada, Reno
Gwen Linde, University of Nevada, Reno
Hyunmee Park, University of South Carolina
Daniel Sturmer, University of Nevada, Reno
Danielle Villa, ExxonMobil (committee)
Ross Whitmore, University of Nevada, Reno (committee)

DR. BRENDA J. BUCK

Professional Preparation:

New Mexico State University Soils, w/minor in Geological Sciences Ph.D. 1996
New Mexico State University Geological Sciences M.S. 1992
University of Notre Dame Geology B.S. 1990

Appointments

Professor, Dept. of Geoscience, University of Nevada Las Vegas, 7/10-present
Associate Professor, Dept. of Geoscience, University of Nevada Las Vegas, 7/04 - 6/10.
Assistant Professor, Dept. of Geoscience, University of Nevada Las Vegas, 8/98 – 7/04.
Assistant Professor, Dept. of Geosciences, Southeast Missouri State University, 5/96 – 7/98.

Publications (5 most closely related)

Soukup, D., **Buck, B.J.**, Goossens, D., Ulery, A., McLaurin, B., Baron, D., and Teng, Y., in press (2012), Arsenic concentrations in dust emissions from wind erosion and off-road vehicles in the Nellis Dunes Recreational Area, Nevada, USA, Journal of Aeolian Research.

Buck, Brenda J., Lawton, T., and Brock, A., 2010, Evaporitic paleosols in continental strata of the Carroza Formation, La Popa Basin, Mexico: record of Paleogene salt tectonics and climate change, GSA Bulletin v. 122, p. 1011-1026.

Buck, B.J., King, J., and Etyemezian, V., 2011, Effects of salt mineralogy on dust emissions: Salton Sea California, USA, Soil Science Society of America Journal v. 75, p. 1958-1972.

Goossens, D. and **Buck, Brenda,** 2011, Effects of wind erosion, off-road vehicular activity, atmospheric conditions and the proximity of a metropolitan area on PM10 characteristics in a recreational site, Atmospheric Environment, v. 45, p. 94-107.

House, P.K., **Buck, B.J.,** and Ramelli, A.R., 2010, Geologic assessment of piedmont and playa flood hazards in the Ivanpah Valley area, Clark County, Nevada (online only): Nevada Bureau of Mines and Geology Report 53. http://www.nbmg.unr.edu/Pubs/r/r53/index.html

(five other significant publications)

McLaurin, B.T., Goossens, D., and **Buck, B.J.,** 2011, Combining surface mapping and process data to assess, predict, and manage dust emissions from natural and disturbed land surfaces: Geosphere, v. 7, p. 260-275, doi:10.1130/GES00593.1

Goossens, D., and **Buck, Brenda,** 2011, Gross erosion, net erosion and gross deposition of dust by wind: field data from 17 desert surfaces, Earth Surface Processes and Landforms. v. 36, p. 610-623.

Goossens, D., and **Buck, Brenda,** 2009, Dust Emission by Off-Road Driving: Experiments on 17 Arid Soil Types, Nevada, USA, Geomorphology, v. 107, p.118-138

Mrozek*, S.J., **Brenda J. Buck**, Patrick J. Drohan, Amy L. Brock*, 2006, Decorative Landscaping Rock as a Source for Heavy Metal Contamination, Las Vegas NV, Soil and Sed. Contamination, 15:471–480.

Buck, B.J., Wolff*, K., Merkler, D., and McMillan, N. 2006, Salt Mineralogy of Las Vegas Wash, Nevada: Morphology and Subsurface Evaporation, Soil Sci. Soc. of America Journal, 70:1639-1651.

Synergistic Activities

Education: Led the creation of the only soil science program within the state of Nevada: a Soils Emphasis at the M.S. and Ph.D. levels within the Geoscience degree program

Honors (selected): *Fellow, Geological Society of America*, 2008. *The M.L. & C.M. Jackson Award*, 2007, Soil Science Society of America, for Outstanding Contributions in Soil Mineralogy/Chemistry. Coauthor on *International Union of Soil Science, Young Micromorphologist Publication Award:* Amy Brock (student), 2008. *Earth Day Award UNLV*, for Excellence in Teaching, 2000.

Research: Received over $7.14 million in research funding (as PI/Co-PI)

International Experience: Co-collaborator, Lead Researcher, or Teacher/Educator for Field Expeditions to the following countries: China, Peru, Argentina, Mexico, Spain, Jordan, Australia, Belize, Chile, St. Lucia, Thailand, Canada, Burkina Faso, Cote d'Ivoire, Italy, Switzerland, Turkey, France

Professional Service (selected): President, Commission 1.1: Soil Morphology, Intl. Union of Soil Science, 2006-2010. 2nd Vice President for the International Union of Soil Science, Commission on Soil Morphology 2002-2006. Chair, Soil Micromorphology Committee, Soil Science Society of America, 2004-2006. Invited speaker & participant for National Academy of Sciences, Frontiers in Soil Science Workshop, 2005. Member, Standing Committee on National Cooperative Soil Survey Standards, Subcommittee on Carbonates, Spring & Fall 2005.

Collaborators and Co-Editors

Ayala, N., Berger-Ritchie, J., Goossens, D., Howell, M, Morton, J., Rowland, S., Soukup, D., Steinburg, Spencer, Sudowe, R., Teng, Y., Williams, A., Yonovitz, M., Young, S. (UNLV): Barbeau, D. (Univ. SC); Barron, D. (Cal-State Bakersfield); Bell, J.W., Ramelli, A.R. (NBMG/Univ. NV-Reno); Brock, A (Univ. TN Chattanooga); Burchfield, B. (MIT), Cole, D. (Oak Ridge Lab), Etyemezian, V., King, J., Nikolich, G. (DRI); Gallegos, R., Lawton, Timothy, Monger, H.C., Ulery, April (NMSU); Garside, L. (NBMG); Harrison, Bruce (New Mexico Tech University); Harkema, J. (Michigan State Univ.); House, P.Kyle (USGS); Keil, D., (Univ. Utah); Martínez-Gutiérrez, G. (U.MX La Paz); McLaurin, B. (Bloomsburg Univ. PA); Merkler, Doug (NRCS); Peden-Adams, M. (Harry Reid Center, NV); Prellwitz, J (U. Miami, Ohio); Proper, S. (Michigan State Univ.); Rech, J (U. Miami, Ohio); Robins, C. (Macalester, MN); Sweeney, M. (U South Dakota)

Graduate and Postdoctoral Advisors

Ph.D. Advisor: H. Curtis Monger, New Mexico State University
M.S. Advisor: G. Mack, New Mexico State University

Thesis and Postgraduate-Scholar Sponsor

Current: Postdoctoral Scholars: Dirk Goossens; Master Students: Nick Wahnefried; Undergraduates: Dana Olsen

Past: Postdoctoral: Colin Robins; PhD Students: Amy Brock, Amanda Williams, Colin Robins; Master Students: Amy Brock, Michael Howell, Michael Jarvis, Brien Park, Janice Morton, John Van Hoesen; Undergraduates: Judy Costa, Seth Page, Jonathan Carter, Robert Davis, Michelle Stropky, Lars Bangen, Mark Reed, Rhonda Fairchild, Corinne Griffing, Stephanie Mrozek, Evelyn Coleman, Katie Wolff, Kuwanna Dyer

DR. EDWARD P. KOLODZIEJ

Professional Preparation

University of California, Berkeley	Post-Doctoral Scholar	2005-2006
University of California, Berkeley	Environmental Engineering	Ph.D. 2004
University of California, Berkeley	Environmental Engineering	M.S. 1999
Johns Hopkins University	Chemical Engineering	B.S. 1998

Appointments

University of Nevada, Reno, Reno, NV. *January 2007 – Present*. Assistant Professor, Department of Civil and Environmental Engineering.

University of California, Berkeley, Berkeley, CA. *January 2005 – December 2006*. Post-Doctoral Scholar/Project Manager.

University of California, Berkeley, Berkeley, CA. *August 1999 - December 2004*. Ph.D. Candidate in Environmental Engineering.

University of California, Berkeley, Berkeley, CA. *October 1998 - August 1999*. Graduate Student Researcher.

Michigan Technological University, Houghton, MI. *Summer 1997*. Student Intern for the Environmental Protection Agency's Science to Achieve Results (STAR) program.

Publications

(five most closely related)

1. Fono, L.J., Kolodziej, E.P., Sedlak, D.L. 2006. "Attenuation of Wastewater-Derived Contaminants in a Wastewater-Dominated River." *Environ. Sci. Technol*, **40**(23), 7257-7263.
2. Kolodziej E.P., Harter T.H., and Sedlak D.L. 2004. "Dairy Wastewater, Aquaculture, and Spawning Fish as Sources of Steroid Hormones in the Aquatic Environment." *Environ. Sci. Technol*. **38**(23), 6377-6384.
3. Kolodziej E.P., Gray J.L., and Sedlak D.L. 2003. "Quantification of Steroid Hormones with Pheromonal Properties in Municipal Wastewater Effluent." *Environ. Toxicol. Chem*., **22**(11), 2622-2629.
4. Mansell, D.S., Bryson, R.J., Harter, T., Webster, J.P., Kolodziej, E.P., Sedlak, D.L. 2011. "Fate of Endogenous Steroid Hormones in Steer Feedlots under Simulated Rainfall-Induced Runoff." *Environ. Sci. Technol*. **45**(20), 8811-8818.
5. Schlenk, D., Sapozhnikova, Y., Irwin, M.A., Xie, L., Hwang, W., Reddy, S., Brownawell, B.J., Armstrong, J., Kelly, M., Montagne, D.E., Kolodziej, E.P., Sedlak, D.L., and Snyder, S. 2005. In Vivo Bioassay-guided Fractionation of Marine Sediment Extracts from the Southern California Bight, USA, for Estrogenic Activity." *Environ. Toxicol. Chem*., **24**(11), 2820-2826.

(other significant publications)

1. Sedlak D.L., Pinkston K.L., Gray J.L. and Kolodziej E.P. 2003. "Approaches for Quantifying the Attenuation of Wastewater-Derived Contaminants in the Aquatic Environment." *Chimia*. **57**(9), 567-569.
2. Lavado, R., Loyo-Rosales, J.E., Floyd, E., Kolodziej, E.P., Snyder, S.A., Sedlak, D.L., Schlenk, D. 2009. "Site-Specific Profiles of Estrogenic Activity in California's Inland Waters." *Environ. Sci. Technol*. **43**(24), 9110-9116.
3. Kolodziej, E.P., and Sedlak D.L. 2007. "Rangeland Grazing as a Source of Steroid Hormones to Surface Waters." *Environ. Sci. Technol.* **41**(10), 3514-3520.

Synergistic Activities

Member, Organic Contaminant Research Committee, American Water Works Association, 2011+

Faculty Mentor: EPSCOR Summer/General Undergraduate Research Awards for Undergraduate Students: Jackson Webster (2008), Robert (Alex) Vaughn (2009), Stephanie Kover (2010), Samantha McBride (2011).

Conference Session Co-chair/Organizer: "Frontiers in Water Reuse: Detection, Advanced Treatment and Environmental Fate of Contaminants of Emerging Concern." American Chemical Society National Conference, Environmental Chemistry Division, Salt Lake City, 2009.

Invited Reviewer: National Science Foundation, Environmental Protection Agency, United States Geological Survey, AOAC, MIT Sea Grant Program, CUNY Collaborative Research Grant Program, U. Illinois Sustainable Technology Research Center; Journal Reviews: Environmental Science and Technology, Water Resources, Science of the Total Environment, Journal of Environmental Quality, Environmental Toxicology and Chemistry, Aquatic Toxicology, Behavior, Journal of Chemical Ecology

Professional Society Memberships: Association of Environmental Engineering Science Professors, American Chemical Society, Society for Environmental Toxicology and Chemistry, Water Environment Federation

Collaborators and Co-Editors

Jeff Armstrong, Orange County Sanitation District
Robert Atwill, U. of California, Davis
Bruce Brownawell, Stony Brook U.
Amy Childress, U. of Nevada, Reno
Art Craigmill, U. of California, Davis
David Cwiertny, U. of Iowa
Jorg Drewes, Colorado School of Mines
Emily Floyd, U. of California, Riverside
Lorien Fono, Malcolm Pirnie Consulting
James Gray, United States Geological Survey
Thomas Harter, U. of California, Davis
Wendy Hwang, U. of California, Riverside
Mary Irwin,U. of California, Riverside
Mike Kelly, City of San Diego
Ramon Lavado, U. of California, Riverside
Jorge Loyo-Rosales, Monterrey Institute Tech.
Alexandra Lutz, Desert Research Institute
Eric Marchand, U. of Nevada, Reno
David Montagne, Los Angeles San. District
Toby O'geen, U. of California, Davis
Chanwoo Park, U. of Nevada, Reno
Sharanya Reddy, Stony Brook University
Yelena Sapozhnikova, U. of California, Riverside
Dan Schlenk, U. of California, Riverside
David Sedlak, U. of California, Berkeley
Shane Snyder, U. of Arizona
Ken Tate, U. of California, Davis
Lingtian Xie, U. of California, Riverside

Graduate and Doctoral Advisors

Doctoral/Post-Doctoral Advisor, David Sedlak, University of California, Berkeley, Thesis Advisors, Garrison Sposito, Tyrone Hayes, UC Berkeley

Thesis and Postgraduate-Scholar Sponsor

(all at University of Nevada, Reno) Jaewoong Lee, Jed Parker, Jackson Webster, Silas Callahan, Wenjun Du, Gerrad Jones, Emily Cole, Nalelli Herrera, Mirinda Hutton, Winn Wilson, Jasmin Arevena

DR. GILES M. MARION

Professional Preparation

A.A.S.	Paul Smiths College	Forestry	1963
B.S.	Syracuse University	Forestry	1965
M.S.	Syracuse University	Forest Soils	1968
Ph.D.	University of California-Berkeley	Soil Chemistry	1974
Postdoctoral	University of Arizona	Soil Chemistry and Modeling	1973-1974

Appointments

2000-date	Associate Research Professor, DRI, Reno, NV
1990-2000	Research Physical Scientist, CRREL, Hanover, NH
1979-1990	Adjunct Professor and Principal Investigator, San Diego State University
1974-1978	Forest Soil Scientist, Weyerhaeuser Company
1972-1974	Research Associate (post-doc in soil chemistry with Gordon R. Dutt), University of Arizona, Tucson

Publications

(five most closely related)

1. Marion, G.M., F.J. Millero, M.F. Camões, P. Spitzer, R. Feistel, C-T,A. Chen. 2011. pH of seawater. Marine Chemistry. 126:89-96.
2. Marion, G.M., D.C. Catling, J.K. Crowley, and J.S. Kargel. 2011. Modeling hot spring chemistries with applications to Martian silica formation. Icarus. 212:629-642.
3. Marion, G.M., F.J. Millero, and R. Feistel. 2009. Precipitation of solid phase calcium carbonates and their effect on application of seawater S_A-T-P Models. Ocean Science. 5:285-291.
4. Marion, G.M. and J.S. Kargel. 2008. Cold Aqueous Planetary Geochemistry with FREZCHEM: From Modeling to the Search for Life at the Limits. Springer.
5. Marion, G.M., P.S.J. Verburg, B. Stevenson, and J.A. Arnone. 2008. Soluble element distributions in a Mojave Desert soil. Soil Sci. Soc. Am. J. 72:1815-1823.

(five other significant publications)

1. Marion, G.M., F.J. Millero, M.F. Camões, P. Spitzer, R. Feistel, C-T,A. Chen. 2011. pH of seawater. Marine Chemistry. 126:89-96.
2. Marion, G.M., D.C. Catling, J.K. Crowley, and J.S. Kargel. 2011. Modeling hot spring chemistries with applications to Martian silica formation. Icarus. 212:629-642.
3. Marion, G.M., F.J. Millero, and R. Feistel. 2009. Precipitation of solid phase calcium carbonates and their effect on application of seawater S_A-T-P Models. Ocean Science. 5:285-291.
4. Marion, G.M. and J.S. Kargel. 2008. Cold Aqueous Planetary Geochemistry with FREZCHEM: From Modeling to the Search for Life at the Limits. Springer.
5. Marion, G.M., P.S.J. Verburg, B. Stevenson, and J.A. Arnone. 2008. Soluble element distributions in a Mojave Desert soil. Soil Sci. Soc. Am. J. 72:1815-1823.

Synergistic Activities

Principal developer of the FREZCHEM model, a unique geochemical model for aqueous solutions at subzero temperatures. This model has been used to further our understanding of cold geochemical processes in the Arctic, Antarctic, Mars, and Europa.

Principal developer of the CALGYP model. This model has been used to examine calcite and gypsum precipitation/dissolution processes and salt movement in desert ecosystems.

Over the past decade, I have reviewed manuscripts for 32 different technical journals and innumerable proposals for NSF, DOE, USDA, NASA, and DOD. I was an Associate Editor of the Journal of Environmental Quality for 6 years (1995-2000). I was a NASA program panel member for PG&G in 2002, OPR in 2004, and MFR in 2006.

Collaborators and Co-Editors

J.A. Arnone, III (DRI); N.T. Bridges (JPL); A.J. Brown (NASA-Ames); W.M. Calvin (Univ. Nevada-Reno); D. Catling (Univ. Bristol, England); J. Crowley (USGS); C.R. de Souza Filho (Univ. Campinas, Brazil); H. Eicken (Univ. Alaska-Fairbanks); R. Feistel (Leibniz-Institut Ostseeforschung, Germany); C.H. Fritsen (DRI); R. Furfaro (Univ. Arizona); E.J. Gaidos (Univ. Hawaii); A.R. Gillespie (Univ. Washington); D. Hogenboom (Lafayette College); S.J. Hook (JPL); J.S. Kargel (Univ. Arizona); W.B. Lyons (Ohio State Univ.); E.V. McDonald (DRI); F.J. Millero (Univ. Miami); M.V. Mironenko (Vernansky Inst.-Moscow); D.R. Montgomery (Univ. Washington); S. Morin (UJF, Grenoble, France); O. Prieto-Ballesteros (Centro Astrobiologia-Madrid, Spain); M. Roberts (DRI); J.A.P. Rodriguez (PSI, Tucson); D. Schulze-Makuch (Washington State Univ.); B.J. Thomson(JPL); P. Verburg (DRI); R. von Glasow (Univ. East Anglia, UK); K.A. Welch(Ohio State Univ.); and S.E. Wood(Univ. Washington).

