California State Polytechnic University
Geological Sciences Department Strategic Plan

Revised March, 2013

This plan is the product of a collaborative effort that incorporates input from Geology Department faculty, students and alumni

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Frontiers and Opportunities in the Geological Sciences

Geoscientists of the next decade will confront regional, national, and global issues related to strained water resources, natural hazards mitigation, shortages of mineral and energy resources, and site evaluations of infrastructure projects or housing tracts. Their endeavors must interface with the environmental challenge of maintaining quality of life while managing development in an increasingly populated world. The Geological Sciences Department produces graduates who understand the science behind active Earth processes and bring quantitative problem-solving skills to the table in an interdisciplinary work environment. They must effectively communicate with engineers, environmental scientists and planners/developers while educating the public about linkages between the solid Earth and its hydrosphere, atmosphere, and biosphere.

The bilingual abilities of many Cal Poly Pomona students offer prime opportunities to export geologic expertise and knowledge of environmental issues to Latin American and Pacific Rim countries. The number of geoscience jobs in industry will grow by 18% from 2008 to 2018, according to the U.S. Bureau of Labor Statistics. Retirement demographics indicate an increasing demand to fill jobs vacated by geologists hired in the 1970's. Particularly important emerging fields in developing countries include those related to water resources exploration and management or environmental challenges of preserving clean groundwater supplies and cleaning up contaminated groundwater sites. Other key growth areas in the Geosciences include: (1) natural hazard analysis and mitigation; e.g., earthquakes, landslides and floods, (2) exploration / development of metals, industrial minerals and energy resources, and (3) environmental quality and global climate change.

Mission Statement

The Geological Sciences Department aspires to provide the highest quality education in Earth Science and its applications. Through hands-on learning methods, faculty-mentored research, and exposure to current technology, students shall acquire skills applicable to careers in Earth Science and related disciplines. The Department's programs emphasize understanding of Earth system processes and their interrelationships, thereby providing students a global perspective needed for problem solving, decision making, and leadership roles in a rapidly-changing world confronted with environmental challenges.

Strategic Planning Template

The following template outlines our plan for accomplishing five strategic **Goals** of the Geological Sciences Department. The template spells out several **Objectives** related to each goal and **strategies** for meeting these objectives. Also listed are a variety of **Success Indicators** that may help track our progress toward attaining the objectives. This planning template is meant to be a "living document" that can be modified in response to changing conditions or external influences.

Goal 1: Achieve Academic Excellence Through Contemporary "Learn-By-Doing" Curriculum

Objectives	Strategies	Success Indicators
1.1 Develop modern undergraduate curriculum with emphases in strategic growth areas	**a)** Design and implement curriculum with Emphasis Areas in Geology, Geophysics /Earth Exploration and Water Resources **b)** Continue to grow and further develop Emphasis Areas **c)** Track student progress through the curriculum **d)** Enhance computational aspects of the GSC curriculum **e)** Update and strengthen GE curriculum	• Updated course descriptions and prerequisites • Curriculum sheet approved and in catalog • Modify curriculum based on student feedback • Quarterly advising sessions • Tracking spreadsheet of student performance • Number of students graduating from each Emphasis Area • Addition of computational components to expanded course outlines • Updated expanded course outlines • New GE course submissions
1.2 Enhance "Learn by Doing" through utilization of contemporary laboratory and field equipment	**a)** Acquire and maintain state-of-the-art laboratory and field equipment **b)** Emphasize lab work and field activities in curriculum **c)** Facilitate student access to laboratories and field activities	• Teaching and research equipment purchases • Maintenance contracts • Lab and field-based courses in curriculum • Lab and field-based Senior projects and Masters theses • Field vehicle and key-card access

