Utah State University
Department of Geology

Self-Study Report

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Prepared by:

John W. Shervais, Head
W. David Liddell, Graduate Program Director
Joel Pederson, Undergraduate Advisor
Thomas Lachmar, Assessment Coordinator

EXECUTIVE SUMMARY
DEPARTMENT OF GEOLOGY
SELF-STUDY 2009

The Department of Geology consists of twelve headcount faculty (9.75 FTE) covering all of the major disciplines within the solid earth sciences. One FTE-HC resides in the Dean's office and 0.5 FTE/one headcount is a lecturer, which reduces the number of faculty contributing to the research mission of the department to 8.25 FTE and ten headcount.

We offer three undergraduate degrees, *BS Geology* (General, Hydrogeology, and Geoarcheology emphases), *BS Applied Environmental Geosciences*, and *BS Earth Science Composite Teaching*, and three graduate degrees, *MS in Geology*, *MS Applied Environmental Geosciences*, and *PhD in Geology*. The Department of Geology at Utah State University has had an advanced degree program in Geology at the Masters level for over 75 years, making it one of the older graduate degree programs on campus. In addition to teaching our majors, we teach a variety of general education courses each semester, including USU courses and Honors courses.

The greatest strength of this department is its faculty. They are strongly committed to the department and the institution, and they are dedicated teachers and researchers. The department prides itself on the excellent relationships maintained between the Geology faculty and university students, both majors and non-majors alike.

The Department of Geology has a strong commitment to high-quality teaching at both the undergraduate and graduate levels. Geology was awarded the *first USU Department Teaching Excellence Award* in 2003 and our faculty commonly lead the College of Science in university-wide teaching evaluations. In addition, one of our junior faculty won a national teaching award in 2005 (GSA Biggs Award) that is the most prestigious within the geosciences (only one is awarded annually).

The Department has a strong commitment to research. Faculty have identified four main program areas in which the department has strengths, each of which encompasses a variety of disciplines within the earth sciences: tectonics/geophysics, sedimentology and sedimentary systems, surficial processes, and petrology/geochemistry.

The Department enjoys strong support from its alumni through contributions to our various endowment funds and from private foundations for equipment purchase. In 2003, the Geology Department established an Advisory Board to advise us on programmatic issues and to assist with development efforts. As a result, private donations to the department have risen to more then $720,000 over the last four years.

Challenges

Challenges facing the Geology Department may be divided into three broad but inter-related categories: challenges to our educational mission, challenges to our research mission, and challenges resulting from budgetary or facility-related issues.

Challenges to the education mission include competition from tier two institutions for undergraduate majors, increased competition for graduate students nationally, and resources for building our expanded graduate programs.

Challenges to the research mission include nationally decreasing funding rates for proposals to the National Science Foundation and other funding agencies, a lack of the modern equipment and facilities needed to sustain robust research programs in geoscience, insufficient technical staff support, and competition for graduate students nationally.

Challenges resulting from budgetary or facility-related issues include low operating budgets, insufficient technical staff support, lack of space needed for growing research and education programs, and the lack of modern research and analytical equipment. Our biggest challenge remains filling faculty vacancies to replace those who retire or leave. We are currently down one headcount faculty and will lose another this Spring. Replacing these faculty is our number one priority.

Recommendations

The Department of Geology established an Advisory Board in 2003 that assists with program evaluation, establishment of realistic goals, and development of the resources needed to achieve those goals. The Department has worked with this board over the last three years to build a department vision and to draft recommendations for how to achieve that vision. These recommendations are listed below.

Undergraduate Students: The Geology Department needs to build its undergraduate major programs through proactive recruitment efforts at high schools,

contacts with undeclared students and students in other science or engineering majors who are seeking to change majors, and seeking transfer students from community colleges. The Geology Department must also seek to increase the number of majors through programs at the Regional Campuses, building on the new initiative to bring faculty at those campuses under the departments in Logan.

Graduate Students: The increasing competition from smaller schools for undergraduate majors requires that USU expand its graduate programs. The Geology Department sees opportunities for increased graduate education opportunities through its new graduate degree programs. To be competitive nationally, the Geology Department must increase TA salaries, and must also continue to provide in-state tuition scholarships to MS students. The Department also needs to increase the number of Research Assistants through an increase in grant funding.

Research Funding: The fundamental long-range goal is to increase research funding to levels of about $100,000 per year per full-time faculty member. This increase in funding level is needed to enhance productivity and support the growing graduate program. In order to be competitive at this level, the department must make provision for systematic improvements in research facilities and in upgrading or replacing research equipment.

Endowment Funding: The fundamental goal is to sustain or increase the level of private funding to Geology endowment accounts to support graduate and undergraduate students, equipment purchases, and other department priorities. The main focus of this effort will be on the Legacy Endowment (which has greater flexibility) but all endowments are targeted for growth up to certain levels.

New and Replaced Faculty Positions: The Geology Department's long-term goal is to build baseline faculty to 12 FTE positions. This will provide the breadth needed to address curriculum needs at both the undergraduate and graduate levels, as well as some of the depth needed for the graduate program. New faculty are especially needed to meet requirements in core geology courses and to provide depth in critical areas. To achieve this goal however, we need first to retain positions that we already have.

Research Faculty: The Geology Department also needs to recruit and retain research faculty who can support themselves, and who will contribute to the depth and breadth of departmental expertise. These research faculty will be a significant resource for graduate and undergraduate students, and could, when needed, teach courses within the department.

Regional Campus Positions: One area of potential growth for department faculty is within the Regional Campus system. These faculty will now be members of the department on the Logan campus and we are committed to integrating them into the teaching and research mission of the department. This could include collaborative research efforts, remote course offerings delivered both to and from the regional campuses, and team-taught classes that involve joint field experiences for the students.

Endowed Chair positions: One way to attract high-level research-oriented faculty is with endowed chair positions. The Geology Department is currently working towards securing sufficient endowment funds to support two chairs with funds for summer salary, research assistants, and travel.

Staff Support: The Geology Department needs a full-time technician to manage the teaching and research labs, and maintain the research equipment. This position will become critical if new analytical equipment is acquired, as discussed below. Finally, the Department needs a 25% time computer systems manager to deal with our growing computer network.

Space: A second long term goal is to gain administrative authority over all space in the Geology Building. Without this space, Geology will have no room for its program to grow into, and the Department will have difficulties even if its programs remain the same size. The Geology Department needs to renovate space in the geology building so that it is more suited to their current needs, and to utilize space that is not being used optimally at this time.

Equipment: To compete nationally in research, the Geology Department must increase the research equipment available in the department. Department faculty must take the lead in preparing equipment proposals to NSF for these needs. Some of this equipment has applications outside of geology and the earth sciences, so it will be a resource for the entire campus.

The *Uintah Basin Entrepenurial and Energy Research Center (UBEERC)* initiative represents a significant opportunity to achieve faculty integration in the near term. The UBEERC is a collaborative effort that seeks to create a multi-disciplinary research center on energy-related issues that enhances the educational mission of the Uintah Basin Regional Campus.

UTAH STATE UNIVERSITY
DEPARTMENT OF GEOLOGY

A. Department Overview

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The department has a strong commitment to research. We have identified four main program areas in which we have perceived strengths, each of which encompasses a variety of disciplines within the earth sciences:

(1) Tectonics/Geophysics: structural geology, contemporary deformation, regional tectonics, and relationships between sedimentary/igneous processes and tectonics.
(2) Sedimentation and sedimentary systems: physical sedimentology, stratigraphy, petroleum geology, low-temperature geochemistry, paleontology, and paleoecology.
(3) Surficial processes: geomorphology, Quaternary geology and geochronology, geoarcheology, hydrogeology, and environmental geochemistry.
(4) Petrology/Geochemistry: igneous and metamorphic processes and the geochemistry of magmatic systems.

Each of these four areas of concentration include faculty from several distinct disciplines within Geology and from related units on campus, including the Department of Plants Soils and Climate (College of Agriculture), the Department of Watershed Sciences (College of Natural Resources), and the Department of Civil & Environmental Engineering (College of Engineering).

Department faculty have carried out research across the globe, in Europe, Asia, and Africa, as well as throughout North and South America. Given our location, much of this work is focused in the U.S. mountain west, which is one of the most varied and important geologic provinces in the world. Our faculty also have projects along active and former plate boundaries in California, the southern Appalachians, the Andaman Islands, and the western Himalayas. Many of our faculty have established solid national reputations for their research and publications, and several are recognized internationally as well.

Department faculty publish regularly in top-quality international journals, including *Nature, Geological Society of America Bulletin, Geology, Bulletin of the Seismological Society of America, Journal of Geology, Journal of Petrology, Contributions to Mineralogy and Petrology, Journal of Metamorphic Geology, Lithos, Journal of Structural Geology, Earth and Planetary Science Letters, Journal of Geophysical Research, Geophysical Research Letters, G-cubed, Journal of Volcanology and Geothermal Research, American Geophysical Union Monographs, Geological Society of America Special Papers, Environmental & Engineering Geoscience, Journal of Hazardous Materials, Environmental Geology, Quaternary Science Reviews, Earth Surface Processes and Landforms, and Physics of Earth and Planetary Interiors.* Faculty also publish regionally important material such as guidebooks and guidebook articles, state survey memoirs and special publications, and geologic maps. Faculty are active in professional organizations and present at both national and regional meetings.

Research is supported by grants from the National Science Foundation, the American Chemical Society/Petroleum Research Fund, the National Oceanic & Atmospheric Administration, the United States Geological Survey, United States Forest Service, Bureau of Reclamation, the Department of Energy, the Utah Geological & Mineral Survey, the Southern California Earthquake Consortium, the International Scientific Drilling Program, Landmark Systems, and a range of petroleum companies (ChevronTexaco, ExxonMobil, Midland Valley).

The Department also enjoys strong support from our alumni through contributions to our various endowment funds and from private foundations for equipment purchase. In 2003, the Geology Department established an Advisory Board to advise us on programmatic issues and to assist with development efforts. As a result, we have seen our private giving expand to over $720,000 over the last four years.

