DEPARTMENT OF GEOSCIENCE
UNIVERSITY OF WISCONSIN-MADISON
FIVE YEAR STRATEGIC PLAN
2013-2018

FACULTY

BRAD SINGER, CHAIR

JEAN BAHR
PHIL BROWN
MIKE CARDIFF
ANDERS CARLSON
ALAN CARROLL
CHUCK DE METS
KURT FEIGL
DANA GEARY
LAUREL GOODWIN
CLARK JOHNSON

CLAY KELLY
STEVE MEYERS
SHANAN PETERS
ERIC RODEN
CLIFF THURBER
BASIL TIKOFF
HAROLD TOBIN
JOHN VALLEY
HERB WANG
HUIFANG XU

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EXECUTIVE SUMMARY

The Department of Geoscience is among the world’s leaders in research and education. Our research programs are both broad and deep in traditional areas of sedimentary geology, hydrogeology, geophysics, mineralogy, petrology, geochemistry, structural geology, and surface processes. While our graduate program has trained generations of leaders in academia and industry, we are also highly committed to educating undergraduate majors and non-science students alike. Moreover, the Department plays a unique role on campus through strong connections to other programs including, for example, participation in the Nelson Institute for Environmental Studies and close collaboration with the College of Engineering to jointly train future geological engineers. In parallel to research on societal problems including climate change, geohazards, the environment, and natural resources, our faculty pursue frontier studies focused on big questions such as the origin of life in the solar system, geologic triggers for global biotic changes, and the deep-seated processes that drive earthquakes and volcanic eruptions.

In order for our nation to secure its energy and other natural resources, to understand threats to its water and environment, and to prepare for hazards posed by earthquakes, volcanism, floods, tsunamis, and global climate change, it is imperative as never before that we produce a population that is both Geoscience literate and which contains a highly educated Geoscience workforce. Recent estimates by the American Geological Institute, Washington D.C., and the American Association of Petroleum Geologists indicate that the current pipeline of Geoscience students is woefully undersized to meet growing demand in the energy and mining industries, the hydrogeology and environmental geology industries, the geological engineering of roads, dams, power plants, and buildings, and in governmental agencies that assess natural hazards. Yet — we face a major challenge in that the demand for professional Geoscientists is expanding far more rapidly than in other fields, precisely at a time when public funding of our University and Department is shrinking dramatically.

Goal

• We aim to improve our stature as a premier program in Geoscience research and education and thus lead the way toward meeting the burgeoning demand for a highly educated Geoscience workforce.

Challenges

Interdisciplinary research that bridges physical, chemical, biological, and environmental approaches to Earth processes offers the greatest potential for discoveries that will impact our science and society at large. During the past decade the hiring of new faculty in geophysics, sedimentary geology, structural geology, geochemistry, and surface processes has led to many highly successful collaborations and synergies across disciplines. However, recent and imminent departures of faculty now threaten this success. To meet our goal we must:

• Re-build and strengthen our core research areas through the hiring of new faculty in the face of a reduced state budget.

• Provide undergraduate and graduate students with the experience, tools, and insight they must have to become future leaders in fulfilling the country’s critical needs. This will require new resources to support graduate teaching and research assistants.

• Invest Departmental resources in new ways to sustain our world-class research infrastructure, including technical support for laboratories and computational facilities.

Meeting our goal will require that the Department engage its Board of Visitors, target support from alumni toward our most critical needs, and work closely with the College of Letters & Science administration to raise awareness of, and support for, these initiatives.
INTRODUCTION

Mission
The mission of the Department of Geoscience is to research and disseminate information on the structure, chemistry, physics, and evolution of the Earth; life on Earth and in the solar system; and the interaction between physical, chemical, and biological processes that shape the Earth. We strive for breadth and excellence in our coverage of the sub-disciplines within geoscience and in the creation, integration, application, and transfer of knowledge in these fields. We aim to be at the forefront of scientific research, to reach a broad audience from students to specialists, and to provide knowledge and training that is most useful to meet societal needs.