		• Records of field trip participants and activities
1.3 Expand curriculum and faculty expertise in the discipline of Hydrogeology / Water Resources	**a)** Hire new faculty member in area of Hydrogeology **b)** Develop new courses in water-related subjects **c)** Promote interdisciplinary connections with other on-campus water-related programs **d)** Build a Hydrogeology Laboratory "wet lab" to provide students with hands-on experience in water-soil-rock interactions and flooding processes	• Faculty search approval • Successful faculty hire • Expanded course outlines • Participation in Lyle Center and Water Center • Collaborations with CE hydrology faculty • Wet lab design proposal
1. 4 Develop new Master's degree program	**a)** Enhance graduate curriculum with new courses built around new faculty expertise **b)** Survey stakeholders Re: optimal class schedule / time modules **c)** Advertise program **d)** Recruit students for admission **e)** Implement program and graduate Master's students	• Expanded course outlines • Curriculum sheet placed in catalog • Compilation of survey results • Web page and mailings • Applicant tracking spreadsheet • Annual MS program review
1.5 Maintain the highest quality teaching / learning environment	**a)** Provide modern teaching facilities **b)** Emphasize importance of excellent teaching and curriculum development **c)** Assess learning outcomes and make continuous improvements to instructional strategies	• Classroom upgrades • Equipment purchases • RTP requirements for teaching • Release time for new course development • Peer and student teaching evaluations • Periodic outcomes assessment reports • Modify curriculum based on student feedback
1.6 Maintain faculty expertise as requirements occur and seek new hires in strategic areas	**a)** Maintain existing faculty expertise in Petrology, Economic Geology, Geochemistry, Petroleum Geology, Earth History, and Ocean / Atmospheric Science, as retirements occur **b)** Request new faculty searches in areas of Energy / Mineral Resources, Earth Surface Processes / Global Climate	• Approval of faculty searches • Successful faculty hires

	Change, Geobiology and Geoinformatics **c)** Attract faculty with language capabilities and research interests that promote international collaboration	

Goal 2: Enhance Faculty and Student Scholarship

Objectives	Strategies	Success Indicators
2.1 Promote Teacher-Scholar model	**a)** Require student-faculty research collaboration **b)** Support faculty and student participation in research conferences **c)** Provide incentives for faculty mentors who link teaching and research **d)** Enhance student field experiences with faculty-led trips to local, regional and international venues	• Research requirements in undergraduate and graduate curricula • Quantitative indicators of Scholarship reported in faculty RTP documents • Faculty and student conference presentations • Completed Senior projects • Completed Masters theses • Awards of travel funds • Student support funds • Supervisory units and release time for thesis project development • Proposals submitted for funding of regional and international field trips • Student participants in local, regional and international field experiences
2.2 Enhance research and analytical capabilities with modern laboratory / field equipment	**a)** Acquire and utilize new teaching and research equipment **b)** Upgrade laboratory /field equipment and computer technology to industry standards	• New equipment purchases • Labs and field activities involving student use of equipment • Software upgrades, equipment calibrations and maintenance contracts

2.3 Enhance grant success	**a)** Write and submit grant proposals **b)** Provide incentives for grant writing **c)** Seek out new sources of funding	• Grant awards • ICR funds directed to faculty PIs • Release time awards for grant-writing • Proposals submitted to new funding agencies with Geology faculty participants • Funding received from new sources
2.4 Place students in graduate schools	**a)** Educate students about graduate school opportunities **b)** Mentor students and connect to appropriate graduate coordinators **c)** Write recommendations and facilitate graduate school applications	• Annual information / strategy session RE: application process • Graduate school applications • Graduate school acceptances

Goal 3: Promote the Geology Department Mission and its Relevance on Campus and in the Community

Objectives	Strategies	Success Indicators
3.1 Enhance the visibility of Geology Department on campus and in surrounding community	**a)** Recruit prestigious speakers for seminars **b)** Advertise Geology Dept seminars of general interest to community **c)** Participate in California Shakeout exercise **d)** Present lectures and/or field trips to community **e)** Develop new GE courses in Earthquake Country and California Water	• Department seminar series • Seminar attendance records • Annual Shakeout event • Talks or field trips given by Geology faculty and students to community audience • Expanded course outlines for new courses
3.2 Expand recruiting efforts	**a)** Periodically update Geology Department brochure **b)** Maintain department website **c)** Participate in community college recruiting events **d)** Conduct tours and open houses for prospective students **e)** Continuously monitor admissions records and directly contact applicants	• Published and distributed brochure • Website "hits" • Community college recruits • Records of formal and informal orientation tours • Applicant tracking spreadsheet

	f) Present lectures at local high schools that teach Earth Science **g)** Increase the number of Geology majors	• Majors tracking spreadsheet including number of Geology majors and where they originated
3.3 Involve Geology Department in research and events with direct societal relevance	**a)** Maintain and grow relationship with US Geological Survey National Earthquake Information Center **b)** Involve students in senior projects and Master's theses with direct ties to local industry and community issues	• USGS Contracts and grants • Locally based senior project and Master's theses
3.4 Increase interaction with Community Colleges	**a)** Participate in shared events (such as USGS-PCC Symposium **b)** Write collaborative proposals with Community College partners **c)** Invite community college students to Geology department events	• Attendance at Symposia • Proposals submitted with Geology Dept involvement • Collaborative grant funding received • Student attendees in Geology Department tours and field trips • Transfer applicants
3.5 Support Geology Club activities	**a)** Promote field trips **b)** Conduct on-campus mineral / rock sales **c)** Sponsor interactions with Geotechnical Engineering Club	• Field trip records • Funds raised from sales • Events attended by both groups
3.6 Maintain and increase diversity of students and faculty	**a)** Maintain gender balance in Geology major **b)** Promote department programs to diverse audiences **c)** Advertise open faculty positions in publications targeted toward diverse groups	• Tracking spreadsheet of applicants and majors • Presentations and tours to various groups • Applicant tracking spreadsheet