The Department of Geology at Utah State University has had an advanced degree program in Geology at the Masters level for over 75 years, making it one of the older graduate degree programs on campus. The Department of Geology has recently added three new degree programs to our traditional offerings: a PhD in Geology, a plan-B terminal Masters in Applied Environmental Geosciences, and an interdisciplinary BS in Applied Environmental Geosciences. These degrees will allow us to broaden the scope of our program, undertake more ambitious, long-term research projects, and reach out to non-traditional students seeking a professional masters program in geoscience.

The department has done very well in its recent recruitment efforts for graduate students. Current students come from all over the United States. The overall quality of our current students is outstanding. We successfully compete for potential graduate students with much larger programs at major universities in the mountain west and beyond. Many of these students go on to successful careers in the petroleum industry, mining, geotechnical-environmental consulting, or government agencies. Others continue their graduate education in major PhD programs.

The Geology Building is one of the classic structures located on the Quad. This location gives our program high visibility within the campus community and projects an image that highlights our long-standing presence on campus. If we gain control over space currently allotted to other programs, this building will provide ample room for our growing program.

B. PROGRAMS OF INSTRUCTION

B1. Undergraduate Programs

The Department of Geology offers instruction leading to BS degrees in Geology, Earth Science Composite Teaching, and Applied Environmental Geosciences. These degrees prepare students for careers in natural-resource extraction industries, geotechnical and environmental consulting, government agencies and land management, and education. Because of their broad scientific base, degrees in geology provide excellent preparation for careers in non-applied professions, such as law and public policy.

BS Geology

This is our primary undergraduate degree program, designed to prepare students for a range of career options in the geosciences. There are three degree emphases, which allow students who have particular career goals in hydrology/engineering geology or geoarcheology to pursue more focused programs of study.

General Geology emphasis: The general geology emphasis is the standard curriculum in geology and it has been the mainstay of the BS program for many years. It remains the option selected by the majority of Geology majors. Graduates are prepared for entry into graduate programs in geosciences or to take entry-level positions in both the public and private sector.

Hydrogeology/Engineering Geology emphasis: The hydrogeology/engineering geology emphasis prepares students for graduate programs in hydrogeology and for careers as hydrogeologists or engineering geologists in government agencies and geotechnical firms.

Geoarchaeology emphasis: The geoarchaeology emphasis combines course offerings in Geology and the Anthropology Division of the Department of Sociology, Social Work, & Anthropology. Geoarchaeology is an interdisciplinary field recognized by section status in the Geological Society of America and by specific symposia at the meetings of the Geological Society of America and the Society for American Archaeology.

BS Earth Science Composite Teaching

The BS in Earth Science Composite Teaching is jointly administered by Geology and the Department of Secondary Education. This five-year program combines an undergraduate curriculum in Earth Science with certification for teaching at the 5^{th} to 12^{th} grade levels. Responsibilities for curriculum and advising are subdivided: the Department of Geology focuses on the geoscience component and the Department of Secondary Education focuses on the professional education component.

BS Applied Environmental Geosciences

The BS in Applied Environmental Geoscience is a new interdisciplinary program that combines parts of the traditional geology curriculum with a variety of courses in related subject areas, such as watershed science, soils, biology, statistics and GIS/remote sensing. This degree prepares graduates for careers with the environmental industry, government regulatory agencies, and policy organizations. Environmental geoscience is applied in a range of diverse situations, such as urban development, waste disposal, resource management, engineering, soils and agriculture, and assessment of natural and artificial hazards.

B2. Graduate Program

The Department of Geology offers three graduate degree programs: the MS and PhD in Geology and the MS in Applied Environmental Geosciences.

Masters of Science Degree in Geology

The department offers advanced study and research opportunities leading to the MS degree in Geology. This is a Plan A, thesis-only degree program. Although many research specialties require advanced courses selected primarily from Geology offerings, additional courses may be selected from other departments on campus. Fields of specialization for graduate research include the following: hydrogeology, igneous petrology, paleoecology, sedimentary geology, process geomorphology, Quaternary geology, geophysics, structural geology, and regional tectonics. The MS degree is considered the optimum degree for professional employment in government agencies and industry. The MS degree is also preparatory for further graduate study leading to the PhD. Employment opportunities for those with the PhD degree are primarily found in industrial research centers and academic institutions.

Master's of Science Degree in Applied Environmental Geoscience - AEG (Plan B)

The department offers advanced study leading to the MS degree in Applied Environmental Geoscience. This terminal degree program (Plan B report) requires a combination of advanced courses selected from Geology offerings, as well as additional courses from other units on campus, such as Civil and Environmental Engineering, Plants, Soils & Climate, Biology, Chemistry & Biochemistry, Mathematics & Statistics, and the College of Natural Resources.

Doctor of Philosophy (PhD)

The Doctor of Philosophy in Geology requires original research in a specific area of geology, demonstration of broad knowledge in the field of geology, and demonstration of depth of knowledge in at least two areas of geology. There are two program tracks for the PhD degree: academic and professional. The academic track is designed to prepare graduates for a career in academia or other teaching-related settings; it includes both coursework in education and classroom teaching experience under the supervision of a faculty teaching mentor. The professional track is designed to prepare graduates for work in professional careers with the petroleum industry, other extractive industries, or environmental and hydrologic consulting. It includes coursework in statistics, information systems, remote sensing, and GIS; completion of a professional internship is encouraged.

B3. Data for Undergraduate and Graduate Degree Programs

MAJORS (FALL SEMESTER)					
Undergraduate Headcount	**2004**	**2005**	**2006**	**2007**	**2008**
Applied Environmental Geoscience				1	1
Earth Science Composite Teaching	7	6	6	2	5
Geology	24	31	38	49	46
Total Undergraduate	**31**	**37**	**44**	**52**	**52**
Graduate Headcount					
Applied Environmental Geoscience					1
Geology MS	23	16	16	16	14
Geology PhD			2	2	3
Total Graduate	**23**	**16**	**18**	**18**	**18**
Total Majors	**54**	**53**	**62**	**70**	**70**
Demographics					
Undergraduate					
% Full-time	87.1%	81.1%	70.5%	90.4%	76.9%
% Female	19.4%	45.9%	38.6%	34.6%	36.5%
% Minority	0.0%	0.0%	6.8%	5.8%	5.8%
% International	3.2%	0.0%	0.0%	0.0%	1.9%
Graduate					
% Full-time	52.2%	56.3%	33.3%	61.1%	27.8%
% Female	17.4%	18.8%	16.7%	33.3%	50.0%
% Minority	0.0%	0.0%	0.0%	5.6%	5.6%
% International	0.0%	18.8%	0.0%	0.0%	0.0%
Student Credit Hours (Fall Semester)	**2004**	**2005**	**2006**	**2007**	**2008**
1000	2112	1573	1766	1896	1905
2000	6	8	15	7	7
3000	170	319	416	389	345
4000	28	20	1	41	4
5000	61	60	51	86	48
6000	141	83	81	104	68
7000				10	18
Total Student Credit Hours	2518	2063	2330	2533	2395
Degrees (Academic Year)	**2003-04**	**2004-05**	**2005-06**	**2006-07**	**2007-08**
Bachelor	3	9	5	4	4
Masters	8	2	6	3	7
Doctoral					
Total Degrees	11	11	11	7	11
First-Year Retention Rate (Fall Cohort)	**2002**	**2003**	**2004**	**2005**	**2006**
	50.0%	100.0%	100.0%	75.0%	66.7%
Six-Year Graduation Rate (Fall Cohort)	**1997**	**1998**	**1999**	**2000**	**2001**
	66.7%	40.0%	100.0%	25.0%	100.0%

B4. Analysis and Assessment

There is no national accreditation or curriculum review in the geosciences. The department has voluntarily participated in the curriculum evaluation offered by the American Institute of Professional Geologists, and meets or exceeds their minimum curriculum requirements. The Composite Teaching in Earth Sciences program is accredited via the USU College of Education by NSTA/NCATE.

A faculty retreat is held each fall, prior to the start of Fall Semester, to review accomplishments of the previous academic year, establish goals for the coming academic year, and review curriculum. Requirements for each degree option are reviewed, as is each individual course offered by the department. A tentative 2-year cycle of course offerings is structured so that individual faculty can anticipate their teaching assignments and advise students accordingly. When appropriate, a similar retreat is held at the end of Spring semester.

Curriculum evaluation and revision is an on-going process. All requirements are reviewed annually at a fall faculty retreat. In addition, input is solicited from various other constituencies on campus: the Department of Watershed Science in the College of Natural Resources, the Anthropology program in the College of HASS, and the broader interdisciplinary campus-wide water research group. We also consult with our Advisory Board, which is composed of alumni, recruiters, and other professionals to ensure that course offerings and degree requirements will adequately prepare our majors for professional employment or advanced study.

Undergraduate Studies in Geology

Department Philosophy on Undergraduate Education

The Geology Department maintains excellence in its undergraduate program by consistent dedication to the quality of instruction. This entails a process of systematic curriculum review (both internal and external) and assessment of instruction methods as well as course content. The department continues to respond to the changing needs of the profession by increasing its emphasis on the quantitative aspects of geologic training, including integration of computer applications and advanced analytical research techniques with current course content. The department encourages faculty to involve undergraduates in their research activities and encourages students to pursue undergraduate research, attend professional meetings, field trips, and other activities that enhance their professional development.

Program Assessment

Assessment is a continuing process in the Geology Department rather than an event. Details regarding program assessment can be found on the Geology Department assessment webpage at: http://www.usu.edu/geo/assessment/assessment.htm. The Department of Geology relies on a variety of tools to periodically assess its undergraduate program, including:

1. *Student Input in Assessment:* Towards the end of spring semester, the department hosts a "feed and feedback" reception for graduating students. After a brief social, the group disperses into small groups of 4 to 6 students and two to three faculty to discuss student perceptions of major courses, skills achieved, inter-relationships between courses and concepts, etc. Each faculty team records information without identifying students and submits the report to the department head for compilation. Results are discussed at a faculty meeting and it often results in programmatic

changes. This format has been found to be more effective than a brief experiment with "oral" content exams for graduating seniors. We now find that students are more relaxed, feel less threatened, and are very responsive.