Graduate and Postdoctoral Advisors

A.L. Leaf. M. S. Degree, SUNY-Syracuse
K.L. Babcock. Ph.D. Degree, University of California, Berkeley
G.R. Dutt. Postdoctoral position. University of Arizona

Thesis and Postdoctoral-Scholar Sponsor

Eric Miller, Dartmouth College, Ph.D. thesis committee
Sean Connin, Dartmouth College, Ph.D. thesis committee
Melody Brown Burkins, Dartmouth College, Ph.D. thesis committee
Mark B. Green, University of Nevada-Reno, M.S. thesis committee
Sheila Kapitzke, University of Nevada-Reno, M.S. thesis committee

WANDA J. TAYLOR

Professional Preparation

Ph.D. University of Utah; Structural Geology and Tectonics, 1989
M.S. Syracuse University; Structural Geology and Tectonics, 1984
B.S. University of Minnesota, Duluth; Geology with Chemistry minor, 1982

Professional Appointments

Professor, University of Nevada, Las Vegas; 2004 - present
Interim Dean, UNLV College of Sciences; 2008 - 2010
Nevada DOE EPSCoR Program Director, 2007 - 2008
Chair of the Geoscience Department, July, 2004-July, 2007
Associate Professor, University of Nevada, Las Vegas; 1997 - 2004
Assistant Professor, University of Nevada, Las Vegas; 1991 – 1997
Research Assistant Professor, University of Utah; 1990 - 1991
Assistant Professor (Sabbatical Replacement), University of Minnesota-Duluth; 1989 – 1990
Exploration Field Geologist, Mobil Oil Corp., Summers, 1989 and 1990
Geology Consultant, BHP-Utah International/FLG, 1988 & 1989; gold exploration
Field Camp Instructor, University of Utah; Summer, 1988

Publications * indicates peer review, # indicates invited, *italics* indicates student author
(five most closely related)

1. * Cashman, P., *DeVilla, D.,* **Taylor, W.J.,** Davydov, V., and Trexler, J., 2011, Late Paleozoic contractional and extensional deformation at Edna Mountain, Nevada: Geological Society of America Bulletin, v. 123, p. 651-668, first published electronically on October 18, 2010, doi:10.1130/B30247.1
2. **Scott, James B., Rasmussen*, Tiana, Luke, Barbara, **Taylor, Wanda**, Wagoner, J.L., Smith, Shane B., and Louie, John N., 2006, Shallow Shear Velocity and Seismic Microzonation of the Urban Las Vegas, Nevada Basin, Bulletin of the Seismological Society of America, v. 96, p. 1068-1077.
3. *#*Williams, N.D.*, and **Taylor, W.J**., 2002, Extensional oblique-slip barrier transfer fault: The Currant Summit fault, east-central Nevada, *in* Ehni, W., and Faulds, J., eds., Detachment and attenuation in eastern Nevada and its application to petroleum potential: Nevada Petroleum Society Field Trip Guidebook, p. 149-163.
4. **Taylor, W.J.,** and *Switzer,* D.D., 2001, Temporal changes in fault strike (to 90^{o}) and extension directions during multiple episodes of extension: An example from eastern Nevada: Geological Society of America Bulletin, v. 113, p. 743-759.
5. ***Taylor, W.J.,** Bartley, J.M., Martin, M.W., Geissman, J.W., Walker, J.D., Armstrong, P.A., and Fryxell, J.E., 2000, Relations between hinterland and foreland shortening, Sevier orogeny, central North American Cordillera: Tectonics, v. 19, p. 1124-1143.

(five other significant publications)

1. *Luke, B., Murvosh, H., **Taylor, W.,** and Wagoner, J., 2009, Three-dimensional modeling of shallow shear-wave velocities for Las Vegas, Nevada using sediment type: Journal of Earth Science, v. 20, p. 555-562.
2. 2. Luke, Barbara, Snelson, Catherine, **Taylor, Wanda**, Sack, Ron, Louie, John, and Wagoner, Jeff, 2005, Seismic studies to understand earthquake hazards and risks in Las Vegas basin: FastTimes, Environmental and Engineering Geophysical Society, v. 10, no 1, p. 38-39.
3. *Luke, B., Murvosh, H., **Taylor, W**., and Wagoner, J., 2009, Three-dimensional modeling of shallow shear-wave velocities for Las Vegas, Nevada using sediment type: Journal of Earth Science, v. 20, p. 555-562.

4. *Stewart, M.E.,* and **Taylor, W.J**., 1996, Structural analysis and fault segment boundary identification along the Hurricane fault in southwestern Utah: Journal of Structural Geology, v. 18, p. 1017-1029.
5. *Walker, J.D., Fletcher, J.M., Fillmore, R.P., **Taylor, W.J.,** Glazner, A.F., and Bartley, J.M., 1995, Connection between igneous activity and extension in the central Mojave metamorphic core complex, California: Journal of Geophysical Research, v. 100, no. B6, p. 10,477-10,494.

Synergistic Activities

1) Advisor of 16 graduate students' research projects/theses and 15 undergraduate students' research projects at UNLV; 2) Educational Outreach on seismic hazards including lectures in elementary schools, hosting public school students in our Applied Geophysics Laboratory, lectures on geology to local clubs; 3) Leader or co-leader of 1 -2 continuing education field trips per year on geology near Las Vegas, 1992 – present; 4) Co-leader of geological field trips for professional societies: five for the Geological Society of America, one for a joint conference of the Geological Society of America and the American Association of Petroleum Geologists and four for the Nevada Petroleum Society; 5) Vice Chair South and member of the Board for the Nevada Earthquake Safety Council.

Collaborators and Co-Editors

Anderson, John, University of Nevada, Reno; Armstrong, P.A., California State University at Fullerton; Axen, G.J., New Mexico Institute of Technology; Bartley, J.M., University of Utah; Bidgoli, T.S., University of Kansas; Cashman, P., University of Nevada, Reno; Davydov, V., Boise State University; DePolo, C.M., Nevada Bureau of Mines and Geology; DeVilla, D., ExxonMobil; Fletcher, J.M., CICESE, Mexico; Fossett, Eric, Occidental Petroleum; French, D.E., Independent Geologist, Billings, MT; Fryxell, J.E., California State University at San Bernardino; Geissman, J., University of New Mexico; Gilbert, J. J., ARCADIS; Glazner, A.F., University of North Carolina; Hurlow, H.A., Utah Geological Survey; Louie, John, University of Nevada, Reno; Luke, Barbara, University of Nevada Las Vegas; Lund, W.R., Utah Geological Survey; Lux, D.R., University of Maine; Martin, M.W., Shell Oil Company; Mccallen, David, Lawrence Livermore National Laboratory; Miller, D.M., U.S. Geological Survey; Miller, J.S., San Jose State University; Murvosh, H.A, Stanley Consultants, Las Vegas; Novack – Langrock, H., ExxonMobil ; Orndorff, R.L., Eastern Washington University; Pearthree, P.A., Arizona Geological Survey; Rodgers, Arthur, Lawrence Livermore National Laboratory; Saldaña, S.C., Noble Oil; Schiefelbein, I.M., ExxonMobil; Schmitt, J.G., Montana State University; Scott, R.B., U.S. Geological Survey; Snelson, C.M. NSTec; Snyder, W., Boise State University; Stewart, M.E., Vassar University; Swadley, W.C., U.S. Geological Survey; Trexler, J., University of Nevada, Reno; Vandervoort, D.S., Cornell University; Wagoner, J., Lawrence Livermore National Laboratory; Walker, J.D., University of Kansas; Williams, N.D., CH2M Hill

Graduate and Postdoctoral Advisors

Brain Wernicke, M.S. advisor, currently at Cal Tech
John Bartley, Ph.D. advisor, University of Utah

Thesis Advisor in the Last Five Years

Current: M.S. - Angela Russo, James Thompson, Jonathan Carter.
Past: M.S. - Eric Fossett, Oxidental Petroleum; Tandis Bidgoli, Ph.D. candidate, University of Kansas; Tyler Knudson, Utah Geological Survey; Willy Rittase, Ph.D. candidate, University of Kansas; Tricia Evans, Hollister / Great Basin Gold; Sam Siebenaler, Newmont Mining Corp.

DR. ERIC A. MARCHAND, PH.D., P.E.

Professional Preparation

1994	Bachelor of Science – Civil Engineering	University of Nevada, Reno
1996	Master of Science – Civil Engineering	University of Nevada, Reno
2000	Ph.D. – Civil Engineering	University of Colorado at Boulder

Appointments

2008 – Present	Graduate Director, Department of Civil and Environmental Engineering; University of Nevada, Reno
2008 – Present	Environmental Engineering Program Director; Department of Civil and Environmental Engineering; University of Nevada, Reno
2006 – Present	Associate Professor; Department of Civil and Environmental Engineering; University of Nevada, Reno
2000 – 2006	Assistant Professor; Department of Civil and Environmental Engineering; University of Nevada, Reno
1996 – 2000	EPA STAR Fellow/Research/Teaching Assistant; Department of Civil, Environmental, and Architectural Engineering; University of Colorado at Boulder
1995 – 1996	EPA STAR Fellow/Research Assistant; Department of Civil Engineering; University of Nevada, Reno

Publications

(five most closely related)

1. Achilli, A., **E.A. Marchand**, A.E. Childress (2011) A Performance Evaluation of Three Membrane Bioreactor Systems: Aerobic, Anaerobic, and Attached-Growth. *Water Sci. Technol.*, in press.
2. Achilli, A., T.Y. Cath, **E.A. Marchand**, and A.E. Childress (2009). The Forward Osmosis Membrane Bioreactor: A Low Fouling Alternative to MBR Processes. *Desalination*, 239:10-21.
3. Chavan, P.V., K.E. Dennett, **E.A. Marchand**, and L.E. Spurkland (2008). Potential of constructed wetland in reducing total nitrogen loading into the Truckee River. *Wetlands Ecology and Management*, 16:189-197.
4. Chavan, P.V., K.E. Dennett, and **E.A. Marchand** (2007). Evaluation of small-scale constructed wetland for water quality and Hg transformation. *Journal of Hazardous Materials, 149*(3), 543-547.
5. Park, C. and **E.A. Marchand** (2006). Modeling Salinity Inhibition Effects During Biodegradation of Perchlorate. *J. Appl. Microbiol., 101*(1): 222-233.

(five other significant publications)

1. Gustin, M.S., P. Chavan, K.E. Dennett, S. Donaldson, **E.A. Marchand**, and G.C. Fernandez (2006). Use of Constructed Wetlands with Four Different Experimental Designs to Assess the Potential for Methyl and Total Hg Outputs. *Appl. Geochem., 21*(11): 2023-2035.
2. Gustin, M.S., P. Chavan, K.E. Dennett, **E.A. Marchand**, and S. Donaldson (2006). Evaluation of Wetland Methyl Mercury Export as a Function of Experimental Manipulations. *J. Environ. Qual., 35*(6): 2352-2359.
3. **Marchand, E.A.** and J. Silverstein (2003) The Role of Enhanced Heterotrophic Bacterial Growth on Iron Oxidation by *Acidithiobacillus ferrooxidans*. *Geomicrobiol. J.*, 20(3):231-244.

4. **Marchand, E.A.** and J. Silverstein (2002) Influence of Heterotrophic Microbial Growth on Biological Oxidation of Pyrite, *Environ. Sci. Technol.*, 36:5483-5490.

5. Peccia, J.L., **E.A. Marchand**, J. Silverstein, and M.T. Hernandez (2000) Development and Application of Small-Subunit rRNA Probes for Assessment of Selected *Thiobacillus* Species and Members of the Genus *Acidiphilium, Appl. Environ. Microbiol*., 66:3065-3072.

Synergistic Activities

Research	▫ Advanced wastewater treatment processes and nutrient dynamics
	▫ Characterization of acidophilic microbes and bioremediation of acid mine drainage
	▫ Development and testing of novel membrane bioreactor (MBR) systems
	▫ Biological reduction of high-salinity, perchlorate-containing wastewaters
	▫ Nutrient dynamics and fate of mercury during wetland treatment
Teaching	▫ Environmental Microbiology, Bioremediation, Biological Unit Operations, Industrial Waste Treatment, Engineering Hydrology, Environmental Chemistry, and Design of Wastewater Treatment Facilities
Outreach	▫ Co-advisor for UNR chapter of Engineers without Borders (EWB)
	▫ Coordinator for Environmental Engineering Explorations summer camp at UNR
Prof. Activity	▫ Registered Professional Engineer (Nevada, #18671)
	▫ Membership: WEF, AEESP, ASCE, ASEE
	▫ Proposal Reviewer – NSF, U.S. EPA, NIEHS, Bi-national Science Foundation
	▫ Paper reviewer – Biotechnol. Bioeng.; Environ. Eng. Sci.; Environ. Sci. Technol.; FEMS Microb. Ecol.; J. Appl. Microb.; J. Environ. Eng.; Biorem. J.; Wat. Res.
	▫ Reuse Nevada Committee Member; Nevada Water Environment Association

Collaborators and Co-Editors

Ken Adams (DRI); V. Dean Adams (UNR); Tzahi Cath (Colorado School of Mines); Amy Childress (UNR); Joseph Cline (UNR); Chuck Coronella (UNR); John Cushman (UNR); Keith Dennett (UNR); Mae Gustin (UNR);Chris Fritsen (DRI); Edward Kolodziej (UNR); Shai Koussevitzky (UNR); Ron Mittler (UNR); Monica Nicolescu (UNR); Jordan Peccia (Yale University); Michael Rosen (USGS); Laurel Saito (UNR); Victor Vasquez (UNR)

Graduate and Postdoctoral Advisors

JoAnn Silverstein, University of Colorado at Boulder (Ph.D.); E. Joe Middlebrooks, retired (M.S.)

Thesis Advisor and Postgraduate-Scholar Sponsor

Ph.D. Students: Chan-Jae Park, Patrick Plumb; Andrea Achilli (co-advisor with A. Childress).

M.S. Students: Rob Dyer, Christopher Ore, Nichole Whisman (co-advisor with J. Adams), Naventhan Kandasamy, Bailey Cannon (co-advisor with V.D. Adams), Jihyo Chong, Christopher Brockway, Nalleli Herrera, Joel Donalson, Jacob Coleman, Collin Emmerson, Nicholas Nussbaum, Anthony Dimpel, Wes Helander, Carson Nikkel

B.S. Students: Brittany Wood, Bailey Cannon, Anthony Dimpel, Collin Emmerson, Brad Suedbeck, Kimberly Rafter, Carson Nikkel

DR. SCOTT W. TYLER

Professional Preparation

B.S. Mechanical Engineering, University of Connecticut; Storrs, Connecticut. June 1978
M.S. Hydrology, New Mexico Institute of Mining and Technology; Socorro, New Mexico
Thesis Title: *Field Results of Borehole Infiltration Tests*. June 1983
Ph.D. Hydrology/Hydrogeology, University of Nevada, Reno, Nevada
Dissertation Title: *Fractal Applications to Soil Hydraulic Properties.* August 1990

Appointments

2009-Present **Director,** Center for Transformative Environmental Sensing Programs
2006-Present **Professor**, Department of Geological Sciences and Engineering
2005 **Visiting Professor:** Catholic University of Chile and EPFL, Lausanne Switzerland
2000-2005 **Professor and Director**, Dept/ of Natural Resources and Environmental Sciences and the Department of Geological Sciences, Graduate Program of Hydrologic Sciences
1998-1999 **Professor**, Desert Research Institute and Dept. of Environmental and Resource Sciences
1992–1998 **Associate Professor**, Desert Research Institute and Dept. of Environmental and Resource Sciences

Publications

(five most relevant)

1. Neilson, B.T., C.E. Hatch and **S.W.Tyler**. 2010. Effects of solar radiative heating on fiber optic cables used in aquatic settings. doi:10.1029/2009WR008354. *Water Resources Res.*
2. Sayde, C., C. Gregory, M. Rodriguez, N. Tufillaro, **S. Tyler**, N. van de Giesen, M. English, R. Cuenca and J. Selker. Feasibility of soil moisture monitoring with fiber optics. 2010. doi:10.1029/2009WR007846. *Water Resources Res.*
3. Steele-Dunne, S., M. Rutten, D. Krzeminska, M. Hausner**, S. W. Tyler,** J. Selker, T. Bogaard and N. Van de Giesen. 2010. Feasibility of soil moisture estimation using passive distributed temperature sensing. doi:10.1029/2009WR008272, *Water Resources Res.*
4. **Tyler, S.W.,** J.S. Selker, M.B. Hausner, C.E. Hatch, T. Torgersen and S. Schladow*. 2009.* Environmental temperature sensing using Raman spectra DTS fiber optic methods. *Water Resources Res.* doi: 10.1029/2008WR007052.
5. **Tyler, S.W.**, S. Burak, J. McNamara, A. Lamontagne, J. Selker and J. Dozier. *2008*. Fiber optic measurement of distributed base temperatures of two snowpacks. *Journal of Glaciology* 54(187):673-679.

(five other significant publications)

1. Suarez, F., J. Aravena, M. Hausner , A. Childress and **S.W. Tyler.** Assessment of a vertical high resolution distributed temperature sensing system in a shallow thermohaline environment. 2011. *Hydrology and Earth System Sciences Discussion: 29-58.*1
2. Suarez, F., A.E. Childress and **S.W. Tyler**. A fully-coupled, transient double diffusive convection model for salt-gradient solar ponds. 2010*. International Journal of Heat and Mass Transfer.* doi:10.1016/j.ijheatmasstransfer.2010.01.017.
3. Moffett, K., **S. Tyler**, T. Torgersen, M. Menon, J. Selker and S. Gorelick. *2008,* Distributed temperature sensing of thermal trends and anomalies in the bed of an intertidal salt marsh and channel: The tidal thermal blanket effect. *Environ. Science and Tech*. 42(3); 671-676. DOI: 10.1021/es071309m.
4. Constanz, J., **S.W. Tyler** and E Kwicklis. 2003. Temperature-Profile Methods for Estimating Percolation Rates in Arid Environments. *Vadose Zone Journal* 2:12-24.
5. **Tyler, S.W.**, P.G. Cook, A.Z. Butt, J.M. Thomas, P.T. Doran and W.B. Lyons. 1998. Evidence of Deep Circulation in Two Perennially Ice-Covered Antarctic Lakes. *Limnology and Oceanography.* Vol 43(4): 625-635.

Synergistic activities

Dr. Tyler has conducted field research on hydrologic cycles in a wide variety of climates and environments, and has extensive experience developing interdisciplinary field teams and field experiments. Dr. Tyler has extensively used tracer methods (temperature, chloride, chlorine-36 and stable isotopes) in soils to track migration of contaminants and recharge at multiple scales in the vadose zone. Recently, he has become a leader in the application of Raman Spectra Fiber Optic Temperature measurements (DTS), working on snow basal temperatures, stream/groundwater interactions, soil temperature and mixing in deep lakes and is the director of NSF's Center for Transformative Environmental Monitoring Programs (www.ctemps.org). He has served as Editor for AGU's Water Resources Research and currently serves on the National Academy of Sciences Panel on Challenges in Hydrologic Sciences, and is a member of the Board of Directors of the Consortium for the Advancement of Hydrologic Sciences, Inc.