Need for a strategic plan
The Department of Geoscience currently comprises 15 Professors, 3 Associate Professors, 2 Assistant Professors, 1 Associate Research Professor, and 6 Research Scientists. There are also 6 technical support staff, 23 postdocs, and 64 graduate students. The number of undergraduate majors in Geoscience has more than doubled in the past three years to 91 students and continues to climb. This year we have more than 60 students enrolled in our major courses and predict 50-60 graduates per year by 2014. Following a 2009 Departmental self-study, in the Spring of 2010 we received the report of the College of Letters and Science Ad Hoc committee charged with reviewing the Department of Geoscience. The recommendations of this review committee had two main thrusts: one is that the Department would benefit by enhancing the communication and engagement among all students, faculty, and staff. Many initiatives, including some outlined in this document, are now underway to address this issue. The second issue raised was that faculty recruitment, inter-departmental collaboration, and the use of gift funds would greatly benefit from a clearly articulated strategic plan. Given the dramatic contraction of the University’s budget during 2011-12, we are at even greater risk of losing faculty – the recent departure of one faculty member, and the announced departure of another, both highly productive researchers – only increases the need for a strategic plan. In light of these issues, the five-year plan outlined here focuses on an aspiration to improve upon our stature as a leader in Geoscience research and education.

The hiring of new faculty is critical to maintaining the strength of our intellectual resources and creating an environment that fosters new interdisciplinary collaborations and excellence. In addition to new faculty, initiatives to diversify and increase support for our academic research staff and infrastructure, improve the graduate program, provide the most effective undergraduate program possible, and enhance our broader impacts and outreach are also high priorities. Funding will come from two sources: (1) The College of Letters and Science, and (2) Gifts to the Department either directly or through the UW-Foundation. The latter will require focused campaigns with input and leadership to be coordinated jointly by the Department’s recently-formed Alumni Relations and Development committee and its Board of Visitors.

TOWARD THE FOREFRONT OF GEOSCIENCE RESEARCH

The Department of Geoscience at UW-Madison is a national and international leader in both scientific research and education. For example, the 2010 National Research Council assessment of 140 doctoral programs ranks the Department 18th based on faculty survey results, and 13th in Research Activity. Moreover, in 2010 US News and World Report ranked our graduate program 13th of more than 120 Earth Science PhD programs in the US, and 8th in the sub-disciplines of Geology and Geochemistry. These rankings reflect the excellence of our faculty and their
ongoing commitment to strengthening traditional core areas of research, while at the same time developing and nurturing leadership in emerging sub-disciplines including, for example, satellite geodesy, biogeochemistry, and cyber-geoinformatics. Below, we outline priorities aimed at strengthening research in these fields and our program at large.

We envision the intellectual discipline of geoscience as a dynamic tetrahedron (Figure below). Its volume includes the Earth system as a whole. Its six edges connect the four vertices: the rock record, the solid Earth, the fluid Earth, and the living Earth. We believe that maintaining excellence in each of these four areas, both within our department and through our relationships to other units on campus, is critical to both our core mission and to providing significant new insights about the Earth and our place in it. By focusing our intellectual and infrastructure resources on exploring these connections, the Department will position itself among the upper echelon of Geoscience programs.

The Department has exceptionally strong, highly visible programs in the broad fields of geochemistry and geophysics. However our programs in these two areas are relatively small compared to more highly ranked peer institutions. We aim to expand upon our strengths in these areas and place the Department among the most elite in the country through the hiring of new faculty in frontier fields of geochemistry and geophysics. This will promote the greatest level of new synergies among faculty and graduate students and foster a new generation of inter-departmental collaborations. In parallel, the Department faces the imminent departure of our only faculty member focused on the behavior of Earth’s cryosphere, recent climatic changes, and modern surface processes.