2. *Value-Added Assessment:* Value-added assessment consists of a written questionnaire which is given on entry into the program and then again prior to graduation. This questionnaire is given first to students entering Geo 3550 Sedimentation-Stratigraphy, generally the first upper-division geology course taken by majors; the same questionnaire is then given again at the conclusion of Geo 5200 Geology Field Camp, our program's capstone experience. Results of the "before" and "after" versions are then compared to get a sense of “value-added” by our curriculum: skills learned or improved over that transition.

3. *College-level Assessment:* Each year, the Dean of the College of Science interviews a number of majors from each department in the college. In addition, every student applying for graduation in the College of Science is given a questionnaire to complete. These collectively provide information on general student satisfaction with the degree program, courses, faculty, and facilities. This information is collected anonymously and then returned to the department in the summer following graduation.

4. *Alumni Participation in Assessment:* The department solicits information from its alumni to assess program success. We provide a copy of current undergraduate degree requirements and ask alumni to: (1) comment on the importance of topic areas and courses, (2) indicate which topics or courses have assisted them most in their careers, (3) indicate which courses they wished they had taken or which we should require, and (4) with respect to using computers in their professional activities, recommend specialized software that we should be using with students today.

In April 2003, the department first met with an advisory board that was formed to provide input and advice on the evolution and strategic directions of the department. The advisory board consists of members drawn from a variety of professional backgrounds, including alumni of the department and non-alumni who have an interest in the department’s direction. We now meet with the advisory board on an annual basis to review our programs.

5. *Faculty Program Assessment:* Assessment information from these various sources is discussed and reviewed by all faculty and used to "tune up" or modify program objectives, course content, and degree requirements. The single most important department activity for reviewing assessment as well as all other aspects of our program is the fall faculty retreat. This 2-day meeting, prior to the start of fall semester, provides a period of reflection on the past year; an opportunity to make changes and/or modifications to requirements, policies, and procedures; and a forum for planning for the coming academic year.

General Education

USU 1360 *Planet Earth*, and Geo 1110 *The Dynamic Earth: Physical Geology* are courses taken by students from all colleges and programs across campus to meet General Education Science breadth requirements. Geo 3100 *Natural Disasters*, Geo 3300 *Geology of the Worlds Oceans*, and Geo 3200 *Earth through Time* are courses taken by students to meet General Education

Science Depth requirements. We view these courses as opportunities to increase student awareness of the "Science of Geology" and the methods of scientific inquiry in a geological context and to increase their appreciation for the geology and natural resources of the state of Utah and the intermountain West. All graduates in the College of Science must complete a science sequence outside of the major. One way in which this requirement may be met is to complete Geo 1110 *Physical Geology* and Geo 3200 *Earth through Time*.

We teach about 5000 student credit hours per year, meaning that about 1600 students per year see one of eight geology faculty each year. Thus, about 12% of all undergraduates are exposed to geology and geology faculty each year, even though we comprise <1% of the total faculty at USU. We also have a strong commitment to the Honors program, for which we teach two courses every year.

Undergraduate Majors

The undergraduate program in Geology at USU goes back to the earliest days of the university. Our program provides an outstanding basis for careers in the geosciences and in related areas such as education and public policy. We have recently broadened our degree options to serve a wider range of interests. We emphasize a personal approach to our majors that involves them in the department and in our research, so that when they graduate they leave with a sense of community within science.

Student Recruitment: The department has a multifaceted approach to recruiting at the BS level. This includes recruitment activities on campus, response to inquiries, distribution of program materials at high school recruiting fairs by the College of Science, communication and visits to feeder institutions, and outreach efforts to local schools. Undergraduate inquiries are sent a copy of the current course requirement sheet, and are directed to our departmental web site (http://www.usu.edu/~geo/). For any inquiries from Utah or the immediate region, students are invited to campus to meet faculty and students and see the department facilities.

Although we undertake these broader recruitment efforts, the department acquires the vast majority of its students as transfers rather than as incoming freshmen. It is clear that this largely reflects the scarcity of Earth Science courses in secondary education and their placement early in that curriculum. This contributes to an acute lack of awareness of Geology as a profession among graduating high school students. A large number of transfers come from Snow College (Ephraim, UT), College of Eastern Utah, Salt Lake Community College, and from USU Distance Education. Many of our students transfer from other programs on campus after taking one of our introductory courses, especially from the College of Engineering and other science departments.

The recruitment of undergraduate majors is an area that we have targeted for emphasis in the coming years and which we have discussed extensively with our advisory board. We need to ally ourselves more closely with regional two-year colleges to improve our transfer pool. This would include visits to the faculty on these campuses and possibly even joint field trips with their students. We need to work closely with our Regional Campuses and Distance Education to grow undergraduate majors at those facilities. This strategy can be particularly effective in places like Uintah Basin where the Regional Campus infrastructure is expanding significantly, and where there is potential for geology faculty permanently assigned on-site.

Scholarship and Assistantship Resources: The department has a number of scholarships specifically for geology majors: the Riemondy Scholarship, the Branch Scholarship, the Hardy Scholarship, and the Rider Scholarship. These and other department endowments have grown substantially over the last few years in response to our heightened development efforts and generous alumni contributions. Geology has consistent success with College-level support for the best of our students, including Questar Scholarships, Undergraduate Research Fellowships, and Willard L. Eccles Undergraduate Research Fellowships. In addition, all geology majors with work-study support are guaranteed jobs within the department.

General Undergraduate Advising: Geology has no staff support for advising, and so all undergraduate majors are advised by the faculty Undergraduate Advisor, Joel Pederson. All faculty engage in informal advising and recruiting.

Student Engagement: One of our goals as educators is to engage our students as scholars and scientist to look at the world differently, and to assess their observations within the framework of knowledge we provide them. We have many ways to do that in Geology. One way is to involve students in faculty research projects; this is discussed below in more detail. Other ways include class and department field trips, the department seminar series, and any other departmental gatherings (formal or informal) where students can mingle with faculty and carry on wide-ranging discussions.

One of the strongest aspects of our programs in Geology are the extensive field trips undertaken in almost all upper level (and many lower level) Geology classes, the departmental field trips held each semester, and our capstone Field Geology course. The best way to learn about the Earth is to go out and make critical, scientific observations: this is the primary purpose of our trips. But they also serve another function, by bringing together groups of students and faculty for day-long or multi-day trips that allow them to interact over long periods. This allows the students to understand how the faculty cognate about their science, and allows the faculty to understand how their students think and how to better teach them. These trips also build *esprit de corps* and create the loyal alums that support us later. Our trips are supported in part by class fees and in part by contributions from alumni who remember how important these trips were for them.

Undergraduate Research: One of the best means we have to teach students what it means to be a scientist is to involve them with faculty in research projects or with industry internships. The Geology Department has a coordinated program to foster undergraduate research and provide course credit for such experiences. A high proportion of our students graduate with some kind of extra-curricular research experience to their credit. This not only enhances their acceptance into graduate schools and employment prospects, but creates satisfied alumni who are loyal to the Department.

Demand for Program Graduates: Demand for graduates in Geology has been growing steadily over the last six years – following the general trend of natural resource commodity prices. However, other factors have also become important. Oversight of almost all building and manufacturing industries by local, state and federal regulatory agencies has created demand for

both regulators (who work for the government agencies) and consultants (who work for the affected industries) to ensure compliance with a growing body of environmental, cultural-resource, and natural-hazard legislation.

There is a sustained high demand for "highly qualified" science teachers in elementary and secondary schools, especially as certified in the state of Utah. Earth Science is an ideal subject area for these students because it can be related directly to tangible objects and things they can observe themselves. Despite this, our Earth Science Composite Teaching remains a steady but small component of our enrollment. Few students see this as a lucrative or enjoyable career path, especially considering the long and highly prescribed curriculum required to meet state certification.

Graduate Studies

Graduate Degree Programs
The MS Geology Degree (Plan A, Thesis) has been the primary graduate program of the Department of Geology for many years. The first MS Geology degree at Utah State University was granted in 1928. The MS Geology degree prepares students to enter the professional field or to pursue advanced degrees. We have recently (2005) added two new degree programs, the MS in Applied Environmental Geoscience and the PhD in Geology. The MS AEG Degree (Plan B, Nonthesis) is a terminal degree that prepares students for entry into professional fields. The PhD Geology degree includes two tracks - an academic track and a professional track. The academic track includes courses on pedagogy from the College of Education and requires students to teach at least one course under the supervision of a faculty mentor during their residence at USU. Thus, they will be well-prepared to enter the academic realm. The professional track includes courses from a variety of fields within and outside of the geosciences. When possible, students will take internships with industry partners. This track is designed to prepare students for work in professional fields.

Department Philosophy on Graduate Education: The Geology Department maintains excellence in its graduate program by consistent dedication to the quality of instruction. This entails a process of systematic curriculum review (both internal and external) and assessment of instruction methods as well as course content. The department continues to respond to the changing needs of the profession by increasing its emphasis on the quantitative aspects of geologic training while not abandoning the field-based aspects which are what probably attracted students to the field in the first place. We include integration of computer applications (flow modeling, advanced statistics, GIS, Matlab) and analytical research techniques (XRD, optically stimulated luminesence) with current course content. The department encourages faculty to involve graduates in all aspects of their research activities and advises students to pursue funding opportunities, attend meetings, field trips, and other activities that enhance their professional development.