Collaborators and Co-Editors

S. Assouline, VIT; J. Munoz, Catholic University of Chile; M. Berli, DRI; M. Parlange, EPFL; M. Conklin, UCM; B. Scanlon, TBEG; J. Constanz, USGS; J. Selker, OSU; F. Day-Lewis, USGS; J. Simunek, UCR; J. Dozier, UCSB; S. Silliman, UND; M. Edmunds, Oxford; S. Steel-Dunne, TU Delft; G.W. Gee, Retired; A. Ward, PNNL; T. Gheezehei UC Merced; P. Wierenga, Retired; N. de Giesen TUD; W. Wood, MSU; R.J. Glass, Sandia; T. Torgersen, NSF; E. Kwicklis, LASL; W.B. Lyons, OSU

Graduate and Postdoctoral Advisors

Dr. Stephen Wheatcraft (Univ. of Nevada Reno, Ph.D. advisor); Dr. Daniel Stephens, New Mexico Tech, M.S. advisor)

Thesis and Postgraduate-Scholar Sponsor

William Albright, Brian Andraski, Fred Ramsing, Clay Cooper, Rich Redd, Ron Parratt, Gitane Royce, Jeff Gamlin, Geoff Webb, Peter Hartsough, Jena Green, Karen Font, Edmund Twum, Stephanie Kampf, David Prudic, David Decker, Jeff Kinder, Joe Leising, Francisco Poch, Sue Burak, Mark Hausner

DR. DEV CHIDAMBARAM

Professional Preparation

Central Electrochemical Research Institute, Karaikudi, TN, India	Chemical and Electrochemical Engineering	B. Tech (1998)
State University of New York at Stony Brook, Stony Brook, NY	Materials Science and Engineering	M. S. (2000)
State University of New York at Stony Brook, Stony Brook, NY	Biomedical Engineering	M. S. (2001)
State University of New York at Stony Brook, Stony Brook, NY	Materials Science and Engineering	Ph. D. (2003)
State University of New York at Stony Brook, Stony Brook, NY	Electrochemistry and Surface Analysis	Post doctoral Feb, 2004 – Sept, 2004

Appointments

University of Nevada, Reno, NV	Assistant Professor (Materials Sc. & Eng.)	2009 Aug - Date
State University of New York at Stony Brook, Stony Brook, NY	Assistant Adjunct Professor (Materials Sc. & Eng.)	2004 June-Date
National Synchrotron Light Source (NSLS)	Spokesperson, Beamlines X11A and X11B	2007 Mar – 2010 Jan
Brookhaven National Laboratory	Assistant Materials Scientist (Environmental Sciences)	2007 Oct-2009 Aug
Brookhaven National Laboratory	Goldhaber Distinguished Fellow (Environmental Sciences)	2004 Oct-2007 Oct
State University of New York at Stony Brook, Stony Brook, NY	*Postdoctoral Associate (Materials Sc. & Eng).*	2004 Feb – 2004 Sept

Publications

Chidambaram, D., Hennebel, T., Taghavi, S., Mast, J., Boon, N., Verstraete, W., van der Lelie, D.. Fitts, J. P., 'Concomitant Microbial Generation of Palladium Nanoparticles and Hydrogen To Immobilize Chromate', *Environmental Science & Technology*, ASAP DOI: 10.1021/es101559r

De Gusseme, B.; Du, L. G.; Hennebel, T.; Renard, P.; **Chidambaram, D**.; Fitts, J. P.; Bruneel, E.; Van, D. I.; Verbeken, K.; Boon, N.; Verstraete, W., 'Virus Removal by Biogenic Cerium', *Environmental Science & Technology* 2010, 44, 6350-6356.

Y. Liu, M. H. Rafailovich, R. Malal, D. Cohn, and **D. Chidambaram**, 'Engineering of bio-hybrid materials by electrospinning polymer-microbe fibers', *Proceedings of the National Academy of Sciences,* 106, 34, 14201 (2009).

Chidambaram, D., J. P. Fitts, T. Hennebel, S. Taghavi, and D. van-der-Lelie, 'Palladium(0) Nanoparticle Formation by Clostridium sp. BC1 Provides an Effective Biocatalyst for Hexavalent Chromium Remediation Proceedings of the 10th International Conference on the Biogeochemistry of Trace Elements. Chihuahua, Mexico, (2009).

Chidambaram, D. 'Extracellular bioreduction: A technology for contaminant removal and reclamation' Abstracts of Papers, 236th ACS National Meeting, Philadelphia, PA, United States, August 17-21, (2008)

Patents

D. Chidambaram, Y. Liu and M. Rafailovich, 'Encapsulated Microbes in Cross-linkable Polymers' – a process for encapsulating microorganisms in polymeric fibers while ensuring their survival to use them as bioactive materials, U.S. Patent Office, Patent Pending. Patent Publication/Serial No. 12/420,088

D. Chidambaram, 'Enhanced Metabolite Generation' – a process for enhancing the production of biofuels and other microbial fermentation products, U.S. Patent Office, Patent Pending. Patent Publication/Serial No. 12/046,707.

D. Chidambaram and A. J. Francis, 'Extracellular Bioreduction' – a process for bioremediation and wastewater treatment, U.S. Patent Office, Patent Pending. Patent Publication/Serial No. 60/896,597.

Synergistic Activities

Lecturer and participant in the Alliance for Graduate Education and the Professoriate (NSF- AGEP) and the New York State Science and Technology Entry Program for minorities

Co-chaired a special session titled '*Advances in remediation technologies for trace elements contaminated sites*' at the 10th International Conference on Biogeochemistry of Trace Elements (ICOBTE) organized by the International Society of Trace Element Biogeochemistry (ISTEB), Chihuahua, Mexico< July 13th-16th (2009). Co-chairs: D. Chidambaram, G. Pierzynski and P. Holm

Co-organized and co-chaired Symposium titled '*Research Related to the Environmental Management Mission of the Department of Energy*', under the auspices of the Division of Nuclear Chemistry & Technology at the 236th Meeting of the American Chemical Society (ACS), Philadelphia, PA, August 17-21 (2008). Co-organizers and co-chairs: G.P. Halada, S.B. Clark, J.B. Gillow and D. Chidambaram.

Reviewer for 13 scientific journals

Collaborators & Other Affiliations

Clayton, C. R., Halada, G. P., Rafailovich,	State University of New York at Stony Brook
Cohn, D., Malal, R.	The Hebrew University of Jerusalem, Israel
Francis, A. J., Fitts, J. P., D. van der Lelie, S.	Brookhaven National Laboratory
Taghavi	Arcadis International
Gillow, J.	Technical University, Denmark
Holm, P. E.	Oklahoma State university
John, G	
Pierzynski, G	Kansas State University
Roeper, D. F.	Naval Research Laboratory
Verstraete, W., Boon, N, Hennebel, T.	Ghent University, Belgium

Graduate and Postdoctoral Advisor

Clayton, C. R.	State University of New York at Stony Brook
Halada, G. P.	State University of New York at Stony Brook
Francis, A. J.	Brookhaven National Laboratory

Graduate and Undergraduate Advising

Jason Hastings, M. S. (Dec 2010); Ph. D. (expected December 2012)
Dharshini Balasubramaniyan, M. S. (Dec 2011); Ph. D. (expected 2014)
Jesse Ruppert, Ph.D. (expected Dec 2013)
David Rodriguez, M. S. (expected May 2012); Ph. D. (expected 2015)
Kimberley DeSouza M. S. (expected Dec 2012);
Undergraduate Summer interns: Community college interns: A. Johnson (2009), G. Merilis (2009), K. Wallace (2008); Native Americans undergraduates: D. Trobrare (2009), T. Mixson (2009)

EMIL J. GEIGER

Professional Preparation

Louisiana State University	Mechanical Engineering	B.S., 2003
University of California, Berkeley	Mechanical Engineering	M.S., 2006
University of California, Berkeley	Mechanical Engineering	Ph.D., 2008
Lawrence Livermore National Lab	Microtechnology	Post-Doc, 2008-10

Appointments

Assistant Professor of Mechanical Engineering University of Nevada-Reno, Reno, NV	July 2010 – present
Post-Doctoral Research Engineer Lawrence Livermore National Laboratory, Livermore, CA	September 2008 – June 2010
Graduate Research Assistant University of California-Berkeley, Berkeley, CA	August 2003 – June 2008
Undergraduate Research Assistant Louisiana State University, Baton Rouge, LA	August 1999 – May 2003

Publications

(five most closely related)

1. **E. J. Geiger**, D. A. Mair, F. Svec, A. P. Pisano, "Development of an injection molding tool for complex microfluidic geometries," *Microsystems Technologies*, vol. 17, 2011, pp. 1537-1540.
2. **E. J. Geiger**, A. P. Pisano, and F. Svec, "A highly-integrated, polymer-based microfluidic platform for disposable applications," *Journal of MicroElectroMechanical Systems*, vol. 19, 2010, pp. 944-950.
3. J.M. Lippmann, **E.J. Geiger**, and A.P. Pisano, "Polymer investment molding: Method for fabricating hollow, microscale parts," *Sensors & Actuators: A. Physical*, vol. 134, 2007, pp. 2-10.
4. D. A. Mair, **E. J. Geiger**, A. P. Pisano, J. M.J. Fréchet, and F. Svec, "Injection molded microfluidic chips featuring integrated interconnects," *Lab on a Chip*, vol. 6, 2006, pp. 1346-1354.
5. R. A. Turner, Y. Desta, K. W. Kelly, J. Zhang, **E. J. Geiger**, S. Cortez, and D.C. Mancini, "Tapered LIGA HARMs," *Journal of Micromechanics and Microengineering*, vol. 13, 2003, pp. 367-372.

(five other significant publications)

1. Dieudonne Mair, **Emil Geiger**, "Disposable, High Pressure Microfluidic Chips," Application Number: PCT/US2007/071607, (pending).
2. M. Higgins and **E.J. Geiger,** "Maskless photolithography using an epiflourescent microscope for microfluidic applications," *ASME International Mechanical Engineering Congress and Exposition*, 2011
3. **E. J. Geiger**, D.A. Mair, A.P. Pisano, and F. Svec, "On-chip actuation of thermally sensitive hydrogel valve," *Micro Total Analysis Systems*, 2008.
4. D. A. Mair, **E. J. Geiger**, T. Schwei, T. Dinio, J. M. J. Fréchet, and F. Svec, "Use of photopaterned nanoporous polymer monoliths as passive mixers to enhance mixing efficiency for on-chip labeling reactions," *Micro Total Analysis Systems*, 2008.
5. **E. J. Geiger**, J. M. Lippmann, J. A. Frank, A. P. Pisano, "Single-step, integrated, assembly and encapsulation of microfluidic bubble generator," *ASME International Mechanical Engineering Congress and Exposition*, 2005.

Synergistic Activities

Instructor

ME 644/444/444L Intermediate Dynamics and Laboratory
ME 451/452 Senior Capstone Design
ME 493 Special Topics – Introduction to Microtechnology (planned for 2012)

Selected Awards

2005-2006 National Science Foundation GK-12 Teaching Fellow
2003-2007 National Science Foundation Graduate Research Fellow

Reviewer

Journal of Micromechanics and Microengineering

Professional Memberships

The American Society of Mechanical Engineers (ASME) (1999 – present)
The American Society of Engineering Educators (ASEE) (2009 – present)

Collaborators and Co-Editors

Dr. Jeff Angermann, University of Nevada, Reno, NV
Prof. John Cushman, University of Nevada, Reno, NV
Dr. Julian Lippmann, University of Buffalo, NY
Dr. Dieudonne Mair, Exponent, Menlo Park, CA
Dr. Frank Svec, Lawrence Berkeley National Laboratory, Berkeley, CA
Dr. Jonathan Trent, NASA Ames Research Center, Moffett Field, CA

Graduate and Postdoctoral Advisors

Postdoctoral Advisor

Dr. Satinderpall Pannu, Lawrence Livermore National Lab, Livermore, CA

Graduate Advisor

Prof. Albert Pisano, Mechanical Engineering, University of California, Berkeley CA

Thesis and Postgraduate-Scholar Sponsor

Graduate Student Advisor (2 graduate students)

Kelsey Eiriksson, University of Nevada, Reno
John Malinowski, University of Nevada, Reno

Undergraduate Research Student Advisor

Jessica Estrada-Lopez, University of Nevada, Reno
MacCallister Higgins, University of Nevada, Reno
Alexandra Hill, University of Nevada, Reno

MARKUS BERLI

Professional Preparation

M.Sc. (Dipl. Ing. ETHZ) in Environmental Engineering
Swiss Federal Institute of Technology (ETH), Zurich, Switzerland, 1996.

Ph.D. (Dr. sc. tech.) in Civil and Environmental Engineering
Swiss Federal Institute of Technology (ETH), Zurich, Switzerland, 2001.

Post Doctorate – Soil Physics
Utah State University (USU), Logan, Jan. 2002 - July 2002.

Post Doctorate – Environmental Physics
University of Connecticut (UConn), Storrs, Aug. 2002 – Aug. 2005

Appointments

July 2011 –	Associate Research Professor	DRI, Las Vegas
2006 – 2011	Assistant Research Professor	DRI, Las Vegas
2005 – 2006	Research Associate	Agroscope Reckenholz-Tänikon (ART), Zurich
2002 – 2005	Postdoctoral Associate	Utah State Univ. and Univ. of Connecticut
1996 – 2001	Research and Teaching Assistant	ETH Zurich

Publications

(five most closely related)

1. Aravena J.E., **Berli M.**, Ghezzehei T.A., Tyler S.W., 2011. Effects of root-induced compaction on rhizosphere hydraulic properties - X-ray micro-tomography imaging and numerical simulations. Environmental Science & Technology 45:425-431.
2. **Berli, M.,** Carminati, A., Ghezzehei, T.A., and Or, D., 2008. Unsaturated hydraulic conductivity of aggregated soils under compression. Water Resources Research, 44, W00C09.
3. Eggers, C.G., **Berli, M.,** Accorsi, M. and Or, D., 2007. Permeability of deformable soft aggregated earth materials: From single pore to sample cross-section. Water Resources Research, 43, W08424.
4. Eggers, C.G., **Berli, M.,** Accorsi, M. and Or, D., 2006. Deformation and permeability of aggregated soft earth materials. Journal of Geophysical Research, 111, No. B10, B10204.
5. **Berli, M**., Accorsi, M.L. and Or, D., 2006. Size and shape evolution of pores in viscoplastic matrix under compression. International Journal for Numerical and Analytical Methods in Geomechanics,30(12), 1259-1281.

(other significant publications)

1. **Berli, M**. Eggers, C.G., Accorsi, M. and Or, D., 2006. Theoretical analysis of mechanical behavior of fluid inclusions for in-situ measurements of soil stress and deformation. Soil Science Society of America Journal, 70, 1441-1452.
2. **Berli, M** and Or, D., 2006. Deformation of spheroidal pores in viscoplastic soil material. International Journal of Geomechanics, 6(2), 108-118.

3. **Berli,** M., Kirby, J.M., Springman, S.M. and Schulin, R., 2003. Modeling compaction of agricultural subsoils by tracked heavy construction machinery under various moisture conditions. Soil & Tillage Research 73(1-2), 57-66.

Synergistic Activities

Dr. Berli's research focuses on soil structure and its influence on hydraulic and mechanical properties of artificial and natural soils. Results from his pervious and current research have been published in peer-reviewed journal articles and were presented in numerous national and international meetings. For his Ph.D., Dr. Berli was in charge of research projects related to subsoil compaction due to gas pipeline construction activities in Switzerland, supported by the Research and Development Fund of Swiss Gas Industry. For his postdoctoral studies, he worked on coupling of mechanics and hydraulics of geomaterials, funded through Swiss National Science Foundation and USDA-NRI. Dr. Berli's research activities on physical soil-root interaction at the micro-scale are supported by NSF. Dr. Berli leads the current DRI research effort on characterizing the influence of fire on soil physical properties, sponsored by USACE, and a DRI-funded pilot project on determining soil moisture from space, employing satellite-based SAR images. He is active in transferring state of the art knowledge from his field of expertise to engineering practice. He teaches Vadose Zone Hydrolgoy (GEOL 719) at UNLV, was a lecturer for physical soil protection for engineers and environmental consultants in Switzerland, assisted teaching in Physical Soil Protection at ETHZ, Environmental Physics at UConn, and Vadose Zone Hydrology at UNLV. He supervised five M.S. students in Switzerland, one M.S. student at UConn and UNLV. He currently supervises three Ph.D. Students at UNR, one Ph.D. student and two M.S. students at UNLV. Dr. Berli was part of the FAIR-Concerted Action on Subsoil Compaction of the European Union and coordinated the contributions of ETHZ to the Concerted Action database. He serves as an Associate Editor for the Journal of Plant Nutrition and Soil Science and as a reviewer for ten international peer-reviewed journals. He is a member of the American Geophysical Union, Soil Science Society of America as well as the Swiss and German Soil Science Society.

Collaborators and Co-Editors

Accorsi, M.L., UConn, Storrs; Chen, L., DRI, Las Vegas; Chief, K., UoA, Tucson; Cook, D., UNLV, Las Vegas; Desaules, A., ART, Zurich; Fenstermaker, L., DRI, Las Vegas; Flühler, H., ETH, Zurich; Ghezzehei, T.A., UC, Merced; Kirby, J.M., CSIRO, Canberra; McDonald, E., DRI, Reno; Menon, M., Univ. of Sheffield; Nico, P., LBNL, Berkeley; Or, D., ETH, Zurich; Regentova, E.E., UNLV, Las Vegas; Schulin, R., ETH, Zurich; Springman, S.M., ETH, Zurich; Thomas, J., DRI, Reno; Tyler, S.W., UNR, Reno; Weisskopf, P., ART, Zurich; Young, M.H., UT Austin, Austin.

Graduate and Post Doctoral Advisors

R. Schulin	ETH Zurich, Switzerland	M.Sc. & Ph.D. Advisor
H. Flühler	ETH Zurich, Switzerland	Ph.D. Committee Member
S.M. Springman	ETH Zurich, Switzerland	Ph.D. Committee Member
D. Or	USU & UConn, USA	Postdoctoral Advisor

Graduate Advisees (*) current

M.S., ETHZ: Schönbächler, D., Zimmermann, S., Jauslin, M., Hug, E., Krähenmann, K.;

M.S., UCONN: Eggers, C.; M.S., UNLV: Pillai, N., Potteti, K.*, Evans, C.*, Ruiz, S.*;

Ph.D., UNR: Steude, J.*, Aravena Ibáñez, J.*, Caldwell, T.*;

Ph.D., UNLV: Jayakody, J.*

Karl F. Pohlmann

Professional Preparation

University of Minnesota	Geology	B.S., 1983
Purdue University	Geosciences	M.S., 1987

Appointments

2000-present	Associate Research Hydrogeologist. Desert Research Institute, Division of Hydrologic Sciences, Nevada System of Higher Education, Las Vegas, Nevada.
1991-2000	Assistant Research Hydrogeologist. Desert Research Institute, Division of Hydrologic Sciences, Nevada System of Higher Education, Las Vegas, Nevada.
1987-1991	Staff Hydrogeologist. Desert Research Institute, Division of Hydrologic Sciences, Nevada System of Higher Education, Las Vegas, Nevada.
1984-1987	Graduate Research Assistant. Purdue University, Department of Atmospheric Sciences, Lafayette, Indiana.
1984	Hydrologic Field Assistant. U.S. Geological Survey, Water Resources Division, St. Paul, Minnesota.
1982-1983	Undergraduate Research Assistant. University of Minnesota, Department of Geology and Geophysics, Minneapolis, Minnesota.