**Programmatic Priorities**

- **Pursue frontier research in Earth Surface Processes.** The interaction of water and ice with rocks is strongly modulated by global climate change and tectonics and with the departure of Associate Professor Carlson (January, 2013) we will lack expertise in this critical field of research. Indeed, the NRC 2011 report places a very high priority on the future study of interactions among: (1) climate, surface processes, tectonics, and deep earth processes, and (2) the co-evolution of life, environment, and climate. The Department will seek to hire a new faculty member to pursue research and teaching that address this priority. In addition to inter-departmental synergies, there are many potential linkages to campus programs in Atmospheric and Ocean Sciences, Geography, Soil Science, and the Center for Climate Research in the Nelson Institute for Environmental Studies.

- **Pursue frontier Geochemistry research.** We aim to do this through hiring a faculty member in geochemistry to replace Professor Sahai who left in 2011. Geochemistry is at the center of a wide range of research areas, from mineralogy to geomicrobiology. The Department has strengths in high-temperature geochemistry, isotope geochemistry, mineralogy, and petrology,
but it is under-represented in low-temperature geochemistry. The Department failed in our bid to retain Sahai, a senior faculty member and leader in low-temperature geochemistry. This is an area identified by the National Research Council (NRC) as critical to the geosciences; its 2011 report on Research Opportunities in the Earth Sciences (NRC 2011) highlights biogeochemical and water cycles in terrestrial environments and the co-evolution of life, environment, and climate as key areas where breakthroughs will have potentially large impacts. This area enjoys a wide range of opportunities for funding, ranging from astrobiology to environmental studies.

- **Pursue frontier Geophysics research.** We plan to do this through hiring of a new faculty member in the field of geophysics. Increasingly, regional to global scale observations of the seismic velocity and electrical conductivity structure, as well as satellite geodesy provide unprecedented detail in imaging of lithosphere, mantle, and deep earth structure and processes. These observations, in concert with rapid advances in computational methods and capacity for realistic three-dimensional simulations of mantle processes, are fueling a renaissance in geodynamic studies identified by the NRC and NSF as a high-priority emerging research opportunity. The addition of a faculty member in geodynamics or computational geophysics would complement the Department’s current focus on crustal and upper mantle deformation using seismology and space geodesy. A presence in this field would also complement currently active research among faculty in disciplines including: computational hydrogeology, geoinformatics, quantitative climate history, structural geology and astrobiology. The potential for additional collaborations and synergies is very high.

**Bolstering Research Infrastructure**

The Department has strong research programs that require continual investment into technical support and instrumentation. For example, we rank #8 nationally in geochemistry and have seven mass spectrometers in four laboratories (including the WiscSIMS national ion probe facility), as well as vibrant geomicrobiology, mineralogy, and geochronology laboratories. Each laboratory houses complex equipment that requires dedicated technical support by Research Scientists. Moreover, programs in satellite geodesy and seismology require engineering support for field deployments, telecommunications, and computation. Newer initiatives in cyber-geoinformatics and computational hydrogeology are taxing Departmental staff dedicated to information technology and computation. Currently, support for Research Scientists, and for Instrumentation and Information Technologists comes from a mixture of Departmental funds, extramural grant funds, and gifts. Cuts to the Department budget mean we must depend increasingly on gift funds and extramural grant funds to support these critical staff positions.

**Priorities**

- We will evaluate our technical and academic staff needs carefully and take advantage of new flexibilities in the use of the College funds. The aim is to invest a larger proportion of Departmental resources into the staff that directly support infrastructure that is vital to meeting our research and graduate education goals.
- We must raise and use gift funds in new ways to leverage additional College support for Department-wide computer and engineering support staff.

**Enhance the role of our Geology Library**

The C. K. Leith Library comprises one of the most comprehensive collections of Geoscience reference materials in the U.S. The Library provides resources and support that are vital, not
only to the Department’s research mission, but also to researchers in State government throughout Wisconsin, and the United States. The Library also plays a prominent role in our teaching and outreach efforts. It does this by acquiring and maintaining physical and electronic collections, providing library reference and research services, and assisting with specific Departmental projects. The Library additionally provides an important space for communal interaction and group collaboration.