Assessment of Graduate Student Progress: Geology graduate student progress is mentored and evaluated in a number of ways:

1. The Graduate Program Director maintains files on all graduate students and tracks milestones in progress (e.g. selection of a thesis/dissertation committee, submission of a program of study, completion of thesis/dissertation proposal, etc.) and academic performance.
2. Students are required to select a thesis/dissertation committee by the end of their first (MS) or second (PhD) semester in the program. The committee can then provide guidance on coursework and thesis research from an early stage in the student's program.
3. Students must complete their Programs of Study, which is a semester by semester plan of coursework, by the end of their second (MS) or third (PhD) semester in residence.
4. Thesis/dissertation proposals are required of all students before they begin the major portion of their field research; all committee members have input to and must approve the final thesis/dissertation proposal.
5. During the spring of each year students must submit a progress report to the Graduate Program Director. This includes information such as progress on coursework, thesis/dissertation progress, and grants and papers submitted.
6. PhD students must complete oral and written exams to evaluate the breadth and depth of their knowledge of geology. Ideally this is completed by the end of their third semester in residency so coursework can be taken to correct any deficiencies that are identified.
7. During the fall of each year all students who are not in their first semester of residence must make an oral presentation to the department on the status of their thesis/dissertation project.
8. Input on the quality of our graduate program efforts are provided by the Geology Advisory Board, which includes many former graduate students.

Graduate Student Recruitment: The department has a multifaceted approach to recruiting at the graduate level, which ranges from formal recruiting booths at national and regional meetings to personal contacts with faculty and students at other universities. Potential students receive a letter from the Graduate Program Director and they are directed to our web site: http://www.usu.edu/geo/.

The department participates in graduate student recruiting at national and regional meetings of the Geological Society of America and at the annual national meeting of the American Geophysical Union. This has led to a significant increase in attracting graduate students from across the country. In particular, we have achieved great success recruiting students from "back East" who are interested in continuing their education in the mountain west. Many of these students are from well-regarded programs at major universities.

For any inquiries from Utah or the immediate region, students are invited to campus to meet faculty and students and see the department facilities. We also invite selected potential graduate students from all over the US to visit campus, based on their undergraduate records, their level of interest in USU, and their match with an interested faculty member. This practice has yielded outstanding results over the last 6 years and continues to be successful.

The Department of Geology is committed to expanding the diversity of its graduate student body. Of its current group of PhD students, there are one white female, one white male, and one

Hispanic male. There is also one black male PhD student who accepted our offer of admission but has requested that his application be placed on temporary hold for personal reasons. In order to attract underrepresented groups the department offers increased graduate stipends for such students.

Admissions and Entrance Skills: The department has established guidelines for admission of applicants to the Geology graduate program. To enter as a matriculated MS student, an applicant must meet the School of Graduate Studies' minimum requirement of a 3.0 GPA and GRE scores of no less than 40th percentile in both verbal and quantitative skills. PhD students are required to have a minimum GPA of 3.4 and scores of no less than 50th percentile in both verbal and quantitative skills. Currently, only students with prior MS degrees are being accepted into the PhD program. All applicants (MS and PhD) are admitted to the program only with the consent of a specific faculty member to serve as their thesis advisor. Course deficiencies are assessed relative to the current Utah State University undergraduate requirements in Geology and the nature of their research emphasis (e.g. geophysics vs. sedimentology).

Financial Support: A critical element of the graduate program recruiting process is the availability and competitive value of teaching assistantships. The Geology Department has 8.5 teaching assistantships with stipends of $13,500 projected for the 2009–2010 academic year (this increases to $15,500 for PhD students that advance to candidacy). These assistantships include a waiver of the out-of-state component of tuition; however, MS students must pay tuition at the in-state rate (approx. $3,400 per year) and carry a minimum of 6 credit hours. A few in-state tuition waivers are available for resident and non-resident graduate students, and the department has committed to covering the in-state tuition for all graduate students since the beginning of the 2007 academic year. All tuition (in-state and out-of-state) for PhD students is covered by the School of Graduate Studies. We also now provide health insurance coverage for all graduate students through the Graduate School Health Insurance Program (student pays 10% of total premium, Department provides the remainder). We need to place greater emphasis on including tuition support for research assistants in all research grants we submit, and on seeking more external funding support for graduate student salaries and stipends.

Placement: USU Graduate students have no problems finding jobs or continuing their education at other institutions. Over the past 6 years we have had essentially 100% success in graduate placement, either as continuing education at the PhD level (11%) or employment within industry (64%), government (18%), or education (7%). All are working in fields related to their degree training in geology or geoscience education (Table B4, next page).

Our students get jobs with a range of private and governmental bodies, including the United States Geological Survey, Bureau of Land Management, the Utah Geological Survey, other state agencies, environmental and geotechnical consulting companies, and within the petroleum industry, where starting salaries are typically around $90,000 per year with an MS. In fact, many of our graduate students begin working before they complete their thesis, which has created problems in getting their degrees completed in a timely fashion.

Table B4. Placement of Graduate Students – 2000-2008		
Sector	**Number of Graduates**	**Percentage of Graduates**
Petroleum	20	45.5%
Agency	8	18.2%
Geotech	7	15.9%
PhD or MD	5	11.4%
Education	3	6.8%
Mining	1	2.2%
Totals	44	100%

B4. Challenges and Recommendations

Undergraduate Students: Increase number of majors through recruitment efforts: We must become more proactive in our recruitment of undergraduate geology majors, especially through distance education and by attracting undeclared students and students in other science, engineering, or natural resource majors who are seeking to change majors. The Uintah Basin campus of USU and its new *Energy Entrepenuership & Research Center* will be a central focus of this objective, although recent budgetary constraints have placed a pending geology position there on hold. We also need to be more aggressive in seeking transfer students from Snow College, the College of Eastern Utah, Southern Utah University, Salt Lake Community College, and the College of Southern Idaho (a two-year community college in Twin Falls, Idaho). To do this we will need to build close relationships with the faculty and academic advisors at these institutions.

A primary concern of both our undergraduate students and the existing USU administration are those experiences outside the traditional geology curriculum--such as internships and undergraduate research experiences. Our department does, we believe, a very good job of involving our better students in research with faculty mentors, tapping into the several sources of minor funding on campus for undergraduate research. Nearly all our faculty are involved in research with one or more undergraduates at a given time. In terms of internships, we are currently working to build contacts with regional consulting and industry to be aware of and provide opportunities for our students. This is an incremental process, and we have significant ground to cover yet towards this end.

Graduate Students: The increasing competition from smaller schools for undergraduate majors requires that we expand our graduate programs. We see opportunities for increased graduate education opportunities through our new graduate degree programs, including the “Plan B” Applied Environmental Geosciences MS Degree (a terminal professional degree that does not require a research project and written thesis) and the PhD degree.

The following will be essential to the expansion of our graduate programs at Utah State University:

1. Increase graduate student enrollment to 30, or an average of 3 students per faculty.
2. Increase TA salary to become more competitive, and increase the number of TA slots available to allow flexibility in recruitment and to recruit the best students available.
3. Increase recruiting efforts for graduate students, especially our new plan B non-thesis program in Applied Environmental Geosciences. Recruiting trips to schools with four-year, but not graduate programs in the region (e.g. BYU-Idaho and Utah Valley University) may also lead to increases in graduate enrollment.
4. Increase the number of Research Assistants within the department through an increase in grant funding. This would free up TAs and allow for an increase in the number of fully-supported graduate students.
5. In order to thrive as a viable, competitive department nationally, the Geology program at USU must grow. While it is possible for us to offer the degree programs outlined above with our current resources, a robust PhD program in Geology will require additional faculty to give the program depth and breadth. Certain geoscience areas such as geochemistry, geophysics and igneous petrology are currently underrepresented on the USU campus.

C. FACULTY

C1. Current Status

The Department of Geology consists of 12 headcount faculty (9.75 FTE) covering most of the major disciplines within the solid earth sciences (Table C1, below). One headcount faculty is housed in the Dean's office and does not appear in the table below.

Table C1. Demographics of Geology Faculty 2004-2008

		2004	2005	2006	2007	2008
Headcount Faculty	Full time	7	6	7	7	9
	Part time (0.5-0.75 FTE)	3	3	3	3	2
Total Faculty		**10**	**9**	**10**	**10**	**11**
Demographics						
	% Female	30.0%	30.0%	30.0%	30.0%	36.0%
	% Minority	0.0%	0.0%	0.0%	0.0%	0.0%
Rank		**2004**	**2005**	**2006**	**2007**	**2008**
	Professor	3	3	3	3	4
	Associate Professor	3	3	4	4	3
	Assistant Professor	3	2	2	2	3
	Lecturer	1	1	1	1	1
Percent Faculty with Terminal Degrees*		**2004**	**2005**	**2006**	**2007**	**2008**
		90.0%	90.0%	90.0%	90.0%	90.9%

* Analysis based on instructional faculty.

Each faculty member teaches a variety of courses: introductory, upper division, and graduate, both required and elective. The present average teaching load is 3 courses over two semesters, or approximately 10 credit hours per year, but the number of contact hours may vary considerably from one faculty member to another depending on the type of courses being taught. In particular, field-oriented courses require a much larger ratio of contact hours per credit hour than lecture courses, and demand greater commitment from the faculty.

Faculty are expected to pursue research within their area of expertise, and it is expected that this research will result in publication in peer-reviewed journals. Simultaneously, faculty are expected to support the programs of instruction, specifically the graduate program, by involving students in research activities leading to the successful completion of the MS and PhD degrees.

Faculty are expected to seek and obtain external funding to support their research efforts, with a level of funding sufficient to support a robust research program in their area of expertise. Faculty who are no longer active in funded research are expected to contribute increased efforts in other areas of department activity (teaching, service). Each faculty member is expected to participate in the professional activities that reflect on their role as scholars and their standing within the community. These activities may include leading field trips, attending professional meetings, presenting scholarly papers, organizing and/or chairing symposia, serving as officers or committee members in professional organizations, and reviewing abstracts, manuscripts, and proposals.