Publications

(five most closely related)

Ye, M., **Pohlmann, K.**, Chapman, J., Pohll, G., Reeves, D.M., 2010. A model-averaging method for assessing groundwater conceptual model uncertainty. Ground Water, 48(5): 716-728. doi:10.1111/j.1745-6584.2009.00633.x

Zhu, J., **Pohlmann, K. F.,** Chapman, J. B., Russell, C. E., Carroll, R. W. H., Shafer, D. S., 2010. Sensitivity of solute advective travel time to porosities of hydrogeologic units. Ground Water, 48(3): 442-447. doi:10.1111/j.1745-6584.2009.00664.x

Carroll, R.W.H., Pohll, G., McGraw, D., Garner, C., Knust, A., Boyle, D., Minor, T., Bassett, S., **Pohlmann, K.,** 2010. Mason Valley Groundwater Model: Linking Surface and Groundwater Processes in the Walker River Basin, Nevada. Journal of American Water Resources Association, 46(3): 554-573. doi: 10.1111/j.1752-1688.2010.00434.x

Pohlmann, K.F., Hassan, A.E., Chapman, J.B., 2002. Modeling density-driven flow and radionuclide transport at an underground nuclear test: Uncertainty analysis and effect of parameter correlation. Water Resources Research, 38(5). doi:10.1029/2001 WR001047

Pohlmann, K., Hassan, A.E., Chapman, J., 2000. Description of hydrologic heterogeneity and evaluation of radionuclide transport at an underground nuclear test. Journal of Contaminant Hydrology, 44(3-4): 353-386. doi:10.1016/S0169-7722(00)00100-5

(five other significant publications)

Reeves, D.M., **Pohlmann, K.,** Pohll, G., Ye, M., Chapman, J., 2010. Incorporation of conceptual and parametric uncertainty into radionuclide flux estimates from a fractured granite rock mass. Stochastic Environmental Research and Risk Assessment, 24(6): 899-915. doi:10.1007/s00477-010-0385-0

Ye, M., **Pohlmann, K.F**., Chapman, J.B., 2008. Expert elicitation of recharge model probabilities for the Death Valley Regional Flow System. Journal of Hydrology, 354(1-4): 102-115. doi:10.1016/j.jhydrol.2008.03.001

Young, M.H., Albright, W.H., **Pohlmann, K.F**., Pohll, G.M., Zachritz, W.H., Zitzer, S.F., Shafer, D.S., Nester, I., Oyelowo, L., 2006. Incorporating parametric uncertainty in the design of alternative landfill covers in arid regions. Vadose Zone Journal, 5: 742-750. doi:10.2136/vzj2005.0112

Ye, M., Neuman, S.P., Meyer, P.D**., Pohlmann, K.F.**, 2005. Sensitivity analysis and assessment of prior model probabilities in MLBMA with application to unsaturated fractured tuff. Water Resources Research, 41, W12429, doi:10.1029/2005WR004260.

Hassan, A.E., Chapman, J.B**., Pohlmann, K.F.,** 2004. Uncertainty analysis of seawater intrusion and implications for radionuclide transport at Amchitka Island's underground nuclear tests, In Coastal Aquifer Management: Monitoring, Modeling, and Case Studies, Edited by A.H.-D. Cheng and D. Ouazar, Lewis Publishers, CRC Press, pp.205-231.

Synergistic Activities

- Co-organizer of monthly seminar series within Division of Hydrologic Sciences that provides opportunity for researchers from our Reno and Las Vegas offices to visit with colleagues in the other office, present a seminar, and discuss mutual research interests and proposal ideas.
- Participation in assessing computational needs, followed by planning and purchasing advanced cluster and grid computing resources, first for the Division of Hydrologic Sciences and then for the wider Institute.
- Development and application of methodologies for incorporating conceptual and parametric uncertainty in numerical models of groundwater flow.
- Ad-hoc reviewer for five journals

Collaborators and Co-Editors

Wayne Belcher, U.S. Geological Survey; Ahmed Hassan, Irrigation and Hydraulics Department, Cairo University, Cairo, Egypt; Greg Ruskauff, Navarro-Interra, LLC; Liying Wang, Department of Scientific Computing, Florida State University; Ming Ye, Department of Scientific Computing, Florida State University

Graduate and Postdoctoral Advisors

Darrell Leap, Purdue University

Thesis Advisor and Post-Graduate-Scholar Sponsor

Thesis advisor: 0
Postgraduate-scholar sponsor (within past 5 years): Matt Reeves, Desert Research Institute
Postgraduate-scholar sponsor (total): 1

DR. RALF SUDOWE

Professional Preparation

Philipps Universität Marburg, Germany	Chemistry	Diplom-Chemiker, 1995
Philipps Universität Marburg, Germany	Chemistry	Ph.D., 1999
Lawrence Berkeley National Laboratory, Berkeley CA	Nuclear Science Division	Postdoc, 1999-2001

Appointments

2006 - University of Nevada, Las Vegas, Assistant Professor of Health Physics and Radiochemistry
2005 – 2006 Lawrence Berkeley National Laboratory, Nuclear Science Division, Staff Scientist
2001 – 2005 Lawrence Berkeley National Laboratory, Chemical Sciences Division, Staff Scientist

Publications

(five most closely related)

1. Gates, J.M., **Sudowe, R.,** Stavsetra, L., Ali, M.N., Calvert, M.G., Dragojević, I., Ellison, P.A., Garcia, M. A., Gharibyan, N., Gregorich, K.E., Nelson, S.L., Neumann, S.H., Parsons-Moss, T., Nitsche, H., *Extraction of niobium and tantalum isotopes using organophosphorus compounds – Part I – Extraction of 'carrier-free' metal concentrations from HCl solutions*, Radiochimica Acta **97**, 167-172 (2009)
2. **Sudowe, R.,** Calvert, M.G., Düllmann, Ch.E., Farina, L.M., Folden, C.M., III, Gregorich, K.E., Gallaher, S.E.H., Hoffman, D.C., Nelson, S.L., Phillips, D.C., Schwantes, J.M., Wilson, R.E., Zielinski, P.M., H. Nitsche, *Extraction of short-lived zirconium and hafnium isotopes using crown ethers: A model system for the study of rutherfordium*, Radiochimica Acta **94** 123-129 (2006)
3. Andersson, S., Nitsche, H., **Sudowe, R.,**, *Berkelium nitrate complex formation using a solvent extraction technique*, Radiochimica Acta **94** 59-61 (2006)
4. Düllmann, Ch.E., Brüchle, W., Dressler, R., Eberhardt, K., Eichler, B., Eichler, R., Gäggeler, H.W., Ginter, T.N., Glaus, F., Gregorich, K.E., Hoffman, D.C., Jäger, E., Jost, D.T., Kirbach, U.W., Lee, D.M., Nitsche, H., Patin, J.B., Pershina, V., Piguet, D., Qin, Z., Schädel, M., Schausten, B., Schimpf, E., Schött, H.-J., Soverna, S., **Sudowe, R.,**, Thörle, P., Timokhin, S.N., Trautmann, N., Türler, A., Vahle, A., Wirth, G., Yakushev, A.B., Zielinski, P.M., *Chemical investigation of hassium (Hs, element 108)*, Nature **418**, 859-862 (2002)
5. Laue, C.A., **Sudowe, R.,** Gregorich, K.E., Hoffman, D.C., *Development of a fast and efficient separation for short lived plutonium isotopes produced in accelerator-based irradiations*, Solvent Extraction and Ion Exchange **18**, 203-221 (2000)

(five other significant publications)

1. Oganessian, Yu.Ts., Abdullin, F.Sh., Bailey, P.D., Benker, D.E., Bennett, M.E., Dmitriev, S.N., Ezold, J.G., Hamilton, J.H., Henderson, R.A., Itkis, M.G., Lobanov, Yu.V., Mezentsev, A.N., Moody, K.J., Nelson, S.L., Polyakov, A.N., Porter, C.E., Ramayya, AV., Riley, F.D., Roberto, J.B., Ryabinin, M.A., Rykaczewski, K.P., Sagaidak, R.N., Shaughnessy, D.A., Shirokovsky, I.V., Stoyer, M.A., Subbotin, V.G., **Sudowe, R.,** Sukhov, A.M., Taylor, R., Tsyganov, Yu.S., Utyonkov, V.K., Voinov, A.A., Vostokin, G.K., Wilk, P.A., Eleven new heaviest isotopes of elements Z = 105 to Z = 117 identified among the products of 249Bk+48Ca reactions, Physical Review C **83**, 054315 (2011)
2. Oganessian, Yu.Ts., Abdullin, F.Sh., Bailey, P.D., Benker, D.E., Bennett, M.E., Dmitriev, S.N., Ezold, J.G., Hamilton, J.H., Henderson, R.A., Itkis, M.G., Lobanov, Yu.V., Mezentsev, A.N., Moody, K.J., Nelson, S.L., Polyakov, A.N., Porter, C.E., Ramayya, AV., Riley, F.D., Roberto, J.B., Ryabinin, M.A., Rykaczewski, K.P., Sagaidak, R.N., Shaughnessy, D.A., Shirokovsky, I.V., Stoyer, M.A., Subbotin, V.G., **Sudowe, R.,** Sukhov, A.M., Tsyganov, Yu.S., Utyonkov, V.K., Voinov, A.A.,

Vostokin, G.K., Wilk, P.A., *Synthesis of a new element with atomic number Z = 117*, Physical Review Letters **104** (2)**,** 142502 (2010)

3. Folden III, C.M., Dragojević, I., Düllmann, Ch.E., Eichler, R., Garcia, M.A., Gates, J.M., Nelson, S.L., **Sudowe, R.,**, Gregorich, K.E., Hoffman, D.C., Nitsche, H., *Measurement of the $^{208}Pb(^{52}Cr, n)^{259}Sg$ excitation function*, Phys. Rev. C **79**, 027602 (2009)
4. Gates, J.M., Nelson, S.L., Gregorich, K.E., Dragojević, I., Düllmann, Ch.E., Ellison, P.A., Folden III, C.M., Garcia, M.A., Stavsetra, L., **Sudowe, R.,** Hoffman, D.C., Nitsche, H, *Comparison of reactions for the production of $^{258,257}Db$: $^{208}Pb(^{51}V,xn)$ and $^{209}Bi(^{50}Ti,xn)$*, Physical Review C **78**, 034604 (2008)
5. Nelson, S.L., Folden III, C.M., Gregorich, K.E., Dragojević, I., Düllmann, Ch.E., Eichler, R., Garcia, M.A., Gates, J.M., **Sudowe, R.,** Nitsche, H., *Comparison of complementary reactions for the production of $^{262, 261}Bh$*, Physical Review C **78**, 024606 (2008)

Synergistic Activities:

- Organized a symposium at the Eighth International Conference on Methods and Applications of Radioanalytical Chemistry, Kona, April 5-10, 2009.
- Organized a symposium at the 42nd Western Regional Meeting of the American Chemical Society, Las Vegas, NV, September 23-27, 2008.
- Organized a symposium at the 227th National Meeting of the American Chemical Society, Chicago, March 25-29, 2007.

Collaborators & Co-Editors

Bond, Evelyn, Los Alamos National Laboratory; Cerefice, Gary, Czerwinksi, Ken, Hodge, Vern, Madsen, Steen, Turner, Mary; University of Nevada, Las Vegas; Düllmann, Christoph,Gesellschaft für Schwerionenforschung, Germany; Eichler, Robert, Paul-Scherrer Institut, Switzerland; Folden III, Charles Texas A&M University; Gates, Jacklyn, Gregorich, Kenneth, Lawrence Berkeley National Laboratory; Henderson, Roger, Shaughnessy, Dawn, Lawrence Livermore National Laboratory; Inn, Kenneth, National Institute of Standards and Technology; Nilson, Mikael, University of California, Irvine; Nitsche, Heino, University of California, Berkeley & Lawrence Berkeley National Laboratory; Omtvedt, Jon Petter, University of Oslo, Norway

Graduate Advisor and Postdoctoral Sponsor:

Reinhard Brandt, Philipps-Universität Marburg, Germany
Darleane Hoffman, Lawrence Berkeley National Laboratory

Thesis Advisor:

Balazs Bene, John Despotopulos, Sherry Faye, Narek Gharibyan, Elaine Go, Derek McLain, RaJah Mena, Audrey Roman, Jeff Rolfes, Amber Wright: University of Nevada Las Vegas: Megan Bennett, Texas A&M University; Wesley Boyd, Lindsey Kelly, Environmental Protection Agency, Las Vegas; Ashlee Daily, Bigelow Aerospace; Zachary Harvey, Southern California Edison; Christopher Klug, Savannah River National Laboratory

1. Budget pages and budget justification

See separate budget pages.

BUDGET JUSTIFICATION

SALARIES: All salaries are based on percentage of full time equivalent salary (FTE). Senior personnel are budgeted at the percentage of time shown using actual salary in the calculation. Faculty members and DRI researchers request 1-2 months of summer salary over the course of the grant period for fieldwork, lab work, and supervisory efforts. Post-doctoral salaries (n=6) vary based upon going rates for different academic fields (Geoscience and Engineering). Graduate Research Assistants are calculated within the rate structure set by the Graduate Colleges and per standard salaries for respective departments. Graduate student support is requested for a total of 9 Ph.D. students. Tuition remission amounts are budgeted separately as "Other Direct Cost" for graduate students as part of their compensation, as allowed by OMB Circular A-21. Undergraduate students and other part-time help are paid hourly salaries based on type of job and level of experience. Salary is requested in order to pay four undergraduate students (B.S.) who will help with time-intensive rock preparation as well as serving as field assistants. A 3% COLA is factored into all salaries.

EMPLOYEE BENEFITS: The following rates are used: Summer salaries for senior personnel are calculated at 4%; Graduate Assistants are calculated at 2% plus Health Insurance at $1,416; Undergraduate rates are calculated at 2%. For budget estimates, rate combinations are applied as necessary and are often rounded to the next percentage point for ease of calculation.

EQUIPMENT
Major equipment purchases are all specifically for the purpose of the proposed project. Estimated costs are based on valid quotes from venders (see attached quotes).

DOMESTIC TRAVEL: Travel is estimated and charged to projects in accordance with State of Nevada travel regulations. Estimates are based on those policy limits. Travel money is requested for three purposes: (1) to travel to the field areas (over the duration of the project, multiple trips to different sections in different mountain ranges will be needed in order to complete the required fieldwork), (2) to travel to between Reno and Las Vegas for team meetings (when possible video conferences will be held instead of physical travel), and (3) to travel to national meetings. Meeting costs are estimated based on recent meeting expenses. Per diem is requested at allowable rates.

MATERIALS AND SUPPLIES: Funds are requested in order to conduct LA-ICP-MS, organic geochemical analyses (TOC, GC, GC-MSD, and GC-MSMS) at rates established by the Recharge Centers (some costs are estimated as the equipment has not yet been purchased and rates are unknown). $\delta^{13}C$ isotopic analyses are requested for ethane samples. We request $3000 for publication costs for UNLV, other entity Publication costs are listed separately. Seismic acquisition costs are calculated using data listed on the UNLV Applied Geophysical Center's web site. Well site permitting, environmental assessment costs and drilling costs are estimated based on recent similar costs and anticipated well depth.

OTHER DIRECT COSTS: Graduate student tuition and fees are budgeted separately as for graduate students as part of their compensation, as allowed by OMB Circular A-21.

INDIRECT COSTS: UNLV Facilities & Administration (F&A) cost is calculated by predetermined rate as stipulated by DHHS Rate Agreement dated 07/28/04 (DHHS Audit Agency, San Francisco). The following rate applies to this budget: UNLV = 44.00% MTDC. UNR = 41.00%, and DRI = 59.00%.

SUMMARY

PROPOSAL BUDGET

Cumulative

FOR NSF USE ONLY

ORGANIZATION: UNLV	PROPOSAL NO.	DURATION (MONTHS) PROPOSED	GRANTED
PRINCIPAL INVESTIGATOR/PROJECT DIRECTOR: Hanson	AWARD NO.		

A. SENIOR PERSONNEL: PI/PD, Co-PI'S, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF-Funded Person-months CAL	ACAD	SUMR	Funds Requested By Proposer	Funds Granted by NSF (If Different)
1.			10	$ 101,013	
2.			6	$ 143,527	
3.		4.5	4.5	$ 105,060	
4.		4.5	4.5	$ 105,060	
5.				$ -	
6. ( ) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)				$ -	
7. ( ) TOTAL SENIOR PERSONNEL (1-6)		9	25	$ 454,660	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. ( ) POST DOCTORAL ASSOCIATES		54	18	$ 779,809	
2. ( ) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)		27	9	$ 307,912	
3. ( ) GRADUATE STUDENTS				$ 330,406	
4. ( ) UNDERGRADUATE STUDENTS				$ 152,904	
5. ( ) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				$ 49,859	
6. ( ) OTHER				$ -	
TOTAL SALARIES AND WAGES (A+B)				$ 2,075,550	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				$ 274,197	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A+B+C)				$ 2,349,747	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000)					
TOTAL EQUIPMENT				$ 1,163,122	
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)				$ -	
2. FOREIGN				$ -	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS					
2. TRAVEL					
3. SUBSISTENCE					
4. OTHER					
( ) TOTAL PARTICIPANT SUPPORT COSTS				$ -	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				$ 635,101	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				$ 3,000	
3. CONSULTANT SERVICES				$ -	
4. COMPUTER SERVICES				$ -	
5. SUBAWARDS				$ 4,736,458	
6. OTHER				$ 654,380	
TOTAL OTHER DIRECT COSTS				$ 8,556,488	
H. TOTAL DIRECT COSTS (A THROUGH G)				$ 12,069,357	
I. INDIRECT COSTS (F&A) (SPECIFY RATE AND BASE)					
off campus % of MTDC Base =					
on campus % of MTDC Base = $6,169,777					
TOTAL INDIRECT COSTS (F&A)				$ 2,930,644	
J. TOTAL DIRECT AND INDIRECT COSTS (H+I)				$ 15,000,001	
K. RESIDUAL FUNDS (IF FOR FURTHER SUPPORT OF CURRENT PROJECT SEE GPG II.D.7.j.)				$ -	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$ 15,000,000	

M. COST-SHARING: PROPOSED LEVEL $	AGREED LEVEL IF DIFFERENT $			
PI/PD TYPED NAME & SIGNATURE*	DATE	**FOR NSF USE ONLY** INDIRECT COST RATE VERIFICATION		
ORG. REP. TYPED NAME & SIGNATURE*	DATE	Date Checked	Date of Rate Sheet	Initials-ORG

NSF FORM 1030

SUMMARY **Year 1**

PROPOSAL BUDGET **FOR NSF USE ONLY**

ORGANIZATION: UNLV	PROPOSAL NO.	DURATION (MONTHS) PROPOSED	GRANTED
PRINCIPAL INVESTIGATOR/PROJECT DIRECTOR: Hanson	AWARD NO.		