**Priorities**

It is essential that the Library continues to chart a cutting-edge approach in support of our research, while further enhancing its role in teaching and outreach. This will require that we address the following priorities:

- Maintain access to print while increasing access to electronic collections.
- Enhance teaching in the geosciences and information literacy for both undergraduate and graduate students through library instruction and reference services.
- Augment outreach efforts to alumni and the public. Among these efforts is to further the digitization of important regional and University resources in collaboration with the Wisconsin Geological and Natural History Survey and UW Digital Collections.
- Work with interested parties to advance preservation of geoscience data and physical specimens such as fossils, rocks, and cores.
- Develop additional financial support for collections and library initiatives through the UW Foundation and other sources.

**Enhance Graduate Student and Post-doctoral Opportunities for Excellence**

To meet our goal, the Department will steer back toward a greater emphasis on the PhD program. To this end, we have recently taken several concrete steps to remove perceived impediments to completion of the doctorate while enhancing the rigor of the process. We aim to increase the number of PhDs and decrease the time to PhD. In pursuit of these objectives, we have recently combined the Department’s two PhD programs (Geology & Geophysics) into one (Geoscience), and modified Departmental guidelines to clarify and emphasize the option to pursue the PhD degree with or without the intervening MS. We have agreed on a common set of milestone experiences for PhD students, including an Assessment exam for all, and streamlined the pathway to the PhD by permitting inclusion of MS work as part of the doctoral dissertation if graduate education was pursued continuously.

**Priorities**

- We will implement the streamlined pathway to the PhD over the next several years.
- We will establish metrics by which we can assess the success of these initiatives.
- Preference in admitting and offering support to new graduate students will be given to those whose likely objective is the doctorate.
- In turn, priority for Departmental support for graduate students as TAs or gift-funded RAs will be directed toward those faculty who demonstrate a capacity to provide future support for these students via extramural grants.
- To continue to attract the most talented students, we must raise new gift funds to offer more competitive stipends for RAs and TAs and multi-year support guarantees.
- We will investigate options to reach new demographics of potential students, including for example offering a professional MS degree in Geoscience.
**Engaging post-doctoral researchers**

The majority of faculty hired at research institutions now has extensive post-doctoral experiences, and this is becoming increasingly common for hires at four-year colleges and universities. Post-doctoral experience is now essential for many PhD positions in public and private research laboratories as well. It is therefore important that the Department participate in training this group of scientists. In recognition of the increasing importance of post-doctoral researchers, NSF and NASA have vigorous programs dedicated to funding post-doctoral fellows. Moreover, NSF now requires mentoring plans for post-doctoral scholars for regular program grants that request salary support for such researchers. A vibrant post-doctoral program is essential to the research mission of the department, and we have commonly found that these researchers add significant value to our undergraduate and graduate programs as well through mentoring.

**Priority**

- To continue to encourage and support a strong post-doctoral research program, to engage our post-doctoral researchers more fully in the livelihood of the Department, and to track their employment and career paths once they leave our program.

**Enhance Outreach Through the Geology Museum**

With an annual attendance of roughly 50,000 people, the Geology Museum is one of the top ten destinations for visitors to campus and it is by far the most popular attraction for K-12 classes. The Museum also maintains a vast collection of geological specimens that are utilized for teaching, outreach, and research in the Department.

Over the past decade, federal funding agencies including the NSF and NASA have increasingly encouraged scientists to include public education and outreach in their research. In many cases, a strong outreach component is necessary for a research proposal to be viable. Through its exhibits and educational programs, the Museum has proven to be an ideal vehicle for faculty, staff, and graduate students to engage the public with their research. By supporting the priorities of the Geology Museum outlined below, the Department will greatly strengthen its outreach and make more of our research accessible and meaningful to the citizens of Wisconsin.