Table C2. Listing of Current Faculty with Active Appointments (Headcout)	
1. **Carol M. Dehler**, PhD 2001 University of New Mexico *Assistant Professor*	Sedimentology and Stable Isotope Geochemistry: clastic sedimentary systems, Neoproterozoic sedimentation, stable isotope systematics of Neoproterozoic carbonates.
2. **James P. Evans**, PhD 1987 Texas A&M University *Professor*	Structural Geology: Deformation and rock mechanics, microstructural analyses of deformed rocks, fault zone processes, deformation in thrust faults, hydrology of fractures and faults.
3. **Donald Fiesinger**, PhD 1976 University of Calgary *Associate Professor*	Igneous Petrology: mafic and felsic magma systems in NW Utah. Former Dean of College. *Retires in June 2009.*
4. **Mary Hubbard, PhD 1988** Massachusetts Institute of Technology *Professor and Dean*	Regional Tectonics and Structural Geology: Regional geology of Himalayas and Alps. *Dean, does not teach.*
4. **Susanne U. Janecke**, PhD 1991 University of Utah *Professor*	Regional Tectonics and Structure: Regional tectonic analyses, extensional deformation; application of structural geology, basin analysis to geologic evolution of North American Cordillera.
6. **Thomas E. Lachmar**, PhD 1989 University of Idaho *Associate Professor*	Groundwater Hydrology: surface and ground water interactions, CO_2 sequestration, and contaminant transport.
7. **W. David Liddell**, PhD 1980 University of Michigan *Professor, Associate Dept Head, and Graduate Director*	Paleoecology and Sedimentology: Coral-reef ecology, sedimentary facies of modern carbonate environments, sequence stratigraphy and sedimentary cyclicity of Paleozoic rocks.
8. **Anthony R. Lowry**, PhD 1994 University of Utah *Assistant Professor*	Geophysics: Continental deformation using seismology, gravity, and GPS, lithospheric rheology from isostatic analysis, volcano geodesy, geodynamics of subduction and continental extension.
9. **Susan K. Morgan,** MS 1988 Utah State University *Lecturer*	Science Education, carbonate sedimentology. Pedagogy in science education, science for elementary education majors.
10. **Joel L. Pederson**, PhD 1999 University of New Mexico *Associate Professor, UG Advisor*	Geomorphology, Paleoclimatology, and Geoarchaeology: climatic controls on landscape change, hillslope processes, late Cenozoic landscape evolution of the Colorado Plateau.
11. **Tammy Rittenour,** PhD 2004 University of Nebraska *Assistant Professor*	Geomorphology, Paleoclimatology, and Geoarchaeology: climatic controls on landscape change; Director USU OSL Geochronology Laboratory.
12. **John W. Shervais**, PhD 1979 University of California, Santa Barbara *Professor and Head*	Igneous Petrology and Geochemistry: Geochemistry of igneous rocks, continental volcanism, origin of ophiolites and island arcs, mantle metasomatism, formation of the lunar crust.

Table C3. Listing of Adjunct Faculty and Emeritus Faculty	
1. Robert Oaks, PhD 1969 Yale University *Professor Emeritus*	Sedimentology and Clastic Sedimentation. Geology and tectonics of northern Utah.
2. Peter Kolesar, PhD 1973 University of California, Riverside *Associate Professor Emeritus*	Low-T Geochemistry & Carbonate petrology: origin of late Tertiary/Quaternary calcite veins and their use in paleoclimatology and groundwater hydrology of the southern Great Basin.
3. David Tarboton ScD 1990 *Professor*	Hydrology: Department of Civil &Environmental Engineering & Utah Water Laboratory. *Adjunct in Geology*.
4. Jack Schmidt, PhD 1987 Johns Hopkins University *Professor*	Fluvial Geomorphology: Department of Geography and Earth Resources, College of Natural Resources. *Adjunct in Geology.*
5. Janis Boettinger, PhD 1992 University of California, Davis *Associate Professor*	Soil Mineralogy: Department of Plants, Soils and Biometeorolgy, College of Agriculture. *Adjunct in Geology.*
6. James P. McCalpin, PhD 1981 Colorado School of Mines *Adjunct Research Professor*	Paleoseismicity, neotectonics, geologic hazard mitigation; GEO-HAZ Consulting, Inc., *Adjunct in Geology.*
7. Nicholas E. Allmendinger, PhD 2004 University of Deleware *Assistant Professor*	Fluvial Geomorphology: Department of Geography and Earth Resources, College of Natural Resources, Uintah Basin Campus. *Adjunct in Geology.*
8. Reese E. Barrick, PhD 1993 University of Southern California *Director Prehistoric Museum*	Director, Prehistoric Museum at the College of Eastern Utah, Vertebrate Paleontology. *Adjunct in Geology.*

C2. Research Activities

Scholarly research is essential to maintaining quality instruction, and it is a critical component in the professional growth and development of the faculty. Research also contributes to the general welfare of our society by providing solutions to problems in areas such as resource development and environmental hazards. Faculty members integrate their own research with the research training of students and they act as role models for instilling professional attitudes and skills.

Geology faculty have engaged in research activity involving colleagues from abroad for many years. Foreign projects and associations include work in Taiwan, Japan, China, Pakistan, India, Oman, Italy, former Soviet Union, Africa, Mexico, Central America, South America, and the Bahamas. Major research initiatives with USU participation include SAFOD (San Andreas scientific drilling project), Project Hotspot (Snake River Scientific Drilling project), and the Grand Canyon Paleoarcheology project.

There are 4 principal areas of research emphasis within the department:

- Sedimentation and sedimentary systems, including petroleum geology, low-temperature geochemistry, sedimentology, and paleoecology.
- Surficial processes, including geomorphology, watershed science, hydrogeology, and environmental geochemistry.
- Tectonics-Geophysics, including geophysics, geodynamics, structural geology, and relationships between igneous and sedimentary processes and tectonics.
- Petrology and geochemistry, including igneous and metamorphic processes, geochemistry of high-temperature systems, and tectonics of igneous and metamorphic rocks.

Sedimentation and sedimentary systems (Liddell, Janecke, Pederson, Dehler, Rittenour)
Faculty Expertise: stratigraphy and sedimentation (especially in continental systems), sedimentary petrology and petrography (both terrigenous and carbonate rocks), petroleum geology, low-T geochemistry, paleontology/paleoecology, marine ecology, limnology.

Research in the broad area of sedimentation and sedimentary systems has focused to a large degree on assessing depositional environments and, from this, the evolution of basins. Activities have concentrated on four areas: sedimentology and development of coral reefs and associated carbonate environments during Pleistocene and Holocene time; cyclic shallow-shelf carbonate deposition during early Paleozoic time; deposition of detrital sediments in tectonically active basins, and Neoproterozoic clastic sediments and Snowball Earth cap carbonates.

Research in paleoecology is focused on communities spanning broad time intervals. Current research activities center on Holocene and early- to mid- Paleozoic carbonate environments, taphonomic (preservational) analyses, and community ecology.

Research in active depositional basins considers the influence of faults and folds on the architecture of syntectonic basin-fill deposits. Progressive development of the structures determines the positions of depositional sub-basins and results in distinctive thickness and facies patterns. Chronostratigraphic analysis allows the age and time-space patterns of faulting and folds to be determined. These methods have been applied to extensional, transtensional and transpressional and foreland settings.

Surficial processes (Lachmar, Pederson, Rittenour, *Allmendinger*, Boettinger*, Schmidt*, Tarboten*)*
Faculty Expertise: Process geomorphology, Quaternary geology, geochronology, geoarchaeology, soil geomorphology, environmental geochemistry, fracture-flow hydrology, surface and ground water hydrology, geographic information systems. (**Adjunct Faculty*).

The surficial processes research program concentrates on climatic, tectonic, and anthropogenic controls on landscapes and on water resources of the intermountain West. Ongoing geomorphic research includes studies of fluvial systems and their response to climate change, landscape evolution of the Colorado Plateau and Grand Canyon, geoarchaeology, applications of luminescence dating, the downstream effects of dams, regulated-river sedimentation and hydrology, and arid-land soil development. Environmental research focuses on aquatic habitat maintenance, soil mineralogy and its environmental applications, ground water and surface water interactions, .the hydraulic properties of faults in central Utah as they relate to CO sequestration,

and the transport of inorganic, organic and radioactive contaminants at hazardous waste sites. Both the geomorphic and environmental research programs are assisted by the application of geographic information systems.

A core feature of our surficial process research program is our new USU Luminescence Laboratory. Our lab focuses on the critical need for absolute dating of Quaternary sediment for environmental, hazard, and geoarchaeological studies through the expanding field of optically-stimulated luminescence. This provides myriad research opportunities for USU faculty and several of our students, and the lab has standing contracts with NSF-Earthscope and the Southern California Earthquake Consortium (SCEC). It also attracts contracts from researchers and students from academic and government-agency institutions around the world on a collaborative basis.

Tectonics-Geophysics (Evans, Janecke, Lowry, Shervais)
Faculty Expertise: structural geology, geodesy, geodynamics, seismology, mechanisms of rock deformation, regional tectonics, basin analysis and modeling, landscape evolution, field geology and mapping, subsurface analysis using borehole and reflection seismic data, paleogeographic and paleotectonic analysis, microscopic to megascopic analysis of fault zones, structural analysis of deformed rocks, and relationships between igneous and sedimentary processes and tectonics.

Research in tectonics is focused on assessing the structural and tectonic evolution of modern and ancient orogenic systems. Research in regional tectonics is focused on strain partitioning in an exhumed transtensional divergent margin, the Salton Trough in southern California. This work examines the influence of extensional folds on growth strata in an evolving extensional basin.

Geologic mapping and structural analyses of the Cordilleran fold and thrust belt examine the prevalence, kinematics and significance of out-of-sequence thrusts, coupled with analysis of newly identified structural culminations in the Idaho-Montana fold and thrust belt. Many of these structural culminations are the locus of later large-magnitude extension, so it critical to properly interpret their geometry, kinematics and tectonic evolution.