A. SENIOR PERSONNEL: PI/PD, Co-PI'S, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF-Funded Person-months CAL	ACAD	SUMR	Funds Requested By Proposer	Funds Granted by NSF (If Different)
1. Hanson Salary: $ 83,125			2	$ 19,026	
2. Taylor Salary: $ 118,109			2	$ 27,034	
3. Salary:				$ -	
4. Salary:				$ -	
5. Salary:				$ -	
6. ( ) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)				$ -	
7. ( ) TOTAL SENIOR PERSONNEL (1-6)			4	$ 46,060	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (2) POST DOCTORAL ASSOCIATES Salary: $ 60,000		18	6	$ 247,200	
2. (1) Project Manager 55000		9	3	$ 56,650	
3. (2) GRADUATE STUDENTS (Ph.D. students. 3 @$21,000/yr.)		9	2	$ 63,000	
4. (4) UNDERGRADUATE STUDENTS (40hrs/wk for 12 wks @ $15/hr)			3	$ 28,800	
5. ( ) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)(1 Admin. Asst. for 3 months)				$ 9,391	
6. ( ) OTHER				$ -	
TOTAL SALARIES AND WAGES (A+B)				$ 451,101	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				$ 58,846	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A+B+C)				$ 509,947	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000) Research vehicle				$ 46,815	
TOTAL EQUIPMENT				$ 46,815	
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)				$ -	
2. FOREIGN				$ -	
F. PARTICIPANT SUPPORT COSTS 1. STIPENDS 2. TRAVEL 3. SUBSISTENCE 4. OTHER				$ 50,000	
( ) TOTAL PARTICIPANT SUPPORT COSTS				$ -	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				$ 135,494	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				$ -	
3. CONSULTANT SERVICES				$ -	
4. COMPUTER SERVICES				$ -	
5. SUBAWARDS Number of subawardees: UNR				$ 1,416,308	
DRI				$ 390,510	
6. OTHER Tuition and fees				$ 6,000	
TOTAL OTHER DIRECT COSTS				$ 1,948,312	
H. TOTAL DIRECT COSTS (A THROUGH G)				$ 2,505,074	
I. INDIRECT COSTS (F&A) (SPECIFY RATE AND BASE) off campus % of MTDC Base = on campus % of MTDC Base = $1,041,951					
TOTAL INDIRECT COSTS (F&A)				$ 494,927	
J. TOTAL DIRECT AND INDIRECT COSTS (H+I)				$ 3,000,001	
K. RESIDUAL FUNDS (IF FOR FURTHER SUPPORT OF CURRENT PROJECT SEE GPG II.D.7.j.)					
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$ 3,000,000	

M. COST-SHARING: PROPOSED LEVEL $	AGREED LEVEL IF DIFFERENT $			
PI/PD TYPED NAME & SIGNATURE*	DATE	**FOR NSF USE ONLY** INDIRECT COST RATE VERIFICATION		
ORG. REP. TYPED NAME & SIGNATURE*	DATE	Date Checked	Date of Rate Sheet	Initials-ORG

NSF FORM 1030

SUMMARY **Year 2**

PROPOSAL BUDGET **FOR NSF USE ONLY**

ORGANIZATION: UNLV	PROPOSAL NO.	DURATION (MONTHS) PROPOSED	GRANTED
PRINCIPAL INVESTIGATOR/PROJECT DIRECTOR: Hanson #REF!	AWARD NO.		

A. SENIOR PERSONNEL: PI/PD, Co-PI'S, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF-Funded Person-months CAL	ACAD	SUMR	Funds Requested By Proposer	Funds Granted by NSF (If Different)
1. Hanson Salary: $ 85,619			2	$ 19,597	
2. Taylor Salary: $ 121,652			2	$ 27,845	
3. Salary: $ -		4.5		$ -	
4. Salary: $ -		4.5		$ -	
5. Salary: $ -				$ -	
6. ( ) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)				$ -	
7. ( ) TOTAL SENIOR PERSONNEL (1-6)		9	4	$ 47,442	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (2) POST DOCTORAL ASSOCIATES Salary: $ 61,800		18	6	$ 127,308	
2. (1) Project Manager		9	3	$ 58,350	
3. (2) GRADUATE STUDENTS (Ph.D. students. 3 @$21,000/yr.)		9	2	$ 64,890	
4. (4) UNDERGRADUATE STUDENTS (40hrs/wk for 12 wks @ $15/hr)			3	$ 29,664	
5. ( ) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				$ 9,673	
6. ( ) OTHER				$ -	
TOTAL SALARIES AND WAGES (A+B)				$ 337,327	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				$ 52,858	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A+B+C)				$ 390,185	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000)					
Thermo Electron Xseries 2 ICP-MS w/ New Wave Laser Ablation System, Accessories and Shipping				$ 285,339	
GC				$ 29,815	
GC-MSD				$ 84,598	
Rock-Eval 6 Analyzer				$ 55,000	
Leico TOC analyzer				$ 42,718	
GC-MSMS				$ 332,704	
TOTAL EQUIPMENT				$ 800,359	
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)				$ -	
2. FOREIGN				$ -	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS					
2. TRAVEL				$ 40,000	
3. SUBSISTENCE					
4. OTHER					
( ) TOTAL PARTICIPANT SUPPORT COSTS				$ -	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES: purchase exisiting seismic, generate new seismic; permits				$ 66,955	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				$ -	
3. CONSULTANT SERVICES				$ -	
4. COMPUTER SERVICES				$ -	
5. SUBAWARDS UNR				$ 777,622	
DRI				$ 400,761	
6. OTHER startup funds for new faculty, tuition and fees				$ 106,180	
TOTAL OTHER DIRECT COSTS				$ 1,351,518	
H. TOTAL DIRECT COSTS (A THROUGH G)				$ 2,542,062	
I. INDIRECT COSTS (F&A) (SPECIFY RATE AND BASE)					
off campus % of MTDC Base =					
on campus % of MTDC Base = $964,081					
TOTAL INDIRECT COSTS (F&A)				$ 457,938	
J. TOTAL DIRECT AND INDIRECT COSTS (H+I)				$ 3,000,000	
K. RESIDUAL FUNDS (IF FOR FURTHER SUPPORT OF CURRENT PROJECT SEE GPG II.D.7.j.)					
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$ 3,000,000	

M. COST-SHARING: PROPOSED LEVEL $	AGREED LEVEL IF DIFFERENT $			
PI/PD TYPED NAME & SIGNATURE* #REF!	DATE	**FOR NSF USE ONLY** INDIRECT COST RATE VERIFICATION		
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NSF FORM 1030

SUMMARY **Year 3**

PROPOSAL BUDGET **FOR NSF USE ONLY**

ORGANIZATION: UNLV	PROPOSAL NO.	DURATION (MONTHS) PROPOSED	GRANTED
PRINCIPAL INVESTIGATOR/PROJECT DIRECTOR: Hanson #REF!	AWARD NO.		

A. SENIOR PERSONNEL: PI/PD, Co-PI'S, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF-Funded Person-months CAL	ACAD	SUMR	Funds Requested By Proposer	Funds Granted by NSF (If Different)
1. Hanson Salary: $ 90,833			2	$ 20,791	
2. Taylor Salary: $ 129,061			2	$ 29,541	
3. New Faculty Salary: $ 67,980			4.5	$ 35,010	
4. New Faculty Salary: $ 67,980			4.5	$ 35,010	
5. Salary: $ -				$ -	
6. ( ) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)				$ -	
7. ( ) TOTAL SENIOR PERSONNEL (1-6)			13	$ 120,352	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (2) POST DOCTORAL ASSOCIATES Salary: #REF!		18	6	$ 135,061	
2. (1) Project Manager		9	3	$ 61,904	
3. (2) GRADUATE STUDENTS (Ph.D. students. 3 @$21,000/yr.)		9	2	$ 68,842	
4. (4) UNDERGRADUATE STUDENTS (40hrs/wk for 12 wks @ $15/hr)			3	$ 31,471	
5. ( ) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				$ 10,262	
6. ( ) OTHER				$ -	
TOTAL SALARIES AND WAGES (A+B)				$ 427,892	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				$ 53,773	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A+B+C)				$ 481,665	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000)					
TOTAL EQUIPMENT				$ -	
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)				$ -	
2. FOREIGN				$ -	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS					
2. TRAVEL					
3. SUBSISTENCE					
4. OTHER					
( ) TOTAL PARTICIPANT SUPPORT COSTS				$ -	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				$ 123,030	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				$ 3,000	
3. CONSULTANT SERVICES				$ -	
4. COMPUTER SERVICES				$ -	
5. SUBAWARDS UNR				$ 847,171	
DRI				$ 851,850	
6. OTHER Drilling, completion, environmental assessment				$ -	
TOTAL OTHER DIRECT COSTS				$ 1,825,051	
H. TOTAL DIRECT COSTS (A THROUGH G)				$ 2,306,716	
I. INDIRECT COSTS (F&A) (SPECIFY RATE AND BASE)					
off campus % of MTDC Base =					
on campus % of MTDC Base = $1,459,545					
TOTAL INDIRECT COSTS (F&A)				$ 693,284	
J. TOTAL DIRECT AND INDIRECT COSTS (H+I)				$ 3,000,000	
K. RESIDUAL FUNDS (IF FOR FURTHER SUPPORT OF CURRENT PROJECT SEE GPG II.D.7.j.)					
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$ 3,000,000	

M. COST-SHARING: PROPOSED LEVEL $	AGREED LEVEL IF DIFFERENT $			
PI/PD TYPED NAME & SIGNATURE* #REF!	DATE	**FOR NSF USE ONLY** INDIRECT COST RATE VERIFICATION		
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NSF FORM 1030

SUMMARY **Year 4**

PROPOSAL BUDGET **FOR NSF USE ONLY**

ORGANIZATION: UNLV			PROPOSAL NO.		DURATION (MONTHS) PROPOSED	GRANTED
PRINCIPAL INVESTIGATOR/PROJECT DIRECTOR: Hanson #REF!			AWARD NO.			
A. SENIOR PERSONNEL: PI/PD, Co-PI'S, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)			NSF-Funded Person-months CAL	ACAD	SUMR	Funds Requested By Proposer / Funds Granted by NSF (If Different)
1. Hanson	Salary: $	90,833			2	$ 20,791
2. Taylor	Salary: $	129,061			2	$ 29,541
3. New Faculty	Salary: $	67,980			4.5	$ 35,010
4. New Faculty	Salary: $	67,980			4.5	$ 35,010
5.	Salary: $	67,980				$ -
6. ( ) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)						$ -
7. ( ) TOTAL SENIOR PERSONNEL (1-6)					13	$ 120,352
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)						
1. (2) POST DOCTORAL ASSOCIATES	Salary:	#REF!		18	6	$ 135,061
2. (1) Project Manager				9	3	$ 61,904
3. (2) GRADUATE STUDENTS (Ph.D. students. 3 @$21,000/yr.)				9	2	$ 68,842
4. (4) UNDERGRADUATE STUDENTS (40hrs/wk for 12 wks @ $15/hr)					3	$ 31,471
5. ( ) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)						$ 10,262
6. ( ) OTHER						$ -
TOTAL SALARIES AND WAGES (A+B)						$ 427,892
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)						$ 53,773
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A+B+C)						$ 481,665
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000)						
TOTAL EQUIPMENT						$ -
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)						$ -
2. FOREIGN						$ -
F. PARTICIPANT SUPPORT COSTS						
1. STIPENDS						
2. TRAVEL						
3. SUBSISTENCE						
4. OTHER						
( ) TOTAL PARTICIPANT SUPPORT COSTS						$ -
G. OTHER DIRECT COSTS						
1. MATERIALS AND SUPPLIES						$ 123,030
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION						$ 3,000
3. CONSULTANT SERVICES						$ -
4. COMPUTER SERVICES						$ -
5. SUBAWARDS		UNR				$ 847,171
		DRI				$ 851,850
6. OTHER						$ -
TOTAL OTHER DIRECT COSTS						$ 1,825,051
H. TOTAL DIRECT COSTS (A THROUGH G)						$ 2,306,716
I. INDIRECT COSTS (F&A) (SPECIFY RATE AND BASE)						
off campus % of MTDC	Base =					
on campus % of MTDC	Base =	$1,459,545				
TOTAL INDIRECT COSTS (F&A)						$ 693,284
J. TOTAL DIRECT AND INDIRECT COSTS (H+I)						$ 3,000,000
K. RESIDUAL FUNDS (IF FOR FURTHER SUPPORT OF CURRENT PROJECT SEE GPG II.D.7.j.)						
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)						$ 3,000,000

M. COST-SHARING: PROPOSED LEVEL $	AGREED LEVEL IF DIFFERENT $			
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NSF FORM 1030

SUMMARY **Year 5**

PROPOSAL BUDGET **FOR NSF USE ONLY**

ORGANIZATION: UNLV			PROPOSAL NO.		DURATION (MONTHS)	
					PROPOSED	GRANTED
PRINCIPAL INVESTIGATOR/PROJECT DIRECTOR: Hanson #REF!			AWARD NO.			
A. SENIOR PERSONNEL: PI/PD, Co-PI'S, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)			NSF-Funded Person-months		Funds Requested By Proposer	Funds Granted by NSF (If Different)
			CAL	ACAD	SUMR	
1. Hanson	Salary: $	93,558			2	$ 21,414	
2. Taylor	Salary: $	132,933			2	$ 30,427	
3. New Faculty	Salary: $	70,019			4.5	$ 36,060	
4. New Faculty	Salary: $	70,019			4.5	$ 36,060	
5.	Salary: $	-				$ -	
6. ( ) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)						$ -	
7. ( ) TOTAL SENIOR PERSONNEL (1-6)					13	$ 123,961	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)							
1. (2) POST DOCTORAL ASSOCIATES	Salary: $	63,654		18	6	$ 139,113	
2. (1) Project Manager				9	3	$ 70,907	
3. (2) GRADUATE STUDENTS (Ph.D. students. 3 @$21,000/yr.)				9	2	$ 66,837	
4. (4) UNDERGRADUATE STUDENTS (40hrs/wk for 12 wks @ $15/hr)					3	$ 32,415	
5. ( ) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)						$ 10,570	
6. ( ) OTHER						$ -	
TOTAL SALARIES AND WAGES (A+B)						$ 443,803	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)						$ 56,513	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A+B+C)						$ 500,316	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000)							
Base platform and drawers						$ 53,000	
LC/MS						$ 262,948	
TOTAL EQUIPMENT						$ 315,948	
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)						$ -	
2. FOREIGN						$ -	
F. PARTICIPANT SUPPORT COSTS							
1. STIPENDS							
2. TRAVEL							
3. SUBSISTENCE							
4. OTHER							
( ) TOTAL PARTICIPANT SUPPORT COSTS						$ -	
G. OTHER DIRECT COSTS							
1. MATERIALS AND SUPPLIES						$ 264,186	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION						$ -	
3. CONSULTANT SERVICES						$ -	
4. COMPUTER SERVICES						$ -	
5. SUBAWARDS		UNR				$ 872,457	
		DRI				$ 463,698	
6. OTHER						$ -	
TOTAL OTHER DIRECT COSTS						$ 1,600,341	
H. TOTAL DIRECT COSTS (A THROUGH G)						$ 2,416,605	
I. INDIRECT COSTS (F&A) (SPECIFY RATE AND BASE)							
off campus % of MTDC	Base =						
on campus % of MTDC	Base =	$1,228,200					
TOTAL INDIRECT COSTS (F&A)						$ 583,395	
J. TOTAL DIRECT AND INDIRECT COSTS (H+I)						$ 3,000,000	
K. RESIDUAL FUNDS (IF FOR FURTHER SUPPORT OF CURRENT PROJECT SEE GPG II.D.7.j.)							
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)						$ 3,000,000	

M. COST-SHARING: PROPOSED LEVEL $	AGREED LEVEL IF DIFFERENT $			
PI/PD TYPED NAME & SIGNATURE* #REF!	DATE	**FOR NSF USE ONLY** INDIRECT COST RATE VERIFICATION		
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NSF FORM 1030

UNR
Engineering
Sponsor: NSF EPSCoR
Project:
Period:

		Year 1		Year 2		Year 3		Year 4		Year 5		TOTAL	
	FY2012	Sponsor		Sponsor		Sponsor		Sponsor		Sponsor		Sponsor	
	Rate	Units	Amount	Units	Amount	Units	Amount	Units	Amount	Units	Amount	Units	Amount
SALARIES													
Professional	**Per Month**												
1. Amy Childress, Professor	$ 13,531	0.00	$ -	0.00	$ -	0.00	$ -	0.00	$ -	0.00	$ -	0.00	$ -
2. Scott Tyler, Professor	$ 17,669	0.00	$ -	0.00	$ -	0.00	$ -	0.00	$ -	0.00	$ -	0.00	$ -
3. Eric Marchand, Assoc. Professor	$ 11,736	1.00	$ 11,736	1.00	$ 12,323	1.00	$ 12,939	1.00	$ 13,586	1.00	$ 14,265	1.00	$ 64,849
4. Dev Chidambaram, Assist Professor	$ 10,446	1.00	$ 10,446	1.00	$ 10,968	1.00	$ 11,516	1.00	$ 12,092	1.00	$ 12,697	5.00	$ 57,719
5. Emil Geiger, Assist Professor	$ 10,492	1.00	$ 10,492	1.00	$ 11,017	1.00	$ 11,568	1.00	$ 12,146	1.00	$ 12,753	5.00	$ 57,976
6. Ed Kolodziej, Assist Professor	$ 9,754	1.00	$ 9,754	1.00	$ 10,242	1.00	$ 10,754	1.00	$ 11,292	1.00	$ 11,857	5.00	$ 53,899
7. Chanwoo Park, Assist Professor	$ 11,468	1.00	$ 11,468	1.00	$ 12,041	1.00	$ 12,643	1.00	$ 13,275	1.00	$ 13,939	5.00	$ 63,366
8. Andrea Achilli, Res Assist Profesor	$ 6,000	4.00	$ 24,000	4.00	$ 25,200	4.00	$ 26,460	4.00	$ 27,784	4.00	$ 29,172	20.00	$ 132,616
9. New faculty member	$ 10,000	6.00	$ 60,000	6.00	$ 63,000	6.00	$ 66,150	6.00	$ 69,456	6.00	$ 72,930	30.00	$ 331,536
Post-Doc													
Post-Doc TBD	$ 4,167	12.00	$ 50,004	12.00	$ 52,500	12.00	$ 55,128	12.00	$ 57,888	12.00	$ 60,780	60.00	$ 276,300
Post-Doc TBD	$ 4,167	12.00	$ 50,004	12.00	$ 52,500	12.00	$ 55,128	12.00	$ 57,888	12.00	$ 60,780	60.00	$ 276,300
		0.00	$ -	0.00	$ -	0.00	$ -	0.00	$ -	0.00	$ -	0.00	$ -
Laboratory Technician													
Technician	$ -	0.00	$ -	0.00	$ -	0.00	$ -	0.00	$ -	0.00	$ -	0.00	$ -
		0.00	$ -	0.00	$ -	0.00	$ -	0.00	$ -	0.00	$ -	0.00	$ -
Graduate Student													
7 PhD students (20 hours/week)	$ 1,800	84.00	$ 151,200	84.00	$ 151,200	84.00	$ 151,200	84.00	$ 151,200	84.00	$ 151,200	420.00	$ 756,000
		0.00	$ -	0.00	$ -	0.00	$ -	0.00	$ -	0.00	$ -	0.00	$ -
Hourly	**Per Hour**												
Undergraduate Student(s) TBD	$ 13.00	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
Hourly Masters Student(s) TBD	$ 20.00	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
Hourly PhD Student(s) TBD	$ 22.50	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
Name		0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
Name		0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
Name		0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
Name		0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
TOTAL SALARIES			$ 389,104		$ 400,991		$ 413,486		$ 426,607		$ 440,373		$ 2,070,561
FRINGE BENEFITS													
Professional	4.0%		$ 2,156		$ 2,264		$ 2,377		$ 2,496		$ 2,620		$ 11,913
Post-Doc	27.0%		$ 27,002		$ 28,350		$ 29,769		$ 31,260		$ 32,821		$ 149,202
Laboratory Technician	40.0%		$ -		$ -		$ -		$ -		$ -		$ -
Graduate Student	15.0%		$ 22,680		$ 22,680		$ 22,680		$ 22,680		$ 22,680		$ 113,400
Hourly	2.0%		$ -		$ -		$ -		$ -		$ -		$ -
TOTAL FRINGE BENEFITS			$ 51,838		$ 53,294		$ 54,826		$ 56,436		$ 58,121		$ 274,515
TOTAL PERSONNEL			$ 440,942		$ 454,285		$ 468,312		$ 483,043		$ 498,494		$ 2,345,076
EQUIPMENT													
LC/MS/MS			$ 250,000	0	$ -	0	$ -	0	$ -	0	$ -	0	$ 250,000
gas chromatograph			$ 11,000	0	$ -	0	$ -	0	$ -	0	$ -	0	$ 11,000
ion chromatograph			$ 48,000	0	$ -	0	$ -	0	$ -	0	$ -	0	$ 48,000
potentiostat			$ 25,000	0	$ -	0	$ -	0	$ -	0	$ -	0	$ 25,000
surface tension analyzer			$ 50,000	0	$ -	0	$ -	0	$ -	0	$ -	0	$ 50,000
computer for modeling studies			$ 5,000	0	$ -	0	$ -	0	$ -	0	$ -	0	$ 200,000
wireless sensing - fabrication from parts			$ 50,000										$ 50,000
membrane treatment system - fabrication			$ 200,000										$ 200,000
TOTAL EQUIPMENT			$ 639,000		$ -		$ -		$ -		$ -		$ 834,000
SUPPLIES & MATERIALS			$ 80,000		$ 80,000		$ 80,000		$ 80,000		$ 80,000		$ 400,000
			$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
			$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
		0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
		0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
		0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
		0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
		0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
		0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
		0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
		0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
TOTAL SUPPLIES			$ 80,000		$ 80,000		$ 80,000		$ 80,000		$ 80,000		$ 400,000
TRAVEL													
Local travel													
Motor pool (per day)	$ 34.00	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
Motor pool (per mile)	$ 0.56	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
To Destination #1													
Airfare		0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
Per Diem - lodging & meals		0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
Rental Car	$ 50	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
To Destination #2													
Airfare		0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
Per Diem - lodging & meals		0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
Rental Car	$ 50	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
To Destination #3													
Airfare		0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
Per Diem - lodging & meals		0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
Rental Car	$ 50	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
To Destination #4													
Airfare		0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
Per Diem - lodging & meals		0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
Rental Car	$ 50	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
To Destination #5													
Airfare		0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
Per Diem - lodging & meals		0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
Rental Car	$ 50	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
TOTAL TRAVEL			$ 8,000		$ 8,000		$ 8,000		$ 8,000		$ 8,000		$ 40,000
OUTREACH ACTIVITIES													
		0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
Total Participant Support			$ -		$ -		$ -		$ -		$ -		$ -
TOTAL OUTREACH ACTIVITIES			$ -		$ -		$ -		$ -		$ -		$ -
SUBCONTRACTS													
Subcontractor Name			$ -		$ -		$ -		$ -		$ -		$ -
Amount Over $25k			$ -		$ -		$ -		$ -		$ -		$ -
Subcontractor Name			$ -		$ -		$ -		$ -		$ -		$ -
Amount Over $25k			$ -		$ -		$ -		$ -		$ -		$ -
Subcontractor Name			$ -		$ -		$ -		$ -		$ -		$ -
Amount Over $25k			$ -		$ -		$ -		$ -		$ -		$ -
TOTAL SUBCONTRACT			$ -		$ -		$ -		$ -		$ -		$ -
Amount Over $25k/subcontractor			$ -		$ -		$ -		$ -		$ -		$ -
OTHER DIRECT COSTS													
Copying & Communications			$ -										$ -
Publication Charges			$ -		$ -		$ -		$ -		$ -		$ -
Lab Costs													
Lab #1 Analysis			$ -		$ -		$ -		$ -		$ -		$ -
Lab #2 Analysis			$ -		$ -		$ -		$ -		$ -		$ -
Outside Lab Analysis			$ -		$ -		$ -		$ -		$ -		$ -
Other Direct Cost			$ -		$ -		$ -		$ -		$ -		$ -
Other Direct Cost			$ -		$ -		$ -		$ -		$ -		$ -
Other Direct Cost			$ -		$ -		$ -		$ -		$ -		$ -
Other Direct Cost			$ -		$ -		$ -		$ -		$ -		$ -
Other Direct Cost - Tuition for 7 grad students			$ 31,500		$ 35,000		$ 38,500		$ 42,000		$ 45,500		$ 192,500
TOTAL OTHER DIRECT COSTS			$ 31,500		$ 35,000		$ 38,500		$ 42,000		$ 45,500		$ 192,500
TOTAL DIRECT COSTS			$ 1,199,442		$ 577,285		$ 594,812		$ 613,043		$ 631,994		$ 3,616,576
MODIFIED DIRECT COSTS			$ 528,942		$ 542,285	$ -	$ 556,312	$ -	$ 571,043	$ -	$ 586,494		$ 2,785,076
INDIRECT COST: Sponsor	41%		$ 216,866		$ 222,337		$ 228,088		$ 234,128		$ 240,463		$ 1,141,882
TOTAL ESTIMATED COST			$ 1,416,308		$ 799,622		$ 822,900		$ 847,171		$ 872,457		$ 4,758,458

Desert Research Institute
Division of Hydrologic Sciences
Sponsor: NSF EPSCoR
Project:
Period:

		Year 1		Year 2		Year 3		Year 4		Year 5		TOTAL	
	FY2012	Sponsor		Sponsor		Sponsor		Sponsor		Sponsor		Sponsor	
	Rate	Units	Amount	Units	Amount	Units	Amount	Units	Amount	Units	Amount	Units	Amount
SALARIES													
Professional	**Per Month**												
1. Markus Berli, Assoc. Research Prof.	$ 9,741	2.00	$ 19,482	2.00	$ 20,456	2.00	$ 21,478	2.00	$ 22,552	2.00	$ 23,680	10.00	$ 107,648
2. Jenny Chapman	$ 13,025	2.00	$ 26,050	2.00	$ 27,352	2.00	$ 28,720	2.00	$ 30,156	2.00	$ 31,664	10.00	$ 143,942
3. Karl Pohlmann	$ 10,836	2.00	$ 21,672	2.00	$ 22,756	2.00	$ 23,894	2.00	$ 25,088	2.00	$ 26,342	10.00	$ 119,752
	$ -	0.00	$ -	0.00	$ -	0.00	$ -	0.00	$ -	0.00	$ -	0.00	$ -
		0.00	$ -	0.00	$ -	0.00	$ -	0.00	$ -	0.00	$ -	0.00	$ -
		0.00	$ -	0.00	$ -	0.00	$ -	0.00	$ -	0.00	$ -	0.00	$ -
Post-Doc													
Post-Doc TBD	$ 4,167	11.00	$ 45,837	11.00	$ 48,125	11.00	$ 50,534	11.00	$ 53,064	11.00	$ 55,715	55.00	$ 253,275
Post-Doc TBD	$ 4,167	11.00	$ 45,837	11.00	$ 48,125	11.00	$ 50,534	11.00	$ 53,064	11.00	$ 55,715	55.00	$ 253,275
		0.00	$ -	0.00	$ -	0.00	$ -	0.00	$ -	0.00	$ -	0.00	$ -
Technologist													
Technician - TBD	$ -	0.00	$ -	0.00	$ -	0.00	$ -	0.00	$ -	0.00	$ -	0.00	$ -
		0.00	$ -	0.00	$ -	0.00	$ -	0.00	$ -	0.00	$ -	0.00	$ -
Graduate Student													
PhD students (20 hours/week)	$ 1,800	0.00	$ -	0.00	$ -	0.00	$ -	0.00	$ -	0.00	$ -	0.00	$ -
Masters students (20 hours/week)	$ 1,600	0.00	$ -	0.00	$ -	0.00	$ -	0.00	$ -	0.00	$ -	0.00	$ -
Hourly	**Per Hour**												
Undergraduate Student(s) TBD	$ 13.00	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
Hourly Masters Student(s) TBD	$ 20.00	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
Hourly PhD Student(s) TBD	$ 22.50	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
Name		0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
Name		0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
Name		0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
Name		0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
TOTAL SALARIES			$ 158,878		$ 166,814		$ 175,160		$ 183,924		$ 193,116		$ 877,892
FRINGE BENEFITS													
Professional	44.9%		$ 30,175		$ 31,683		$ 33,267		$ 34,930		$ 36,677		$ 166,732
Post-Doc	36.7%		$ 33,644		$ 35,324		$ 37,092		$ 38,949		$ 40,895		$ 185,904
Technologist	55.8%		$ -		$ -		$ -		$ -		$ -		$ -
Graduate Student	20.1%		$ -		$ -		$ -		$ -		$ -		$ -
Hourly	2.8%		$ -		$ -		$ -		$ -		$ -		$ -
TOTAL FRINGE BENEFITS			$ 63,819		$ 67,007		$ 70,359		$ 73,879		$ 77,572		$ 352,636
TOTAL PERSONNEL			$ 222,697		$ 233,821		$ 245,519		$ 257,803		$ 270,688		$ 1,230,528
EQUIPMENT													
			$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
			$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
			$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
			$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
			$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
			$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
TOTAL EQUIPMENT			$ -		$ -		$ -		$ -		$ -		$ -
SUPPLIES & MATERIALS													
			$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
			$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
		0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
		0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
		0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
		0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
		0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
		0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
		0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
		0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
TOTAL SUPPLIES			$ -		$ -		$ -		$ -		$ -		$ -
TRAVEL													
Local travel													
Motor pool (per day)	$ 34.00	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
Motor pool (per mile)	$ 0.56	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
To Destination #1													
Airfare		0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
Per Diem - lodging & meals		0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
Rental Car	$ 50	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
To Destination #2													
Airfare		0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
Per Diem - lodging & meals		0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
Rental Car	$ 50	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
To Destination #3													
Airfare		0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
Per Diem - lodging & meals		0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
Rental Car	$ 50	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
To Destination #4													
Airfare		0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
Per Diem - lodging & meals		0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
Rental Car	$ 50	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
To Destination #5													
Airfare		0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
Per Diem - lodging & meals		0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
Rental Car	$ 50	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
TOTAL TRAVEL			$ -		$ -		$ -		$ -		$ -		$ -
OUTREACH ACTIVITIES													
		0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -	0	$ -
Total Participant Support			$ -		$ -		$ -		$ -		$ -		$ -
TOTAL OUTREACH ACTIVITIES			$ -		$ -		$ -		$ -		$ -		$ -
SUBCONTRACTS													
Subcontractor Name			$ -		$ -		$ -		$ -		$ -		$ -
Amount Over $25k			*$ -*		*$ -*		*$ -*		*$ -*		*$ -*		$ -
Subcontractor Name			$ -		$ -		$ -		$ -		$ -		$ -
Amount Over $25k			*$ -*		*$ -*		*$ -*		*$ -*		*$ -*		$ -
Subcontractor Name			$ -		$ -		$ -		$ -		$ -		$ -
Amount Over $25k			*$ -*		*$ -*		*$ -*		*$ -*		*$ -*		$ -
TOTAL SUBCONTRACT			$ -		$ -		$ -		$ -		$ -		$ -
Amount Over $25k/subcontractor			*$ -*		*$ -*		*$ -*		*$ -*		*$ -*		$ -
OTHER DIRECT COSTS													
Copying & Communications	1.00%		$ 2,227		$ 2,338		$ 2,455		$ 2,578		$ 2,707		$ 12,305
Publication Charges			$ -		$ -		$ -		$ -		$ -		$ -
Lab Costs													
Lab #1 Analysis			$ -		$ -		$ -		$ -		$ -		$ -
Lab #2 Analysis			$ -		$ -		$ -		$ -		$ -		$ -
Outside Lab Analysis			$ -		$ -		$ -		$ -		$ -		$ -
Other Direct Cost			$ -		$ -		$ -		$ -		$ -		$ -
Other Direct Cost			$ -		$ -		$ -		$ -		$ -		$ -
Other Direct Cost			$ -		$ -		$ -		$ -		$ -		$ -
Other Direct Cost			$ -		$ -		$ -		$ -		$ -		$ -
Other Direct Cost			$ -		$ -		$ -		$ -		$ -		$ -
TOTAL OTHER DIRECT COSTS			$ 2,227		$ 2,338		$ 2,455		$ 2,578		$ 2,707		$ 12,305
TOTAL DIRECT COSTS			$ 224,924		$ 236,159		$ 247,974		$ 260,381		$ 273,395		$ 1,242,833
MODIFIED DIRECT COSTS			$ 224,924		$ 236,159		$ 247,974		$ 260,381		$ 273,395		$ 1,242,833
INDIRECT COST: Sponsor	59%		$ 132,705		$ 139,334		$ 146,305		$ 153,625		$ 161,303		$ 733,272
TOTAL ESTIMATED COST			$ 357,629		$ 375,493		$ 394,279		$ 414,006		$ 434,698		$ 1,976,105

7. **Current and Pending Support**

Current and Pending Support

Investigator: **Dr. Giles M. Marion**	Other agencies (including NSF) to which this proposal has been/will be submitted

Support: x☐ Current ☐ Pending ☐ Submission planned in near future ☐ *Transfer of support

Project/Proposal Title: Salinity gradient solar ponds for collection and storage of solar energy,

Source of Support: NVREC
Total Award Amount: $ 47,610 Total Award Period Covered: 2010-present
Location of Project: NV
Person-Months Per Calendar Year Committed to the Project: 1.6 Academic Year 1.6 Summer 0

Support: x☐ Current ☐ Pending ☐ Submission planned in near future ☐ *Transfer of support

Project/Proposal Title: FREZCHEM: An aqueous geochemical model for Mars

Source of Support: Mars Fundamental Research Program
Total Award Amount: $ 168,000 Total Award Period Covered: 2010-present
Location of Project: NV
Person-Months Per Calendar Year Committed to the Project: 1.5 Academic Year 1.5 Summer 0

Support: x☐ Current ☐ Pending ☐ Submission planned in near future ☐ *Transfer of support

Project/Proposal Title: Modeling complex geochemical processes in the outer planets regions

Source of Support: NASA, Outer Planets Research
Total Award Amount: $ 402,000 Total Award Period Covered: 2010-present
Location of Project: NV
Person-Months Per Calendar Year Committed to the Project: 2.5 Academic Year 2.5 Summer 0

Support: x☐ Current ☐ Pending ☐ Submission planned in near future ☐ *Transfer of support

Project/Proposal Title: Collaborative Research: Geochemistry and microbiology of the extreme aquatic Environment in Lake Vida, East Antarctica

Source of Support: NSF
Total Award Amount: $ 664,507 Total Award Period Covered: 2009-present
Location of Project: Antarctica
Person-Months Per Calendar Year Committed to the Project: 1 | 1 Academic Year | 0 Summer

Support: x☐ Current ☐ Pending ☐ Submission planned in near future ☐ *Transfer of support

Project/Proposal Title: Martian geochemical applications with FREZCHEM

Source of Support: NASA, Mars Fundamental Research
Total Award Amount: $ 355,000 Total Award Period Covered: 2009-present
Location of Project:
Person-Months Per Calendar Year Committed to the Project: 2.5 | 2.5 Academic Year | 0 Summer

Investigator: **Dr. Andrew D. Hanson**	Other agencies (including NSF) to which this proposal has been/will be submitted

Support: x☐ Current ☐ Pending ☐ Submission planned in near future ☐ *Transfer of support

Project/Proposal Title: History and Origin of Mineral Deposits in northern Nye County, Nevada

Source of Support: USGS
Total Award Amount: $ 138,310 Total Award Period Covered: 2010-2012
Location of Project: NV
Person-Months Per Calendar Year Committed to the Project: 0 | Academic Year | Summer

Current and Pending Support

Investigator: **Dr. Eric Marchand** | Other agencies (including NSF) to which this proposal

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: **Environmental Fate of Synthetic Growth Promoters Used in Animal Mechanistic Studies of Hormone Photolysis, Biodegradation and Sorption in Natural Systems**

Source of Support: **US Department of Agriculture (USDA)**

Total Award Amount: **$399,945** Total Award Period Covered: **1/10-12/12**

Location of Project: **University of Nevada, Reno**

Person-Months Per Year Committed to Cal: Acad: **0.5** Sumr: **0.5**

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: **Investigating pesticide contamination in small lakes in Khorezm,**

Source of Support: **National Science Foundation (NSF)**

Total Award Amount: **$139,995** Total Award Period Covered: **1/09 – 12/11**

Location of Project: **University of Nevada, Reno**

Person-Months Per Year Committed to Cal: Acad: Sumr: **0.2**

Support: ☐ Current ☒ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: **A fully integrated membrane bioreactor system for wastewater treatment remote areas**

Source of Support: **SERDP**

Total Award Amount: **$1.01M** Total Award Period Covered: **7/12 – 6/16**

Location of Project: **University of Nevada, Reno**

Person-Months Per Year Cal: Acad: Sumr: **1.0**

Support: ☐ Current ☒ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: **Multidisciplinary REU on Renewable Energy at the University of Nevada,**

Source of Support: **NSF**

Total Award Amount: **$243,897** Total Award Period Covered: **5/10-4/13**

Location of Project: **University of Nevada, Reno**

Person-Months Per Year Cal: Acad: Sumr: **0.2**

Support: ☐ Current ☒ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: **A Low-Energy Wastewater Treatment Process for Producing High Quality Water**

Source of Support: **WateReuse Foundation**

Total Award Amount: $**25K** Total Award Period Covered: **1/11 – 7/11**

Location of Project: **University of Nevada, Reno**

Person-Months Per Year Committed to Cal: Acad: Sumr: **0.2**

Current and Pending Support

Investigator: **Dr. Amy Childress**

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: Osmotically Assisted Desalination: A Low Energy Reverse Osmosis Hybrid Desalination System

Source of Support: Bureau of Reclamation (first year obligated at $217,837 second year pending at $168,457)

Total Award Amount: $ 386,293 Total Award Period Covered: 10/10 through 9/12

Location of Project: UNR

Person-Months Per Year Committed to Cal: Acad: Sumr: 1

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: Water Desalination Using Renewable Energy

Source of Support: NV Renewable Energy Commission

Total Award Amount: $236,717 Total Award Period Covered: 9/10 through 12/12

Location of Project: UNR

Person-Months Per Year Committed to Cal: Acad: Sumr: 1

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: Advanced Heat/Mass Exchanger Technology for Geothermal and Solar and Renewable Energy Systems

Source of Support: Department of Energy

Total Award Amount: $ 1.5 M Total Award Period Covered: 6/10 through 5/12

Location of Project: UNR

Person-Months Per Year Committed to Cal: Acad: Sumr: 0.73

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: Protocol for Evaluating Chemical Pretreatment for High Pressure Membranes

Source of Support: Water RF and WQR Australia

Total Award Amount: $ 363,368 Total Award Period Covered: 6/10 through 11/11

Location of Project: UNSW and UNR

Person-Months Per Year Committed to Cal: Acad: Sumr: 0

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: Evaluation of Membrane Characterization Methods

Source of Support: Water Research Foundation

Total Award Amount: $400,000 Total Award Period Covered: 6/08 through 12/11

Location of Project: UNR

Person-Months Per Year Cal: Acad: Sumr: 1

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: Novel Hybrid Membrane Desalination Process with Minimal Pretreatment and Concentrate

Source of Support: CA Department of Water Resources

Support: ☐ Current ☒ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Total Award Amount: $450,957 Total Award Period Covered: 4/07 through 9/11