Goal 4: Foster Interdisciplinary Collaborations

Objectives	Strategies	Success Indicators
4.1 Strengthen interactions with College of Engineering	**a)** Teach sufficient Engineering Geology courses to accommodate demand of Civil Engineering Department **b)** Advertise seminars and encourage attendance of	• Numbers of sections / students enrolled in GSC 321/L and GSC 415/L • Seminar attendance records • X-ray lab usage by

	Engineering students and faculty **c)** Share laboratory facilities	Materials Engineering Dept
4.2 Maintain and expand interdisciplinary relationships with other colleges and departments on campus	**a)** Enhance service component to other disciplines **b)** Develop research and teaching collaborations with faculty from other disciplines (e.g., Civil Engineering, Plant Science, Biology, Regenerative Studies, Geography, Physics) **c)** Promote guest lectures utilizing faculty between disciplines **d)** Encourage collaborative thesis projects and field trips involving students and faculty from other disciplines	• Service courses • Cross-listed courses • Numbers of non-Geology majors enrolled in GSC core courses • Multidisciplinary proposals • Invited guest lectures • Co-advisement of theses • Cross-disciplinary field trips
4.3 Pursue involvement with the new Cal Poly Pomona Water Center	**a)** Participate in planning / brainstorming sessions **b)** Contribute to interdisciplinary proposals involving other water-related programs on campus **c)** Develop cross-disciplinary courses related to water issues	• Notes and ideas • Water-related proposals • Water-related courses with student participants from other disciplines

Goal 5: Develop External Relationships and Support Mechanisms

Objectives	Strategies	Success Indicators
5.1 Interact with Geology alumni and industry stakeholders	**a)** Maintain alumni database and communicate regularly with alumni **b)** Invite alumni and industry representatives to Geology Department events **c)** Organize Advisory Board of alumni and industry stakeholders **d)** Pursue fundraising opportunities where appropriate	• Updated Alumni database • Annual Alumni Newsletter • Annual Alumni Reunion • Suggestions for program improvement • Financial and gift-in-kind contributions to the Geology Dept
5.2 Connect Geology majors with industry and government employers	**a)** Maintain and database of employers **b)** Advertise employment and internship opportunities to appropriate students	• Employer database • Number of students applying to and being accepted in internship programs

	c) Organize career fairs; invite program managers and employers to campus **d)** Track placement and career paths of Geology graduates	• Career fairs attended by Geology majors • Spreadsheet documenting job placement and career paths of alumni
5.3 Promote student scholarship awards	**a)** Advertise scholarship competitions annually **b)** Maintain scholarship funds **c)** Solicit contributions to scholarships	• Annual scholarship award ceremony • Foundation scholarship accounts • Tracking spreadsheet of scholarship contributions
5.4 Enhance fund-raising efforts directed toward local industry stakeholders	**a)** Target companies that employ Cal Poly Geology interns and graduates **b)** Invite stakeholders to lunches with students	• Notes from meetings • Contributions from industry

Areas of Anticipated Growth

The three areas outlined below underscore the future global importance of geoscientists as technical experts in the development and management of Earth's finite resources, key players in natural hazard mitigation, and stewards of sensible environmental practice.

1. Natural Resource Exploration, Development and Management

The global economy and population continue to grow, driving unprecedented world demand for natural resources, particularly in developing countries. Geologists and geophysicists possess the practical field training and quantitative skills necessary to locate, evaluate and extract groundwater, metals, industrial minerals and fossil fuels. Fresh water has become a precious commodity, and recent emphasis on solar energy and electric cars is driving demand for metals used in photovoltaic cells and rechargeable batteries. Natural resource exploration, development and management must continue if Earth's living standards are to be maintained. New niches open regularly as hydrogeologists team up with scientists in other disciplines to grapple with huge environmental challenges, such as forecasting how changing climate will affect water resources and aquatic life. Existing faculty strengths in economic geology, geophysics, geomorphology and structural geology put the Department of Geological Sciences in an excellent position to produce graduates qualified to address these pressing issues. Potential new hires in hydrology and Earth systems science will

further reinforce teaching and research in natural resources. Three important areas of resource production require geologic expertise tempered with environmental awareness:

Water Resources

- Maintaining an adequate water supply for residential, agricultural and industrial use is essential to human livelihood.
- Jobs and careers for hydrogeologists and hydrologists abound not just in California, but worldwide: groundwater exploration and extraction, water quality monitoring, water resource planning, groundwater modeling, use of recycled and reclaimed water, remediation of contaminated groundwater, etc. Environmental consulting companies, which employ about 80% of hydrogeologists in the United States, currently report four jobs for every qualified graduate, according to the American Geological Institute (AGI).
- Modern geophysical instrumentation provides a cost-effective means to map the shallow Earth and infer its physical properties. The resulting three-dimensional information is crucial to the exploration for groundwater, metals, and petroleum resources, as well as assessment of foundation characteristics.
- Geoscientists must continue to work with both public and private agencies to assure an adequate supply, sage management and a safe quality of water.
- Water management will be vital to future growth of the Inland Empire and California's deserts where surface water is limited but groundwater storage is significant.
- Hydrogeologists might work independently or in collaboration with biologists, chemists, engineers, planners and government regulatory agencies.

Metals and Industrial Minerals

- Precious and base metals exploration is burgeoning after a 25–yr hiatus during which few new mines were developed. Unstable currency markets in particular have driven the demand for gold and silver. Between 2002 and 2011gold prices increased 467% from $300/oz to $1400/oz. Copper continues to be the primary conductor in electrical power grids. Precious metals capable of efficient conduction at high temperatures are essential in computer hardware and other microelectronic products.
- Emerging "green" technologies of solar energy, electric cars and air purifiers implicitly require rare metals like gallium, germanium, cadmium, nickel and platinum in the construction of photovoltaic cells, rechargeable batteries, catalytic converters and factory scrubbers.
- Metals such as molybdenum that form strong, flexible alloys with steel are essential for drilling hardware and pipelines. The need to drill deeper holes and transport water and petroleum great distances across land will accelerate demand for these metals.
- Metals with high melting temperatures, high strength and low density are in great demand by the aerospace industry.

- Industrial minerals like sand, gravel, lime, and gypsum constitute crucial raw materials for the construction and road-building industry.
- Geoscientists trained in mineral exploration are currently in high demand, while professors with this expertise are nonexistent in most Geology departments. Cal Poly Pomona's Geology Department has two such faculty members.

Energy Resources

- Fossil fuels serve as an essential bridge to a future of carbon-neutral energy alternatives. This transition on a global scale will undoubtedly take decades. Production of petroleum, natural gas and coal will continue to be a priority until alternative energy technologies gain efficiency and become cost effective.
- Exploration for uranium to fuel nuclear power plants and site investigations for these plants and the safe long-term storage of spent nuclear waste are growth areas for future geologists.
- Working in collaboration with policy makers at all governmental levels, geoscientists will aid in charting the best practical course for future energy exploration.

2. Natural Hazard Analysis and Mitigation

A large fraction of Earth's residents live in the vicinity of tectonic plate boundaries and must cope with earthquakes, landslides and volcanic eruptions. 60% of the world's population resides within 100 kilometers of a coast where hurricanes, floods, severe storms pose significant hazards. Climate change, rising population density in urban communities and increasing development in high risk areas all contribute to amplify the threats from natural hazards, leading to an increase in the average costs of property damage from natural hazards in the U.S. Geoscientists not only identify, monitor, and assess these hazards using cutting edge observational and analytical tools, but also work closely with engineers, governmental agencies and city planners to help develop strategies and technologies to mitigate loss of property and life. One need not look beyond Pomona to appreciate the need for geologic expertise. The active San Jose fault transects the most densely populated sites on campus. Cal Poly Pomona is centered within a group of hills prone to landslides and severe rainstorms. Its location in a highly active geologic environment provides a natural laboratory conducive to teaching and research related to natural hazards. The Department of Geological Sciences at Cal Poly Pomona is exceptionally suited for education and research in the field of natural hazard analysis and mitigation due to its expertise in seismology and engineering geology, its strong ties with the Civil Engineering Department in the College of Engineering and its collaborators at the National Earthquake Information Center of the U.S. Geological Survey and the Observatorio Volcanológico y Sismológico de Costa Rica.