Large-magnitude late Miocene to Recent extension in SE Idaho and northern Utah is being investigated for its structural, tectonic, and stratigraphic significance. The paleogeography of the region will ultimately be reconstructed and the origin and age of the younger modern Basin and Range topography will be identified. The age and kinematics of cross faults (normal faults with odd orientations) adjacent to the track of the Yellowstone hot spot are the subject of another study to determine their overall tectonic significance and possible tie to subsidence along the eastern Snake River Plain.

Research in structural geology is focused on processes of rock deformation, with studies ranging from field mapping of structures to detailed petrologic examination of deformed rocks. Research includes kinematic and mechanical analysis and field mapping of map-scale structures. Fractured and faulted rocks are studied to determine permeabilities of naturally deformed rock and to evaluate regional flow paths and the hydraulic character of faults on the regional scale. Micro–scale hydrology will lead to modeling of fluid-rock interactions, whereas regional scale models will provide constraints on the amounts of fluids involved in large-scale deformation and help

identify the likely driving mechanisms of fluid flow in compressional and extensional regimes. The study of microstructures is concerned with the interaction of chemical and deformation processes in the nucleation and growth of fault and shear zones.

Geophysics research seeks a better understanding of the processes and properties of deformation of the solid Earth and planets. Studies incorporate most of the geophysical toolbox including seismology (including USArray data), gravity, topography, surface heat flow and geodesy (including PBO data). These are combined in physical models to explore the forces at work and their rheological controls. These tools are currently being applied to better understand the earthquake cycle on faults, earthquake hazard, volcano processes, and rifting of continents.

Petrology and geochemistry (Shervais, Fiesinger*)
Faculty Expertise: Igneous petrology, metamorphic petrology, geochemistry of magmatic systems (*retires this year).

Research in petrology focuses largely on the origin and evolution of basic to intermediate magmatic systems and rocks formed from these magmas. Projects include the origin of accreted arc terranes in the southern Appalachians and Pakistan, the multi-stage origin of ophiolites, plume-related volcanism and its interaction with continental lithosphere in the Snake River Plain, Idaho, metasomatism and magmatism in the upper mantle, and the formation and evolution of lunar highlands crust.

Research in petrology related to tectonics includes studies of the Kohistan arc terrane and its boundary with the Indian plate in northern Pakistan, eclogite and granulite metamorphism related to continental collision in the Carolina terrane, the origin of accreted terranes along with eastern and western margins of Laurentia, and the origin of ophiolites and island arcs and their relationship to tectonic evolution of active plate margins.

Research Support
Research activities within the department are funded by government agencies, industry, and private foundations, and carried out with a range of collaborative investigators. A summary of grant activity is presented in Table C4, which compares total Contract and Grant Awards each year for the last 10 years within the Geology department.

Table C4. Contract and Grant Awards by Fiscal Year – Department of Geology.

Year Awarded	1997-98	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07
Total awards	$391,113	$238,688	$409,080	$293,634	$641,185	$154,493	$240,046	$380,900	$556,720	$499,435

Funding has been obtained from the National Science Foundation, the American Chemical Society/Petroleum Research Fund, the National Oceanic & Atmospheric Administration, the United States Geological Survey, the Bureau of Reclamation, United States Forest Service, the Department of Energy, the Utah Geological & Mineral Survey, the Southern California Earthquake Consortium, SEPM, the International Scientific Drilling Program, Landmark Systems, and a range of petroleum companies (Chevron, ExxonMobil, Midland Valley).

Cooperative research activities have been undertaken with personnel from the Utah Water Research Lab, USU Ecology Center, USU departments of Plants, Soils & Climate, Civil & Environmental Engineering, and Watershed Sciences; and off campus with personnel from the University of Utah, University of Delaware, Indiana University, University of Colorado, Idaho State University, the U.S. Geological Survey, the Idaho Geological Survey, Stanford University, Peking University, BYU-Idaho, University of Cincinnati, Texas A&M University, University of Oregon, University of California, University of Michigan, University of New Mexico, University of Memphis, University of Southern California, New Mexico Tech, St Louis University, Glasgow University, Western Washington University, Harvard, and the University of Barcelona.

Graduate students have received funding from the United States Geological Survey, DOSECC (the United States scientific drilling consortium), ChevronTexaco, Utah Geological & Mineral Survey, Sigma Xi, Geological Society of America, the American Association of Petroleum Geologists, the Eccles Foundation, the Tobacco Root Geological Society, and the NW Federation of Gem and Mineral Societies.

Endowment funding within the department also contributes to graduate student support in the form of awards (e.g., the J.S. Williams Award), tuition coverage, travel funding for professional meetings and fieldwork, and support for completing and publishing their research. The growth of this funding is the direct result of graduate alumni contributions, as well as matching funds from employers and contributions from the petroleum industry.

Other support (direct funding, equipment, supplies, research specimens, technical data, etc.) has been provided by industries such as Chevron Overseas Production and LandMark Systems, who have funded a 3D geophysical workstation worth $669,000 to support research in basin analysis and sedimentary systems, and by Midland Valley Inc., who have provided structural modeling software (2D Move, 3D Move). Further donations from private foundations (Browning, Jones Foundations) has led to significant equipement purchases, including a Panalytical (Philips) X-ray diffraction spectrometer, portable research grade GPS stations, two instruments for the Optical Luminescence Geochronology Laboratory, and two field vehicles (Chevy Suburban and GMC Yukon XL).

Research Productivity

Research productivity is generally good despite changes in faculty over the last three years. Total publications in journals and refereed book chapters range from 13-22 per year, and average about two publications per FTE faculty each year over the last four years (Table C5).

Table C5. Publications Per Calendar Year 2003-2006

Calendar Year	2003	2004	2005	2006	2007	2008
Publications	13	14	22	16	13	15
Books			2			1
Maps-Tech Reports	2	2	6	7	2	2
Abstracts	29	48	46	23	39	36
Publication/FTE	1.7	1.7	2.7	1.9	1.6	1.8

In addition, faculty have edited three books and published a total of 15 geologic maps and six technical reports over that time period – an average of about 3.5 map-reports each year. It should be noted that geologic maps require extensive independent field review by the publishing agency, and are subject to editorial oversight prior to publication, similar to peer-reviewed publications. Geologic maps form the basis for later analysis in refereed journal articles and as such are critical to much of what geoscientists do – they are the “databases” we mine for geologic insight.

Another measure of faculty productivity is the number of abstracts published each year in association with professional meetings and conferences (Table C5). Over the last four years Geology faculty have averaged almost 4.5 abstracts per faculty FTE per year. This number reflects robust collaborative research efforts and student contributions, as well as presentations by the participating faculty. It demonstrates a high level of research activity that bodes well for future publication productivity.

While the productivity recorded above is considered acceptable in the geosciences, in order to achieve national recognition we will need to do better than we have in the past. In particular, much of this productivity results from a few especially productive faculty. This is due in part to new faculty who are just ramping up their publication productivity and in part to older faculty who contribute largely in teaching and service. To significantly improve our productivity, we will need to engage both groups in increasing their scholarly output. We plan to achieve this by closer mentoring of junior faculty and by collaborative engagement of the older faculty.

C3. Extension And Community Service

The Department of Geology offers introductory courses on a regular basis through the University's Life Span Learning Class Division at Moab, Roosevelt/Vernal, Tooele, and Brigham City. A list of qualified instructors (having as a minimum an MS in Geology) is maintained to provide quality instruction at each of these locations. Other University Extension activities include offering Geo 1010 and Geo 3200 through the "Independent Study" program.

Professional Service: Geology faculty regularly review grant proposals for NSF and other agencies, review manuscripts for professional journals, and write book reviews. Faculty regularly participate in regional, national, and international meetings of professional societies as session chairs, conveners of symposia, keynote speakers and field trip leaders. Specific faculty membership in professional organizations are included in the faculty vitae.

Community service is defined as the department's response to the needs of the community. In a broader context, it gives the department the opportunity to educate the general public on the role of the geologist in responding to the needs of society and the science of geology. The department has a designated community service coordinator who responds to requests for information, presentations, loan of materials, and other forms of assistance. The coordinator then schedules appropriate faculty or grad students to respond to these requests. The department also participates in the Community Emergency Response Team (CERT) and gives lectures on earthquake hazards and other topics of interest to the general public.

The single most important departmental outreach activity has been "Rock and Fossil Day," a pubic open house in the Geology Building. In addition to permanent displays, faculty and students set up various hands-on activities throughout the building, such as an identification area, rocks in thin section, "rock" videos, and fault and earthquake information. Other agencies and organizations are also invited to participate, such as the Utah Museum of Natural History, the Utah Geological Survey, the Mineral Collectors of Utah, and local well-known mineral and fossil collectors.

The department has provided lectures, field trips, displays, and study materials to a variety of groups in northern Utah and southern Idaho. These groups include public schools, Scouts, church groups, Cache Geological & Archaeological Society, Audubon Society, League of Women Voters, Rotary Club, Cache Valley Historical Society, Mineral Collectors of Utah, the Golden Spike Gem & Mineral Society, and the Cache Valley Nature Center. The department has provided specimens and identified samples for the Cache Valley Nature Center, the Utah Geological Association, and a number of schools in the valley.

The department makes the following items available for use in the classroom: a slide presentation on the geology of Utah; labeled sets of rocks, minerals, and fossils; an assortment of mounted charts and topographic and geologic maps; stream tables and groundwater models; and an assortment of videos and photographic slide sets. Materials available for teachers are presented on a web page linked via the Geology home page.

C4. Analysis and Assessment

Faculty Teaching Quality: As winners of the first USU *Award for Department Teaching Excellence*, the Department of Geology is committed to quality teaching from all of our faculty. This commitment is reinforced by our consistently high departmental averages in Student Course Evaluations in the College of Science, and by the Geological Society of America's *Biggs Earth Science Teaching Award*, won by Joel Pederson in 2005 – the most prestigious national teaching award in geoscience. We continue to address quality teaching through our peer-review process and through our on-going assessment efforts already discussed.