**Priorities**

The Museum's overarching goals for the next five years are to lay the groundwork for a comprehensive renovation of its exhibit area, and to build on its successes with showcasing Departmental research. To ensure that these goals are met the Museum plans to:

- Upgrade key elements of its infrastructure. These efforts will focus on acquiring compact shelving for the new repository and modernizing the fossil preparation lab.
- Garner more support from the College so that the Museum is funded at a level commensurate with other museums on campus and at peer institutions.
- Grow an endowment with the assistance of the College and the UW Foundation to increase the financial stability of essential Museum operations.
- Create an outreach training program for faculty and graduate students.
**DELIVER A WORLD-CLASS UNDERGRADUATE EDUCATION**

The Department undertook in 2010-11 a major revision of its undergraduate curriculum and we are in the second full year of its implementation. The new curriculum provides our students with strong base through a “core” set of courses, while offering flexibility to pursue tracks in Geology, Geophysics and Engineering Geology, and Environmental Geoscience. An endowed Student Field Experience fund supports many field-based activities associated with these courses. The number of undergraduate majors has doubled between 2010 and 2012 to more than 90 students and continues to grow. While this is a strong indicator that careers in Geoscience are as attractive as ever, it also places enormous pressure on our ability to offer enough laboratory sections for several of our courses, as well as maintaining our traditionally strong field-based training. In the face of this pressure, we must strive to prepare our undergraduate majors for graduate study and successful careers as professional Geoscientists.

**Priorities**

- Work with the College of Letters and Science and the College of Engineering to increase the number of Teaching Assistants for our classes in mineralogy, petrology, and other high-demand courses.
- Develop metrics that will identify strengths and weaknesses of the new curriculum and ways that it might be improved.
- Establish procedures by which we can assess how students fare once they graduate.
- Maintain the high level of field-based training required by graduate schools and industry.
- Expose undergraduate students to the importance that philanthropy has played in creating for them a truly excellent Geoscience education.

**ENGAGING ALUMNI AND INDUSTRY PARTNERS IN FULFILLING OUR GOAL**

We have long enjoyed a productive relationship with our alumni. Perhaps more than ever, our alumni and industry partners are critical to the excellence of the Department by providing expertise, training, support, and career opportunities to our students. There has been a dramatic turn-over in faculty composition during the past decade. It is important that we engage our alumni by introducing them to the new faculty and to keep them abreast of exciting research and educational programs in a timely manner. Our Board of Visitors, the first on campus, plays a key role in this effort by providing information on career trends and spearheading fundraising activities. Strong, sustained support from the energy industry in the form of graduate student Research Assistantships, student field work, and funds for specific projects also help to provide the margin of excellence.

**Priorities**

We will strengthen relations with alumni by engaging them in new ways. To do this, the Department has created an Alumni Relations and Development Committee comprising the past Department Chairs.

- This Committee will work closely with the Department Chair and the Board of Visitors to raise awareness among our alumni of the Department’s priorities and to seek input as to how alumni support will best help us achieve our goal.
- We will highlight a set of ongoing activities for which targeted annual gifts offer an appropriate means of support. For example: the weekly Department lecture series, graduate student field support, undergraduate field camp scholarships, and sponsorship of the Outcrop alumni magazine might be supported through annual gifts.
• We will establish a quarterly electronic newsletter for alumni with updates on awards and new research, as well as providing a web-based means of giving to the Department.

**CONCLUSIONS**

This strategic plan prioritizes: (1) hiring faculty in three key areas of Geoscience research, (2) bolstering support for our research infrastructure, (3) enhancing the quality of our graduate program, (4) preparing a large number of undergraduate majors for graduate school or careers as professional Geoscientists, and (5) engaging alumni in new ways to help provide the necessary financial resources. As the next five years unfold, the Department’s faculty and staff will address these priorities with an eye on our main goal of leading in research and fulfilling critical national needs in the workforce. We appreciate that each priority is associated with challenges, not the least of which is the precipitous decline in state funding. Notwithstanding these challenges, improving our leadership position among premier Geoscience programs will propel the Department of Geoscience and the University of Wisconsin forward.

*The future Geoscience workforce learning through field experiences:*

![Geology 202 Undergraduate Introduction to Geologic Structures South Dakota, September 2011](image1)

![2012 Wasatch Uinta Summer Field Camp Utah](image2)

![Geology 370 Undergraduate Petrology Field Trip, Keewenaw Peninsula MI, April 2012](image3)