Infrastructure and Residential Development

- California is particularly prone to earthquake, landslide, fire and flood hazards and as the state's population grows, urban and residential development will increasingly occur in higher risk seismic zones or regions prone to slope instability. Geologists and engineers with geologic training can help assess and mitigate these risks. Seismological studies of earthquake-induced ground motion provide crucial information for the design of seismic-safe buildings
- Much of the infrastructure in the United States is aging and in need of repair while some requires new technology, according to a recent report of the American Society of Civil Engineers. Critical lifelines, energy infrastructure and levee systems are essential to economic growth. For example, the catastrophe of Hurricane Katrina demonstrated how fragile and flawed our levee system is, including the largest and oldest levee systems along the Mississippi River and the Central Valley. Geoscientists and engineers play a critical role in the location and design of infrastructure to increase its resilience to natural hazards and minimize its impact on the natural environment.

Seismic Hazards

- Records of ground motion due to earthquakes from seismic networks yield real time information on earthquake location and magnitude. Automated systems, as developed by faculty at the Department of Geological Sciences, can rapidly assess the number of people exposed to severe shaking and inform emergency responders, government agencies, and the media to the scope of the potential disaster. Future research and development will link these networks to practical early warning systems in urban areas.
- A powerful tool in seismic hazard analysis is the emerging discipline of paleoseismology, which is aimed at unraveling the history of past earthquakes using field observations of earthquake related geological structures. These studies provide important information about the recurrence interval of earthquakes by extending our record of earthquake occurrence back thousands of years into the past.

3. Environmental Quality and Global Climate Change

Understanding today's complex environmental issues will require knowledge of how the solid Earth interacts with its hydrosphere, atmosphere and biosphere; i.e., "Earth System Science." One charge of the geoscientist is to articulate the science behind environmental processes. Global warming and climate change have recently become household terms. Geoscientists provide an important time perspective in their studies of pre-human global climate fluctuations. Their training in Earth System Science makes them ideal, nonpartisan advisors to policy makers. The Department of Geological Sciences seeks to strengthen its

knowledge base in environmental sciences by hiring an Earth systems scientist and a hydrogeologist, augmenting existing faculty expertise in fluvial geomorphology. Our planned hydrogeology lab will provide students with hands-on experience in water-soil-rock interactions and flooding processes.

- Production of natural resources and development of land must occur with greater cognizance of Earth's environment. Geoscientists play important roles in assessing site characteristics and writing Environmental Impact Statements.
- Contamination of surface water and groundwater is a crucial global issue. Lessons learned by developed countries must be shared with developing countries to avoid repeating mistakes. Successful mitigation techniques should likewise be passed on.
- Each year the world requires more waste treatment and disposal. The challenge is to accomplish this efficiently and securely with a minimum impact on ecosystems and human health.

Demographic and Economic Considerations

The demographics of Cal Poly Pomona make the Geological Sciences Department especially well-poised for the future international impact. The campus will continue to have large Asian and Latino populations. Many of these students are bilingual. Such cultural and linguistic attributes are attractive for the global demands of the future, particularly in resource-rich countries of Asia and Latin America that have limited infrastructure and pressing needs for environmental oversight. Well-trained, bilingual geoscientists interested in international exposure will have their choice of employment in the global market.

Retirement statistics provide additional insight into job opportunities for geoscientists. The American Geological Institute reported in October, 2008 that:

1. The majority of geoscientists in the workforce are within 15 years of retirement age.
2. The percentage of geoscientists between 31 and 35 years of age is less than half of geoscientists between 51-55 years old.
3. Even in oil & gas companies, which typically offer the highest salaries of all geoscience employing industries, the supply of new geoscientists is short of replacement needs.

These observations reflect a well known fact in the geosciences that a hiring boom in the late 1970's and early 1980's was followed by two decades of decline in the petroleum and mineral exploration industries. The current shortage of trained geoscientists coincides with a surge of activity in the three growth areas outlined above. This is further reflected by statistics from the U.S. Bureau of Labor Statistics, which indicate that the number of

geoscience jobs in industry will grow by 18% from 2008 to 2018, much faster than the projected total of a 10% increase for all occupations.

The recent Cal Poly Pomona External Environmental Scan singled out hydrology as the fastest growing occupation. Interestingly, the Los Angeles Times recently reported Natural Resources (including water) and Mining to be one of the three significant industries that experienced job growth during 2008. Another factor is the current shortage of geologists with doctoral degrees to replace a wave of retiring university professors. There is a growing need for qualified teachers to train the future geoscience workforce. The bottom line is: the next ten years will be an opportune time to enter the geoscience profession.