Location of Project: UNR

Project/Proposal Title: A Fully Integrated Membrane Bioreactor System for Wastewater Treatment in Remote Applications

Person-Months Per Year Cal: Acad: Sumr: 0.67

Source of Support: SERDP

Total Award Amount: $ 1,355,016 Total Award Period Covered: 3/12 through 1/15

Location of Project: UNR

Person-Months Per Year Committed to Cal: Acad: Sumr: 1

Support: ☐ Current ☒ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: This proposal

Source of Support:

Total Award Amount: Total Award Period Covered:

Location of Project:

Person-Months Per Year Committed to Cal: Acad: Sumr:

Current and Pending Support

Investigator: **Dr. James H. Trexler**	Other agencies (including NSF) to which this proposal has been/will be submitted

Support: x☐ Current ☐ Pending ☐ Submission planned in near future ☐ *Transfer of support

Project/Proposal Title: : Carbon Stable Isotope Ratio Stratigraphy: A Test of the Method in Limestones

Source of Support: NSF Award 1038702

Total Award Amount: $ 59,736 Total Award Period Covered: 2010-2012

Location of Project: NV

Person-Months Per Calendar Year Committed to the Project: Academic Year Summer

Investigator: **Dr. Brenda J. Buck**	Other agencies (including NSF) to which this proposal has been/will be submitted

Support: x☐ Current ☐ Pending ☐ Submission planned in near future ☐ *Transfer of support

Project/Proposal Title: Human Health Risk Assessment of Nellis Dunes Recreational Area

Source of Support: BLM
Total Award Amount: $ 2,500,000 Total Award Period Covered: 2011-2014
Location of Project: NV
Person-Months Per Calendar Year Committed to the Project: 3 Academic Year 0 Summer 3

Investigator: **Dev Chidambaram**	Other agencies (including NSF) to which this proposal has None

Support: [X] Current [ ] Pending [ ] Submission Planned in Near Future [ ] * Transfer of Support
Project/Proposal Title: Energy from Food Wastes (Co-PI)
Source of Support: Department of Energy
Award Amount (or Annual Rate): $200,00 Period Covered: 9/1/2010-9/30/2012
Location of Project: University of Nevada, Reno
Person-Months Committed to the Project. Cal. Acad: Sum: 1

Support: [ ] Current [x] Pending [ ] Submission Planned in Near Future [ ] * Transfer of Support
Project/Proposal Title: Microbially-Functional Material Based Bioreactors for Continuous Production of Biofuels And Industrial Feedstock
Source of Support: National Science Foundation (NSF)
Award Amount (or Annual Rate): $312,755 Period Covered: 4/1/2012-3/31/2015
Location of Project: University of Nevada, Reno
Person-Months Committed to the Project. Cal. Acad: Sum: 1

Support: [x] Current [ ] Pending [ ] Submission Planned in Near Future [ ] * Transfer of Support
Project/Proposal Title: The University of Nevada, Reno Fellowship Program in Materials and Thermal Science for Nuclear Power
Source of Support: Nuclear Regulatory Commission
Award Amount (or Annual Rate): $399,997 Period Covered: 6/1/2010-5/31/2014
Location of Project: University of Nevada, Reno
Person-Months Committed to the Project. Cal. Acad: Sum: 0

Support: [ ] Current [x] Pending [ ] Submission Planned in Near Future [ ] * Transfer of Support
Project/Proposal Title: Multi-Institutional Development and Use of Hybrid (Online/Classroom) Course on the Broader Implications and Ethics of Nanotechnology
Source of Support: National Science Foundation (NSF)
Award Amount (or Annual Rate): $35,878 Period Covered: 10/1/2011 –09/30/2013 (TBD)
Location of Project: University of Nevada, Reno
Person-Months Committed to the Project. Cal. Acad: Sum: 0.5

Support: [x] Current [ ] Pending [ ] Submission Planned in Near Future [ ] * Transfer of Support

Project/Proposal Title: Development of Advanced Nuclear Reactor Materials and Combustion Courses at the University of Nevada, Reno

Source of Support: Nuclear Regulatory Commission

Award Amount (or Annual Rate): $83,000 Period Covered: 8/24/2011 – 9/30/2013

Location of Project: University of Nevada, Reno

Person-Months Committed to the Project. Cal. Acad: Sum: 0.5

Support: [x] Current [ ] Pending [ ] Submission Planned in Near Future [ ] * Transfer of Support

Project/Proposal Title: Faculty Development Program in Nuclear Materials

Source of Support: Nuclear Regulatory Commission

Award Amount (or Annual Rate): $450,000 Period Covered: 8/4/2011-9/30/2014

Location of Project: University of Nevada, Reno

Person-Months Committed to the Project. Cal. Acad: Sum: 1.5

Current and Pending Support

The following information should be provided for each investigator and other senior personnel. Failure to provide th information may delay consideration of this proposal.

Investigator: **Chanwoo Park**

Other agencies (including NSF) to which this proposal has

Support: [ ] Current [☒] Pending [ ] Submission Planned in Near Future [ ] *Transfer of Support

Project/Proposal Title: Energy-Water-Environment Nexus

Source of Support: NSF

Total Award Amount: $15,000,000 Total Award Period Covered: Three years (2012~2016)

Location of Project: University of Nevada, Reno

Person-Months Per Year Committed to the Cal: Acad: Sumr: 1

Support: [ ] Current [☒] Pending [ ] Submission Planned in Near Future [ ] *Transfer of Support

Project/Proposal Title: A fully integrated Membrane Bioreactor System for Wastewater Treatment in Remote

Source of Support: SERDP

Total Award Amount: $1,355,000 Total Award Period Covered: Four years (2012~2016)

Location of Project: University of Nevada, Reno

Person-Months Per Year Committed to the Cal: Acad: Sumr: 0.75

Support: [☒] Current [ ] Pending [ ] Submission Planned in Near Future [ ] *Transfer of Support

Project/Proposal Title: Advanced Heat/Mass Exchanger Technology for Geothermal and Solar Renewable Energy

Source of Support: DOE

Total Award Amount: $1,200,000 Total Award Period Covered: September, 2010 ~ September, 2012

Location of Project: University of Nevada, Reno

Person-Months Per Year Committed to the	Cal:	Acad:	Sumr: 1.0

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Current and Pending Support Page 1 of 2

Other agencies to which this proposal has been/will be submitted: None

Investigator: **Dr. Markus Berli**

Support: ☒ Current ☐ Pending ☐ Submission Planned ☐ *Transfer

Project/Proposal Title: Determining Sources of Highway Runoff Fine Sediment in Stormwater, Streams, and Lake Tahoe using Fingerprinting Techniques

Source of Support: USDA Forest Service

Total Award Amount: $188,448 Total Award Period Covered: 07/01/08 – 08/31/12

Location of Project: Las Vegas

Person-Months Per Year Committed to the Project. Cal: 0.25 Acad: Sumr:

Support: ☒ Current ☐ Pending ☐ Submission Planned ☐ *Transfer

Project/Proposal Title: Global Military Operating Environments: Linking Natural Environments, International Security, and Military Operations (GMOE)

Source of Support: DoD-Army

Total Award Amount: $1,265,000 Total Award Period Covered:10/01/08 – 09/30/12

Location of Project: Nevada

Person-Months Per Year Committed to the Project. Cal:0.75 Acad: Sumr:

Support: ☒ Current ☐ Pending ☐ Submission Planned ☐ *Transfer

Project/Proposal Title: Urban Flood Demonstration Program

Source of Support: US Army Corps of Engineers

Total Award Amount: $2,403,515 Total Award Period Covered: 09/16/08 – 09/15/13

Location of Project: NV, NM, CA, AZ

Person-Months Per Year Committed to the Project. Cal: 2.0 Acad: Sumr:

Support: ☒ Current ☐ Pending ☐ Submission Planned ☐ *Transfer

Project/Proposal Title: GMOE II: Linking Natural Environments, International Security, and Military Operations with a Focus on Afghanistan and SW Asia

Source of Support: DoD-Army

Total Award Amount: $1,880,000 Total Award Period Covered: 09/01/09 – 08/31/12

Location of Project: Nevada, Panama, SW Asia, Afghanistan

Person-Months Per Year Committed to the Project. Cal: 1.0 Acad: Sumr:

Support: ☒ Current ☐ Pending ☐ Submission Planned ☐ *Transfer

Project/Proposal Title: Investigation of the Effect of Virgin River Water Quality on Native Fishes

Source of Support: Washington County Water Conservancy District
Total Award Amount: $132,565 Total Award Period Covered: 06/21/11-06/30/12

Location of Project: Utah
Person-Months Per Year Committed to the Project. Cal: 1.0 Acad: Sumr:

Current and Pending Support Page 2 of 2

Other agencies to which this proposal has been/will be submitted: None

Investigator: **Dr. Markus Berli**

Support: ☐ Current ☒ Pending ☐ Submission Planned ☐ *Transfer
Project/Proposal Title: Collaborative Research: Root Water Uptake at the Rhizosphere Scale – Bridging the Gap Between Plant Physiology and Soil Physics

Source of Support: NSF
Total Award Amount: $424,785 Total Award Period Covered: 02/01/12-01/31/15
Location of Project: Nevada
Person-Months Per Year Committed to the Project. Cal: 2.0 Acad: Sumr:

Support: ☐ Current ☒ Pending ☐ Submission Planned ☐ *Transfer
Project/Proposal Title: Collaborative Research: SI2-SSI: The Immersive Gateway: sustainable cyberinfrastructure for scientific workflow enhancement through natural user interfaces

Source of Support: NSF
Total Award Amount: $618,866 Total Award Period Covered: 04/01/12-03/31/16
Location of Project: Nevada
Person-Months Per Year Committed to the Project. Cal: 0.82 Acad: Sumr:

Support: ☐ Current ☒ Pending ☐ Submission Planned ☐ *Transfer
Project/Proposal Title: Abiotic and Microbial Mechanisms of Soil Carbon Flux and Storage in Arid Ecosystems

Source of Support: DOE EPSCoR
Total Award Amount: $589,904 Total Award Period Covered: 03/13/12-03/12/15
Location of Project: Nevada
Person-Months Per Year Committed to the Project. Cal: 2.0 Acad: Sumr:

Support: ☐ Current ☒ Pending ☐ Submission Planned ☐ *Transfer
Project/Proposal Title:

Source of Support:

Total Award Amount: $	Total Award Period Covered:
Location of Project:	
Person-Months Per Year Committed to the Project.	Cal: Acad: Sumr:

Current and Pending Support

Investigator: **Jenny B. Chapman**	Other agencies (including NSF) to which this proposal has

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title:
Technical Research Engineering and Development Services Contract

Source of Support: U.S. Department of Energy
Total Award Amount: $35,926,593 Total Award Period Covered: 11/1/11-10/31/16
Location of Project: southern Nevada
Person-Months Per Year Committed to the Cal: 4 Acad: Sumr:

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title:
Technical Support for Nevada Offsites to DOE Office of Legacy Management through S.M. Stoller Corp.

Source of Support: U.S. Department of Energy
Total Award Amount: $1,000,000 (est.) Total Award Period Covered: 10/1/07-9/30/12
Location of Project: southern Nevada
Person-Months Per Year Committed to the Cal: 3 Acad: Sumr:

Support: ☐ Current ☒ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title:
Technical Support for Nevada Offsites to DOE Office of Legacy Management through TBD M&O contractor

Source of Support: U.S. Department of Energy
Total Award Amount: $1,000,000 (est.) Total Award Period Covered: 10/1/12 – 9/30/17
Location of Project: southern Nevada
Person-Months Per Year Committed to the Cal: 3 Acad: Sumr:

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

New faculty member **Dr. Emil Geiger** has no current or pending federal support.

Investigator: Edward Kolodziej | Other agencies (including NSF) to which this proposal

Support: **X** Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: Environmental Fate of Synthetic Growth Promoters Used in Animal Agriculture: Mechanistic Studies of Hormone Photolysis, Biodegradation and Sorption in Natural Systems.

Source of Support: U.S. Department of Agriculture, Agriculture and Food Research Initiative
Total Award Amount: $ 399,945 Total Award Period Covered: 1/1/2010 – 12/31/2012
Location of Project: University of Nevada, Reno; University of California, Riverside
Person-Months Per Year Committed to 0.67 Cal: Acad: Sumr: 0.67

Support: **X** Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: Transport and Mitigation of Beef Cattle Veterinary Pharmaceuticals and Hormones in Surface and Sub-surface Runoff from Grazed Watersheds.

Source of Support: U.S. Department of Agriculture, Agriculture and Food Research Initiative
Total Award Amount: $ 141,041 Total Award Period Covered: 11/1/2009 – 10/31/2012.
Location of Project: University of California, Davis; University of Nevada, Reno
Person-Months Per Year Committed to the Project. 0.67 Cal: Acad: 0 Sumr: 0.67

Current and Pending Support

Investigator: **Pohlmann, Karl F** | Other agencies (including NSF) to which this proposal has been/will be submitte

Support: X Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Evaluation of Landfill Conditions and Potential Impacts on Water Resources in Rural Clark County, Nevada

Source of Support: U.S. Department of Agriculture
Total Award Amount: $207,961 Total Award Period Covered: 10/01/2011 – 09/30/2012
Location of Project: Clark County, Nevada
Person-Months Per Year Committed to the Project. 1.7 Cal: X Acad: Sumr:

Support: X Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Technical Research, Engineering, and Development Services for U.S. National Nuclear Security Administration/Nevada Site Office

Source of Support: U.S. Department of Energy, Underground Test Area Project
Total Award Amount: $1,800,000 Total Award Period Covered: 11/2011 – 10/2016
Location of Project: Nevada

Person-Months Per Year Committed to the Project. 4 Cal: X Acad: Sumr:

Support: X Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Significance of Groundwater Divides in Water Accounting and Return Flow Calculation for Lower Colorado River Aquifers

Source of Support: U.S. Bureau of Reclamation

Total Award Amount: $274,385 Total Award Period Covered: 10/2009 – 3/2012

Location of Project: Colorado

Person-Months Per Year Committed to the Project. 1.5 Cal: X Acad: Sumr:

Support: X Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Technical Support for Southern Nevada Health District for Oversight of Reid Gardner Station Landfill

Source of Support: Southern Nevada Health District

Total Award Amount: $40,585 Total Award Period Covered: 5/2011 – 6/2012

Location of Project: Clark County, Nevada

Person-Months Per Year Committed to the Project. 1 Cal: X Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Source of Support:

Total Award Amount: $ Total Award Period Covered:

Location of Project:

Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

*If this project has previously been funded by another agency, please list and furnish information fo immediately preceding funding period.

Current and Pending Support

Investigator: **Dr. Ralf Sudowe**

Other agencies (including NSF) to which this proposal has been/will be submitte

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: Neutron capture measurements on Tm-171 and Pm-147

Source of Support: National Nuclear Security Administration

Total Award Amount: $600,000 Total Award Period Covered: 01/11/2010 - 01/10/2013

Location of Project: University of Nevada, Las Vegas

Person-Months Per Year Committed to the Project. Cal: 3 Acad: Sumr: 3

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: Rapid automated dissolution and analysis techniques for radionuclides in recycle process streams

Source of Support: National Nuclear Security Administration Office of Nonproliferation and International

Total Award Amount: $378,214 Total Award Amount: $378,214

Location of Project: University of Nevada, Las Vegas

Person-Months Per Year Committed to the Project. Cal: 1 Acad: Sumr: 1

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: Development of rapid actinide pre-concentration methods for the radiochemical analysis of samples

Source of Support: National Security Technologies, LLC

Total Award Amount: $89,999 Total Award Period Covered: 08/15/2011 - 12/31/2011

Location of Project: University of Nevada, Las Vegas

Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: Nuclear fuel cycle distance learning and experiential learning course

Source of Support: U.S. Nuclear Regulatory Commission

Total Award Amount: $397,701 Total Award Period Covered: 10/01/2009 - 09/30/2012

Location of Project: University of Nevada, Las Vegas

Person-Months Per Year Committed to the Project. Cal: 0.5 Acad: Sumr: 0.5

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: Nuclear Science and Security Consortium (NSSC)

Source of Support: National Nuclear Security Administration - Office of Proliferation Detections (NA-221

Total Award Amount: $378,189 Total Award Period Covered: 07/01/2011 - 06/30/2016

Location of Project: University of Nevada, Las Vegas

Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

*If this project has previously been funded by another agency, please list and furnish information fo immediately preceding funding period.

8. **Facilities, Equipment, and Other Resources**

UNLV

LABORATORIES

UNLV Geoscience department maintains the following, which are available for this project: 1) Fully equipped machine shop, 2) Rock-crushing room with jaw crushers (2 sizes), disc-grinder, sieves, Rotap, and shatterbox, 3) Rock-saw room and Wilfley Table, 4) Mineral separation lab with fume hoods, Frantz magnetic separator, and binocular picking microscope.

Andrew D. Hanson

Hanson's lab is equipped with a research-grade petrographic microscope with teaching arm, an auto-point counting stage, and a digital camera for taking photomicrographs. A total station, laser particle size analyzer, HMT mineral separation set up and fume hood are also available.

Wanda J. Taylor

Taylor's Structure and Tectonics Laboratory at UNLV contains a research-grade petrographic microscope; assorted sieves, air abraders and other supplies for making mineral separates to be used for dating rocks; GPS units, a TopCon robotic Total Station for measuring relief in millimeters; and a variety of camping equipment including tents, cookware, generator/inverter, solar lights, etc. It is located in the Lilly Fong Geoscience Building (LFG).

The UNLV Applied Geophysics Center (of which Taylor is a part of the faculty that share this resource) contains a variety of equipment, but those relevant to this proposed project include a Ground Penetrating radar system, a 4WD Ford F250 that was purchased in 2005, a 2007 4WD Chevy Tahoe equipped with tools and shovels as may be needed for field work, and ~40 feet of benches in the in-door laboratory space for the layout and examination of samples. It is located in the Science and Engineering Building, which is a short walk away from LFG.

HEALTH PHYSICS

The radioanalytical separations and measurements proposed can be carried out in four laboratories in the Bigelow Health Sciences Building and one laboratory in the new Science and Engineering Building. These laboratories are covered under the broad scope UNLV radioisotope license and are actively maintained by the UNLV radioprotection program. The laboratories occupy approximately 1800 ft^2 with capabilities to handle radionuclides from tracer to gram level. The laboratories have hoods and bench space suitable for a wide range of studies. They contain a large variety of analytical equipment and instrumentation. All of these instruments can be used with radioactive samples. A 490 ft^2 radionuclide counting laboratory with alpha, beta, gamma, and scintillation detectors is available as well.

1. Major Equipment:

The following equipment is available to this research project either through the Health Physics program or through the Radiochemistry program at UNLV and can be used with non-radioactive as well as with radioactive samples:

Radioanalytical Instrumentation

- Alpha Spectroscopy System (2)
- HPGe Gamma Detectors (8)
- HPGe Well Detector
- NaI(Tl) Gamma Detectors (3)
- Alpha/Beta Gas-Proportional Counter
- Gas-less Automatic Alpha/Beta Counting System
- Liquid Scintillation Counter (2)
- Ultra Low-Level Liquid Scintillation Counter
- Automated Gamma Counter

- Thermoluminescence Dosimeter Reader
- Autoradiography System

Analytical Instrumentation

- UV-Visible Spectrometer
- Ion Chromatography System
- HPLC System

Solid Phase Characterization

- FT-Infrared Spectrometer

General Laboratory Equipment

- Closed Vessel Microwave Digestion System
- Open Vessel Microwave Digestion System
- Supercritical Fluid Extraction System
- Automated Titrator
- Refrigerated Ultracentrifuge

COMPUTERS

Andrew D. Hanson: PC's with ArcView, statistical software packages, Platte River Associates 1D basin modeling software, and seismic interpretation software (Petrel) are available in Hanson's lab.