Faculty Recruitment and Retention: Faculty recruitment and retention is a significant issue for all units at USU. We recently lost an outstanding junior faculty member to another university because of the poor financial climate at USU, lack of significant pay increases, and limited opportunities for graduate recruitment before our PhD program was approved. Much of this is outside the control of an individual department. We now have a range of graduate and undergraduate programs that allow us to maximize the potential of all our faculty, but we are limited in our response to salary issues by the state legislature.

Salary Equity: The department has been very successful in hiring research-oriented faculty, but in the process of paying competitive salaries, the salary differential between the assistant, associate, and full professor ranks within the department has been compressed. This compression is verified by a number of standard surveys of geoscience and geology department salaries across the country. This cannot be addressed solely at the department level because a small department lacks the resources to attack it aggressively.

USU salaries for assistant professors are reasonably competitive, but salaries for associate professors are below average and full professors are considerably below average. The issue of salary equity has been an on-going concern campus-wide in recent years and will continue to grow. This situation is exacerbated by the recent economic downturn.

Resources For Faculty Development: Although the department has limited financial resources for faculty development, faculty requests for professional meeting registration, field trips, and short courses are funded near the 100% level. Initial support comes from the department and if additional support is needed, from the College of Science and/or the Vice President for Research. We also receive significant support from the College and the Vice President for Research for start-up funds for new faculty.

The University has a competitive starter grant program for new faculty with grants on the order of $15,000, including 1-month summer salary. Faculty are limited to one award which must be received within the first two years of employment. Faculty are encouraged to use these grants to develop research programs and to then compete for outside funds to maintain these programs and support graduate-student M.S. thesis research.

C5. Challenges and Recommendations

The challenges facing faculty today are greater than they have ever been since the expansion of state-funded universities after World War II. These challenges relate in part to conditions that are outside the control of faculty and have major impacts on the state-funded university system. These include relatively flat enrollments in the recent past and projected future, a growing proportion of the high school population that come from minority groups that do not traditionally attend college, the collapse of the Federal government as a reliable funding source in response to ballooning war debts and runaway tax cuts, and the reluctance of our State legislature to fund higher education at levels consistent with our needs. This situation is exacerbated by the recent economic collapse.

Demographic trends predicting flat enrollments and the increase in high school graduates who might not attend college is a challenge for all units in the university, but is particularly acute for small specialized programs like Geology and Earth Science. We must respond to these trends with proactive recruiting models that address both secondary education (the high school population) and the community college transfer population; we can no longer sit back and wait for the students to come to us, we must go to them. This will require concerted outreach efforts at both the college and department levels.

Funding challenges are especially acute for faculty. Federal funding agencies in the Earth Sciences have seen little or no real growth in funding over the last five years, making it increasingly difficult for faculty to obtain the funding needed to finance robust research programs, support students, and motivate productivity. The situation is especially dire for untenured faculty trying to establish their research credentials. This crisis is not likely to go away until the defense funding situation becomes more stable and funding for science is expanded. The current economic crisis may result in short term funding increases, but long term stability will require a significant shift in Federal tax philosophy. Until it does, we foresee an impact of negative tenure decisions and increased turnover in junior faculty.

Despite this challenge, we will be looking to faculty to increase their research funding by submitting more proposals that target critical needs and have enhanced probabilities for funding. Faculty will also need to persist in the face of declining funding rates and continue to submit proposals that address important scientific problems in innovative ways.

Recommendations and Goals

Research Funding: Our fundamental long-range goal is to increase research funding to levels of about $100,000 per year per full-time faculty member. This increase in funding level is needed to enhance productivity and support our growing graduate program. In order to be competitive at this level, our department must make provision for systematic improvements in research facilities and in upgrading or replacing research equipment.

This will be possible only if the Federal funding for the sciences improves. We will also need to look more closely at funding opportunities with private foundations such as the Petroleum Research Fund and international organizations such as the International Continental Drilling Program that target research in specific arenas and are outside the Federal budget realm.

Endowment Funding: Our fundamental goal here is to sustain or increase the level of private funding to our endowment accounts to support graduate and undergraduate students, equipment purchases, and other department priorities. The main focus of this effort will be on the Legacy Endowment (which has greater flexibility) but all endowments are targeted for growth up to certain levels. Our Geology Advisory Board is already working to achieve these goals.

Laboratory Technician: There is need for a Geology technician. At present, equipment maintenance, instruction on use of equipment, and equipment/instrument supervision are carried out by one or two faculty. Demands by remaining faculty, graduate students in Geology, and others in the university who use department facilities are sufficient to have a serious impact on faculty time.

Research Faculty: We also need to recruit and retain research faculty who can support themselves, and who will contribute to the depth and breadth of departmental expertise. These research faculty will be a significant resource for graduate and undergraduate students, and could, when needed, teach courses within the department. They will, however, need space for offices and research labs – space that we not have at present, due to the allocation of significant space in the Geology building to Biology, Math, and Radiation Safety.

Critical Mass: A limiting factor in the development of faculty research programs within this department continues to be the small number of faculty. Each faculty member is a specialist in a particular sub-discipline of geology as required to meet the needs of the curriculum. Consequently some faculty may not have the opportunity to interact and exchange ideas with colleagues having similar research interests on a day-to-day basis. Our strongest “critical mass” areas are in tectonics (structure/sedimentation/petrology) and sedimentary processes.

In addition, we do not have enough faculty in some critical major disciplines (e.g., geophysics, mineralogy/petrology) to cover core curriculum requirements. This overloads faculty in some

areas with core courses, and makes it difficult for them to offer graduate-level courses. It also sharply limits the attractiveness of the department to graduate students in these disciplines.

One solution to this problem that we are pursuing is the recruitment of soft-money research faculty who can support themselves and lend both breadth and depth to our research and instructional programs. When possible, we would provide additional support to these faculty through part-time teaching assignments, paid for with funds for the instructor's slot. We consider this to be one of our highest priorities, given the low likelihood of significant expansion in tenure-track positions within the department or the college.

Fully-Funded Staff Assistant: The department also recently hired a new staff assistant 0.75 FTE to assist in the main office. This position is currently unfunded; that is, we do not have permanent funds in our E&G personnel budget to cover this position – it is funded totally with operating budget funds. We consider it essential to faculty productivity in both teaching and research to fund this position permanently on a full time basis.

New Faculty Positions: Our basic long term goal is to build our baseline faculty to 12 FTE positions. This will provide the breadth we need to address curriculum needs at both the undergraduate and graduate levels, as well as some of the depth needed for our graduate program, particularily the PhD program. New faculty are especially needed to meet existing requirements in core geology courses and in areas where we have no current faculty. We recently added a new faculty hire (Rittenour) but have lost another position, for no net gain.

Regional Campus Positions: One area where we can see potential growth of department faculty is within the Regional Campus system. These faculty will now be part of the department on the Logan campus and we are committed to integrating them into the teaching and research mission of the department. This could include collaborative research efforts, remote course offerings delivered both to and from the regional campuses, and team taught classes that involve joint field experiences for the students. Toward this end, the Geology Department has partnered with Distance Education to convert a classroom in the Geology Building into a fully-mediated distance education classroom capabable of both synchronous and asynchronous teaching modes.

The *Uintah Basin Energy Entrepenuership and Research Center (UBEERC)* initiative represents our best opportunity to achieve this type of faculty integration in the near term. The UBEERC is a collaborative effort between the VP Research office and the Uintah Basin Regional Campus that seeks to create a multi-disciplinary research center on energy-related issues that enhances the educational mission of the Uintah Basin Regional Campus. Geology is already involved in the planning of this center and we expect to be well-represented in the final product.

Endowed Chair positions: One way to attract high-level research-oriented faculty is with endowed chair positions. These endowments provide incentive for faculty to locate at USU and build active, externally funded research programs. We are currently working towards securing sufficient endowment funds to support two chairs with funds for summer salary, research assistants, and travel. These chairs will be limited term, renewable positions to insure continued research productivity during the tenure of the occupant. We also hope to leverage chair funding for new faculty lines within the department.

D. SUPPORT SERVICES

D1. Department Administration: Staff, Budget, and Facilities

Staff

The Department of Geology currently employs one full-time staff member at the Administrator's Assistant level, who is responsible for managing the office and part-time office staff, student assistants, and student technicians, maintaining and updating personnel records and payroll through the Banner system, reconciling and managing all department financial accounts (including E&G, development, indirect cost return, and externally-funded grants), and maintaining all student records. The Administrators Assistant is assisted by a single 0.75 FTE staff assistant, and by a variety of student assistants (when available). The part-time staff assistant is responsible for travel, mail, and general reception duties.

We recently funded a part-time computer support technician at 10 hours per month. As the size and complexity of our computer network grows (especially with the addition of geophysical computing systems) we will need to grow this position accordingly.

Budgets

Department budgets are broken down into two major categories: Personnel Services and Operating (Table D1). This does not include fringe benefits, which are accounted separately and added into our personnel budget as salary is paid. The recent uptick in our personnel budget reflects the return of a former Dean to our department.

Table D1. Geology Department E&G Budget Lines, FY2004 through FY2008

Department of Geology Budget	FY2004	FY2005	FY2006	FY2007	FY2008
Personnel services	$607,809	$628,291	$643,709	$668,309	$777,782
Operating	$35,300	$41,300	$41,300	$41,300	$41,300
Total E&G Budget	$643,109	$669,591	$685,009	$709,609	$819,082

Most operating funds are consumed by telephone services, duplicating, and office supplies. Class fees are assessed for most Geology courses having scheduled labs or field trips to cover the cost of motor pool vehicles and replacement costs for consumables (rocks, minerals, thin- section materials, hand-outs, lab kits, etc.). Unfortunately, class fees have risen significantly over the last five years as operating budgets remained flat or (for several years) were reduced by up to half in response to university budget shortfalls.

In order to counter this effect, we have made a concerted effort over the last several years to enhance program support through the development process. This support comes from three principal venues: corporate support (especially petroleum companies that recruit at USU), alumni support (including matching funds for alumni donations from corporate employers), and foundation support (which has funded many of our recent equipment purchases). The corporate and alumni donations fund scholarships for graduate and undergraduate students, our distinguished lecture series, field trips, student travel to professional meetings, and even field

expenses for some student projects. This private support was critical to our program when operating budgets were slashed a few years ago; it now allows us to significantly enhance both our educational and research mission.

Facilities

Instructional And Office Space: The department has enjoyed much improved instructional and office space since moving into the Geology Building in July of 1989. Each tenure-track faculty member has an office/research area of sufficient size for a computer workstation, drafting table, and/or microscope table. Three dedicated teaching labs are used for most Geology course lecture and lab sections (if enrollments are under 24). Courses with larger enrollments must utilize rooms from the university classroom pool, such as BNR auditorium, TSC auditorium, Widtsoe lecture hall, and Geol 301 (Biology lab). Two of the three teaching labs have large preparation areas next to them for storage of geologic specimens and other teaching materials. A number of research labs exist for special- function teaching such as the sediments lab, X-ray lab, sample-preparation lab, and thin section lab.

Teaching facilities in the Geology building vary greatly in quality. Geo 217A has been converted to a fully-mediated distance education classroom. The pool lecture hall Geo 105 has been partially equipped with digital enhancements (computer video projector, DVD, VCR). We have added similar capabilities to one of our small lecture-lab rooms (Geo 102) using a variety of departmental funds. Similar upgrades are needed in other rooms.

Laboratory and Equipment Resources: Laboratory equipment for research and teaching covers the spectrum of quality and quantity. There are at least three generations of petrographic microscopes in use and two generations of binocular microscopes. Major analytical equipment consists of an X-ray diffraction system, an X-ray fluorescence system, and the Optically Stimulated Luminescence laboratory, located on the Innovation Campus.

The X-ray fluorescence unit is a Philips 2400 spectrometer purchased by the department head in 1998 for $180,000 and brought to USU as part of his startup. This instrument is capable of rapid and accurate analysis of major and trace elements in rocks, soils, and other materials with minimal operator effort.

A new Panalytical X-ray diffraction spectrometer was purchased in 2003 with a major gift from the Val D. Browning Foundation ($40,000) and matching funds from the Department of Geology, the College of Science, and the VP Research. This instrument is equipped for fully automated scanning of mineral or other solid samples, and is linked to a computer system for automated peak matching and identification, mineral identification and characterization.

The USU Optically Stimulated Luminescence Geochronology Laboratory was funded by two major gifts from the Val D. Browning Foundation (total $240,000), and matching funds from VP Research, and the NSF-Instrumentation and Facilities program. This laboratory has recently been constructed by Associate Professor Joel Pederson and Assistant Professor Dr. Tammy Rittenour at the USU Innovation Campus because suitable lab space is not available within the Geology Building. This instrument is capable of dating multi-grain or single grain quartz sand samples to determine their age of burial, up to circa 400,000 years old. This fills an important gap between

Carbon dating (circa 45,000 years max) and Ar-Ar dating (very imprecise at less than 500,000 years). This is one of only six similar labs in the United States, making Utah State a leader in this exciting new technology.

Our new Geophysics hire, Tony Lowry, has purchased four research grade (mm precision) GPS receivers and electrical-resistivity imaging equipment that can be used for both research and teaching. In addition, we have recently received another major gift from the Browning Foundation that will be used to purchase ground-based LIDAR imaging equipment and systems for computer-assisted field mapping. Other research equipment housed within the department includes:

1) Two new (2008) four-wheel drive field vehicles: a Chevy Suburban and a GMC Yukon XL.
2) USU Optically Stimulated Luminescence Geochronology Laboratory.
3) GIS Computer Laboratory, comprising five PC workstations with Arc Info and other GIS software, a digitizing table, and scanners.
4) Two Zeiss research petrographic microscopes with analog and digital photography, plus five other research petrographic microscopes and sixteen student petrographic microscopes. The Zeiss research microscopes cost $40,000 each.
5) Two Total Surveying workstations ($7,000 each) for creating 3D digital maps of terrane and geology.
6) Six portable Research Grade (mm-precision) GPS receivers.
7) Two Met3 sensors for measurement of atmospheric pressure, temperature and humidity.
8) Giddings mobile drill rig with utility trailer, for drilling water test wells, soil sampling, and rock coring to depths of 800 feet ($27,000).
9) General-purpose computer resources, including computers, flatbed scanners, slide scanners, color and monochrome laser printers, that are available for student use, and a 42” wide HP plotter for large format printing.
10) Complete sample preparation facilities for rocks and soils, including thin section and probe mount facilities, hand-portable rock coring drill and bits, a drill press for coring rocks, and diamond-tipped drill bits.
11) Extensive collection of rock and mineral samples from around the world. The teaching collection includes hundreds of donated mineral specimens, which vary from museum quality display samples to mini-mounts of rare and exotic minerals. It also contains comprehensive suites of rock samples, including drill core from the famed Stillwater complex donated by the mining company.
12) Extensive collections of fossils, primarily marine invertebrates and terrestrial vertebrates.

D2. Analysis and Assessment

Our most important immediate goal is to retain faculty positions and to replace retiring faculty strategically to reflect changing research goals in earth science. A secondary goal is to obtain funds for office and technical support staff. The work load generated by our department is clearly too much for a single office staff person, which is all we currently have salary funding for (other staff are paid from operating funds).

A department of our size and complexity needs two full time office staff to maintain department records and assist the faculty with their teaching and research missions. Compared to other departments in the College we are woefully understaffed. This problem has been exacerbated by the conversion to Banner, which has nearly doubled the time needed to deal with simple financial and personnel transactions. In effect, doubling our current office staff will return the department to the level of support we had in 2004, before the Banner conversion.

We also need to permanently fund a Laboratory Technician to support both our teaching and research missions. This position will become critical as we gain more analytical equipment. Some faculty have accrued sufficient research funds to support some personnel (OSL lab) but the need for a department level technician remains.

Earth and Environmental Science Geochemistry Laboratory: One of our long-term goals for Facilities and Resources is the establishment of an *Earth and Environmental Science Geochemistry Laboratory*, to be housed in the Geology Building. This lab will encompass a new low-vacuum SEM with digital EDS analytical system and an ICP-MS with 213 nm laser ablation device, as well as the existing XRF and XRD spectrometer.

This lab is envisioned as an inter-disciplinary facility that will service analytical needs in Geology, Soils, Chemistry, Biology, Engineering, and Natural Resources. It is hoped that most of the funds for equipping this lab and for hiring additional technical support will come from proposals submitted to NSF and other Federal agencies. Our plan is for this facility to become an umbrella for fluid ad hoc linkages between researchers in different areas of expertise, and an incubator for inter-disciplinary studies in earth sciences, soils, and environmental geochemistry.

D3. Challenges and Recommendations

The Department of Geology faces three major challenges in the coming years: staff support, space and equipment.

New Faculty Positions: The Geology Department has lost one faculty to retirement in 2006 and will lose another this year. Over that time we added one new faculty position – a net gain of zero. We need especially to replace faculty in key curriculum areas to maintain programmatic balance and to strengthen the research mission of the department.

Staff Support: The staffing problems have been discussed earlier and can be summarized here with a simple list. The department needs to expand its office staff to at least two full-time employees: one administrator's assistant (in place) and one staff III or IV assistant (now 0.75 FTE). This will allow the admin assistant to focus on budget management while the staff III-IV deals with travel, payroll, and managing student helpers. The Department also needs a full-time

technician to manage the teaching and research labs, and maintain the research equipment. This position will become critical if new analytical equipment is acquired, as discussed below. Finally, the Department needs a 25% to 50% time computer systems manager to deal with our growing computer network.

Space: A second long term goal is to gain administrative authority over all space in the Geology Building, as personnel from Biology and Math, and the radiation safety office, are moved elsewhere, and as laboratory and classroom facilities are transferred to Geology. Without administrative authority over this space, we have no room into which our program can grow, and we will have difficulties even if our program remains the same size.

Finding new space for Math-Stat and Biology will ultimately solve the space issue. Math-Stat has three faculty and seven lecturers housed in five rooms in the Geology building, and has control over six classrooms as well. Biology also controls one classroom. The lack of suitable lab space in the Geology Building forced us to locate the OSL Geochronology Lab on the Innovation campus, where we must pay for space rental as well as phones and data lines. Ideally, this facility should be located on campus where it would be more accessible to students and other faculty.

Space Utilization and Renovation: We need to renovate space in the geology building so that it is more suited to our current needs, and to utilize space we have that is not being used optimally at this time. Our research and laboratory needs have changed greatly in the last 10 years and the current configuration of our building does not reflect those needs. Much of this can be done with existing funds or with small amounts of renovation funds.

Equipment: Although we have had considerable success with foundation funding for equipment over the last four years, some of the analytical equipment we need to build a credible program will cost more than we can expect to raise privately. This means that department faculty will need to take the lead in preparing equipment proposals to NSF for these needs. Some of this equipment has applications outside of geology and the earth sciences, so it will be a resource for the entire campus.

Preparation and submission of integrated equipment proposals to purchase an analytical SEM with digital EDS and an ICP-MS with 213 nm laser ablation device need to be priorities for both the department and the university. This equipment will form the core of a proposed Earth and Environmental Science Geochemistry Laboratory. Department faculty have submitted an equipment proposal to NSF for an SEM with EDS that is currently under review.

The *Uintah Basin Energy Entrepenuership and Research Center (UBEERC)* initiative represents a significant opportunity for us to expand our programs into the Uintah Basin. The Geology Department needs to remain involved in the planning process for this center, and position ourselves to take maximum advantage of the center when it is complete.

Core Laboratory: Several of our faculty our becoming involved in work on scientific drill core. We have a small core laboratory that is now located in the Art Barn which may soon move to the Animal Science building. Creating a viable and well-equipped core lab will significantly enhance our ability to fund scientific drilling projects.