Wanda J. Taylor: The Structure and Tectonics lab contains three desktop Dell and Gateway computers that are all less than three years old and are running up-to-date software. Software includes Windows, MS Office, Adobe Design Premium Suite including Illustrator and Photoshop, Rockware by Rockworks, GeOrient and StereoWin for plotting stereographs, Global Mapper and ESRI GIS packages, as well as a variety of programs that enable internet access. All of these computers are networked through the WiFi system and each has attached color printers and scanners. In addition, the lab contains five HP Toughbooks for use in the field and they have the same software as the desktop computers.

In addition UNLV provides IT staff through the Office of Information technology. The can provide assistance over the phone, through email, by desktop streaming, or by coming directly to faults and staff offices. They are well trained and work well together as a team to solve problems.

OFFICE EQUIPMENT

UNLV and UNR provide offices to tenured and tenure-track faculty and DRI provides offices to their research staff members.

MAJOR EQUIPMENT

UNLV Geoscience

(1) $^{40}Ar/^{39}Ar$ Dating: Any required $^{40}Ar/^{39}Ar$ dating will be done at the Nevada Isotope Geochronology Laboratory which is housed in the Science and Engineering Building at UNLV. The laboratory features a high-sensitivity, low-blank MAP 215-50 rare gas mass spectrometer with a custom collector assembly including a quiet electron multiplier with ion counting electronics. Argon extraction and delivery is accomplished with a low volume all metal extraction line which features a dual laser microprobe system (CO_2 and ultraviolet lasers), a resistance heated vacuum furnace, cryogenic pumping system, pneumatic valves, and a quadrapole mass spectrometer for background gas characterization. The entire system is computer controlled and automated using LabSPEC software developed by Dr. Bruce Idleman at Lehigh University.

(2) Electron Microanalysis and Imaging Laboratory: The Electron Microanalysis and Imaging Laboratory at UNLV includes two major instruments: (1) a JEOL 8900 Electron Probe Microanalyzer (EPMA) optimized for quantitative, non-destructive chemical analysis of solid materials on a micron scale and (2) a JEOL 5600 Scanning Electron Microscope (SEM) optimized for imaging micron to millimeter scale topography. The EPMA is equipped with four fully automated wavelength dispersive spectrometers (WDS) each equipped with 2 crystals capable of quantifying elements ranging from boron to uranium. Concentrations of at least 0.10 wt % can be measured to within ~1% of the measured abundance, elements present in smaller concentrations can also be measured with less precision. An energy dispersive spectrometer (EDS) collects a full spectrum of x-rays and is capable of rapidly identifying elements present in a sample. The EPMA is also outfitted with backscattered electron, secondary electron, and cathodoluminescence (CL) detectors capable of producing "real time" images, or automated images in tandem with x-ray mapping to further characterize an area of interest. A fully automated stage, capable of holding up to nine one-inch round samples (or six petrographic sections) has reproducibility of less than one micron. The JEOL 5600 SEM has an image resolution of up to 50 nm at 100,000 times magnification. The manual stage can accommodate four 1cm diameter samples or one sample up to 3.2 cm diameter. The SEM is equipped with a backscattered electron and secondary

electron detectors and an Oxford ISIS EDS system capable of qualitative analysis. Topographic and compositional images can be processed on the screen to show pseudo-color and critical point measurements of features. The images can also be combined, allowing for easy comparison of samples or different magnifications. Images can be stored and transferred digitally. The laboratory is maintained by a full-time, state funded Ph.D. level electron microscopy specialist; both instruments currently are maintained under full service contracts with JEOL and Oxford.

(3) XRD/ XRF: The department of Geoscience has a new Panalytical (formerly Philips) X'Pert Pro X-ray Diffraction spectrometer utilizing a Theta-Theta goniometer and 3 kW generator. Additional components include a 15 position sample changer with sample spinner, a temperature/humidity stage, texture cradle with accompanying texture analysis software and Rietveld analysis capabilities. Our X-ray Fluorescence spectrometer is a new Panalytical Magix Pro 4.0 kW wavelength dispersive Sequential X-ray spectrometer. Quantitative major and trace element analyses are carried out on solids (fusion disks and press pellets), liquids and loose powders using a Rhodium X-ray tube and various analyzing crystals (LiF 200, LiF 220, PE, GE). A 36 position sample changer is available.

(4) Stable Isotope Laboratory: The Las Vegas Isotope Science (LVIS) lab performs stable isotope analyses needed in the proposed study. The stable isotope laboratory is equipped with: 1) a BrF5 line with six nickel bombs for the extraction of oxygen from silicates and oxide minerals; 2) a Costech elemental analyzer and Finnigan TC-EA for continuous-flow C, N, S, H and O isotope measurements of geological and biological material; 3) a gas bench and automated carbonate device for analysis of carbonate minerals; 4) microdrill system for analysis of small spot sizes of carbonate minerals; 5) a CO_2 (10.6mm) laser-based fluorination system for oxygen isotope analyses of mineral grains, powders and bulk materials; and 6) a UV (213nm Nd:YAG) laser-based fluorination system for high spatial resolution (~50mm) in situ oxygen analysis. Isotope ratio measurements are made on a Finnigan MAT 252 mass spectrometer and a Finnigan Delta Plus XL located in the stable isotope laboratory. These mass spectrometers are equipped with Faraday cup collectors for CO_2, H_2, SO_2, N_2 and O_2, including both $^{18}O/^{16}O$ and $^{17}O/^{16}O$ ratio determinations. Both mass spectrometers are differentially pumped for operation in continuous-flow mode.

Dr. Brenda Buck

The UNLV ESAL (Environmental Soil Analytical Laboratory) supports research involving characterization of rock, soil, water and plant tissues. ESAL performs chemical and physical analyses using approved EPA, NRCS, USGS, and other approved techniques. The lab has standard wet-chemistry facilities to analyze particle size, pH, EC, trace element analyses, organic matter, percent gypsum, calcium carbonate content, and epoxy equipment for making thin sections. The lab specializes in total elemental analyses (major and trace elements) through either EPA method 3052 or USGS four-acids method. The lab is capable of measuring soluble salts including nitrate, sulfate, chloride, carbonate, acetate, formate and bromade using Dionex ion chromatography system 3000. ESAL can also provide upon request, trace element bioaccessibility extractions for lung or gastric exposures to specific materials. Particle size analyses can be performed through hydrometer, or laser particle size analyses using the Mastersizer 2000. Additionally, the lab specializes in particle size separation techniques using both wet and dry sieving, and an AdvanTech ATM L3P sonic sifter.

Additional equipment includes a Microwave Digester, Mechanical Vacuum Extractor, Damon/IEC HN-SII Centrifuge, Tyler Sieve Shaker, drying oven, Leica GZ7 Microscope, Ohause scales (2), Beckman pH meter, and Accumet EC meter, standard petrographic microscopes with point-counting-, teaching arm-, and digital camera-capabilities, sieves, scales, ultrasonic cleaners, mortar and pestles, sodium polytungstate for density separations, and heavy mineral separator equipment. Field equipment includes all standard soil science sampling equipment in addition to the Wacker BTS 1035 Quickie Saw used to cut and sample rocks or indurated soil horizons. ESAL operates as a cost center.

- Vario MAX CNS Elemental Analyzer
- ICS 3000 Ion Chromatography
- Analyst 400 Atomic Absorption Spectrometer

- Lambda 25 Spectrometer
- Ethos D Microwave Digestion system
- MS 2000 Laser Particle size analyzer
- Model 24VE Programmable Vacuum Extractor
- AS 200 Analytical Wet Sieving Set
- Eppendorf 5810 Centrifuge
- Model TJ-6 Centrifuge
- IEC HN-SII Centrifuge
- RX-86 Sieve Shaker
- ATM L3P Sonic Sifter
- Thermolyne Type 2200 Hot Plate
- TP 1536 Champion Abrasive Blasting Cabinet

UNR Engineering

Facilities, Equipment, and Other Resources

Laboratories

The Environmental Engineering Laboratories of the Civil and Environmental Engineering Department at the University of Nevada, Reno include approximately 5,000 square feet of floor space. The Laboratories of Electrochemical Research Group (ERG) of the Chemical and Materials Engineering (CME) Department at the University of Nevada, Reno are housed in Laxalt Mineral Research (LMR) and the Advanced Research Facility (ARF) buildings and include approximately 4,000 square feet of floor space. Instrumentation and facilities available for materials characterization and environmental research. Instrumentation available for all standard water quality analyses includes:

Civil and Environmental Engineering Equipment
Atomic adsorption spectrophotometer – Perkin Elmer, Model 3030
Epifluorescent microscope – Nikon Model Eclipse E-400 with SPOT image analysis
Flow Injection Analyzer – Lachat, Model Quik Chem 8500
Gas chromatographs – Hewlett Packard, Model 5980 and Model 6890
Gas chromatograph/mass spectrometer – Hewlett-Packard, Model 5890/5971
High performance liquid chromatograph – Hewlett-Packard, Model 1050
Inductively coupled plasma spectrophotometer – Perkin Elmer, Model Optima 2100DV
Ion chromatograph – Dionex, Models ICS 2000 and DX-300
Jar testing apparatuses: Phipps & Bird, 2 - model PB 700
Multi parameter portable instruments - YSI 556
Particle counter – Coulter, Multisizer IIe Model
Particle size distribution analyzer – Coulter, Model LS 230
Portable spectrophotometers - HACH DR 2500,
Scintillation counter – Beckman, Model LS 5000 CE
Total organic carbon analyzer (Combustion) – Shimadzu TOC-V_{CSH}
Total organic carbon analyzer (Persulfate Oxidation) Tekmar Dohrmann, Phoenix 8000
Turbidimeters - benchtop HACH 2100, portable HACH Model 2100P,
UV/Vis spectrophotometer – Varian, Model CARY 300 Bio
Ultrapure water systems - Millipore Direct Q/ RiOs 16 and Elix 3

Mechanical Engineering Equipment
DMM/DATA Acquisition Systems - Keithley Instruments, Model 2700-DAQ-80, 2701-DAQ-80
DATA Acquisition Systems - National Instruments, Model NI uSB-9162, BNC-2120

Multimeters – HP, Model 3478A
Thermocouple welder – Omega, Model TL-Weld
High precision scale - Ohaus, Model Adventurerpro AV313
High precision scale - Scount Pro SP6000
DC power supply - Agilent technologies, Model N5770A
Heat exchangers - FlatPlat, Model 131002833, 131002572
High temp bath – Grant, Model HE1030D
Recirculation chiller/heater – Polyscience, 6106
Recirculation chiller/heater - Cole-Parmer, R-12122-20
Spectrum analyzer module - Tektronix, Model 1401A
Function generator - Rohde & Schwarz, Model 821.2016.32
Oscilloscopes – Hitach, Model VC6145
Ultrasonic cleaner - Cole-Parmer, 08895-14
Vacuum pump – Barnant, Model 400-1901
Vacuum pump – Swiftech, Model mcp665-b
Vaccum pump – alcatel, Model 2033c2
Hot plate - Thermo scientific, Model SP131325
Pirani vacuum gauge - consolidated vacuum corp., Model GP-210C
Low temperature oven - Blue M
Sieve shaker - Cole-Parmer, Model EW-59986-01
Mass flow controllers
Flowmeter – McMillan, Model 104 Flo-sen
Flowmeter - blue-white Model f 45500lhn-8
Pressure transducers – omega, Model PX209, PX603, PX2300
Pressure calibrator - Omega, Model PCL-1B
Turbine flow meters - Cole-Parmer, Model EW-32718-00, EW-32718-04
Temperature/process limit controllers – Omega
Tabletop vibrating electric shakers, McMaster

Civil and Environmental Engineering Major Equipment

Major instruments for membrane surface and performance characterization that are located in the Environmental Engineering Laboratories include:

3 submerged membrane bioreactors test units
4 bench-scale membrane test units:
- Pressure filtration unit with stirred cell and pressure vessels from Sterlitech
- Fully automated crossflow system, SEPA CF from Osmonics
- Partially automated forward osmosis system
- Partially automated membrane distillation system

3 pilot-scale membrane test units
- Forward osmosis system
- Pilot-scale low pressure RO/NF system 1-1-1 (3 elements) 4040 up to 300 psi from Osmonics
- Pilot-scale UF automated system with automatic backwashing

Pilot-scale solar pond/membrane distillation system

Contact angle goniometer – Rame Hart, Model 100-00-(115)-S
Electrophoretic mobility analyzer – Zeta-Meter, Model 3.0+
Streaming potential analyzer – CAD Instrumentation, ZetaCAD Model

An atomic force microscope (Digital Instruments, Nanoscope IIIa) and a scanning electron microscope are housed in the Division of Metallurgical and Materials Engineering and are available for the PI to use. An FTIR-ATR and an XPS are housed in the Department of Chemistry and are available for the PI to use.

Mechanical Engineering Major Equipment
Major equipment are for material preparation/sintering/property characterization of micro-scale metallic and ceramic materials

2 high temperature quartz-tube furnaces – Thermoco, Model MB-71
Gas supply system (H2, N2, Ar)
Hydrogen room with high flow ventilation and gas detection systems
Fume hood

2 falling-film evaporator systems (evaporation experiment 1 RT cooling capacity)
Boiling experiment apparatus (pool and thin-film boiling)
Two-phase cooling loop for electronic cooling (2kW cooling capacity)

Electrochemical Research Group Facilities

The Microbial Electron Transfer Applications (META) Laboratory
The META laboratory, part of the ERG, consists of a dedicated microbiological facility for isolation and culturing of aerobic and anaerobic microbes. The laboratory also houses the following:
Anaerobic glove chamber
Autoclave (Tuttnauer)
Incubators (New Brunswick scientific and Lab Line)
Ultra low freezers (new Brunswick Scientific)
Optical microscopes
Electrospinning facility for preparing hydrogel fibers, 30 kV power source (Gamma High Voltage Research), and micro syringe pumps
Beckman spectrophotometers
Electrochemical low-current Potentiostat (Gamry Femtostat)
UV-VIS scanning spectrometer (Shimadzu UV-1801PC) with multi sample chamber

Environment and Sustainable Energy Research Group
Perkin Elmer (Series II, CHNS/O analyzer Model 2400)- CHNS-O Analyzer is an elemental analyzer dedicated to the simultaneous determination of the amount of % of Carbon, Hydrogen, Nitrogen, Sulphur and Oxygen contained in organic, inorganic and polymeric materials and in substances of different nature and origin i.e. solid, liquid and gaseous samples.

Thermogravimetric Analyzer (Shimadzu, TGA-50)- This thermobalance gives satisfying performance with respect to all criteria in vibration tolerance, stability, noise level, tolerance of room temperature fluctuations, and stand-alone ability with computer control.

FTIR Spectrometer (Biorad FTS 6000)- Greater light throughput and higher sensitivity, capable of analyzing liquid, gas and solid samples with Aldrich, Nicolet, Galactic and Sadtler Library databases.

HPLC, High Performance Liquid Chromatography, (Shimadzu LC-20AB)- A steel column was used with 150 X 3.2mm packed with C18, particles with diameter 7µm. Has high sensitivity up to the order of nanograms. It has two detectors one based on the UV absorption of the compounds and the other based on the RID (Refractive index Detector).

Gas Chromatography (Shimadzu GC-2010)- Enhanced productivity with high-speed analysis and reduced downtime. It has the most sensitive detectors ever, which gives unsurpassed reproducibility for all applications.

UV-VIS spectroscopy (Shimadzu UV-2401PC)- Optical characterization of liquid samples is possible in the UV and Visible regions. This equipment is also equipped with integrating sphere accessory for measurement of diffuse reflectance and absorbance of solid samples.

Instrumentation in the Electrochemical Research Group

The laboratories are well equipped for conducting electrochemical research pertaining to materials, environmental and biological sciences. The laboratory has a significant amount of glassware and custom-made glassware for electrochemistry research. The laboratory has a dedicated 18.2MΩ water supply for electrochemical research and houses a variety of instrumentation such as:

Several Potentiostats (Gamry Model No G300 and G750)
Electrochemical AC-Impedance Spectrometers (Gamry EIS 300)
High Performance Liquid Chromatography (HPLC, Shimadzu)
Fourier Transform Infrared Spectrometer (Spectrum 100)
UV-Visible spectrometers (Shimadzu UV-2401PC, upgraded to the near infra-red region)
Ultrasonic Baths
Gas Chromatograph (HP Plus)
Inductively coupled plasma atomic emission spectroscopy
Atomic absorption spectrometer
Tunable High Power Laser (Spectra Physics Model:2580)
Reversible Hydrogen Storage Measurement (Sieverts Apparatus), Make HyEnergy LLC, Model: PTPro2000)
BET surface area (Micromeritics)
Thermo gravimetric analyzer (Perkin Elmer TGA 7)
Shimadzu Gas Chromatograph with thermal conductivity detector

Materials Characterization

Further, the CME department houses several materials characterization equipment which are available for use within the department. They include:

Fourier Transform Infrared Spectrometer (Perkin Elmer)
Thermal Gravimetric and Differential Thermal Analysis (Perkin Elmer TG-DTA)
Dynamic light scattering instrument (Malvern Zetasizer Nano ZS)
Gas chromatograph (Agilent, DC power source, HP 6890)
Nanosize Particle analyzers (Spectrex ILI 1000, SediGraph500, AcoustoSizer-2000)
Laser Zee Meter (Model 500)
Surface area measurement unit (Micromeritics)
BET Surface Area Analyzer (Micromeritics FlowSorb III 2300)
Perkin Elmer Elemental Analyzer
Thermogravimetric Analyzer (TGA-50, Shimadzu)
Philips 3100 X-Ray Diffractometer
Differential Scanning Calorimetry (Shimadzu, DSC 60)
Several high temperature and vacuum ovens.

Electron Microscopy and Microanalysis Facility

The EMM Facility is part of the CME department and his housed in the LMR building. The facility also has its own dedicated research technician to perform analysis, train users and maintain the instruments. EMM facility consists of:

Hitachi S-4700 Field-Emission Scanning Electron Microscope – The S-4700 has a guaranteed resolution of 1.5nm at 15 kV at the EDX and specimen exchange position. The instrument also offers excellent low kV performance with guaranteed resolution of 2.1 nm at 1 kV.

JEOL 2100F Transmission Electron Microscope – The JEOL 2100F is an advanced Field Emission Electron Microscope featuring ultrahigh resolution and rapid data acquisition. The instrument has been developed to achieve the highest image quality and the highest analytical performance in the 200 kV class analytical TEM with a probe size under 0.5 nm.

Atomic Force Microscope (AFM, Nano R2, Pacific Nano Technology) – It has the capability for contact, tapping and force mode imaging. It also has Kelvin Probe mapping and conductivity mapping. The second atomic force microscope (Nanoscope IIIA) is used for mapping of surface topography.