Sloan Career Cornerstone Center

Geosciences Overview

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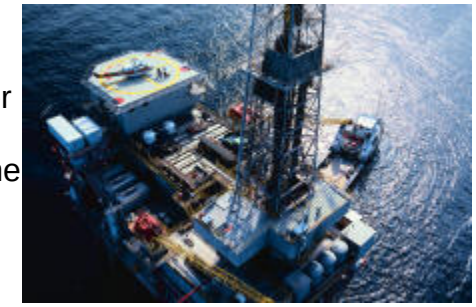
The Field



Most geoscientists work in the petroleum industry, mining industry, environmental firms, and in government agencies. Historically the petroleum industry employs the largest number of geoscientists and currently nearly 40% of geoscientists are employed in the exploration and production of oil and gas. The environmental industry now employs nearly 20% of geoscientists, many working in consulting firms. Mining was once a dominate geoscience employer, but today only about 10% of geoscientists work in private industry related to mining. Government agencies employ another 10% of geoscientists, including most oceanographers and atmospheric scientists. Geoscientists in the government work in many different capacities, from pure research to policy development. Only about 5% of geoscientists work as educators. This important group of geoscientists is crucial to the development of future geoscientists.

Like many sciences and engineering, the geosciences have seen an increase in the diversity of the workforce. Today nearly 20% of geoscientists are female and females are beginning to be seen in the upper levels of management. The age distribution of the geosciences is strongly dependent on the industry examined. For instance, the petroleum industry has a large number of geoscientists approaching retirement, as well as a number in the 30-40 year old range.

Preparation

The job market can be very competitive depending on the field you choose and the timing of your job search. There are a number of things you can do to make yourself more marketable in a tight job climate. Continue to develop your people skills, particularly by developing and maintaining a personal network of contacts. Also remain active in the professional community by being involved with the professional societies, attending meetings, working on committees, and presenting papers. Another strategic aspect of improving your marketability is to develop strong technical skills and identify a unique but relevant niche of expertise and skills that few people have. Also develop an understanding of the business issues of the company and industry in which you are looking to work.

Business and Economics

Understand the business side of your discipline, particularly how the science is applied to add value to the company. Once you are involved in a company, work close to the core of the business and develop skills that are indispensable to the business. Additionally, learn the economics of your industry on both a local and global scale. People are hired in industry to help companies make money, save money and solve problems. Know how your science and your scientific abilities contribute to those goals. Realize that much of what you learned in school was not just scientific knowledge and techniques, but the ability to think analytically and solve problems.

Field Work

Field work is a central experience for most all geoscientists. Earth is the laboratory for geoscientists, with most all aspects of work related directly back to some level of field investigation. Often field work is a major attraction for students entering the geosciences. The prospect of earning money to experience the wonders of many great nature environments is a strong enticement. Most all geoscience programs, and certainly all geoscience employment opportunities expect field experience as part of your educational background. The base of this experience is most often geology field camp, normally six weeks of intensive field mapping and interpretation during the undergraduate program. Often field experience is expanded through internships and graduate work, improving one's attractiveness to employers.

One aspect of the field work experience is the development of complex analytical skills, including spatial visualization and developing comprehensive, synthesized conclusions from often sparse data. These are some of the non-technical skills that many employers find attractive.

However, in the professional world, field work is an expensive but often necessary part of the job. Most professional geoscientists spend only a small fraction of their time in the field, spending most of their efforts in the office and laboratory working with the data that they or their colleagues have collected either in the field or through remote sensing techniques. Only a fraction of professional geoscientists spend a majority of their time in the field, so if the field experience is the driving interest in your pursuit of a geoscience career, you will need to investigate what jobs are available that provide that level of field work.

Analytical Thinking

Geoscientists are often attractive to employers, even outside of the profession, because of the unique blend of analytical skills most geoscience training provides. The geosciences are not a purely quantitative science; it is still heavily dependent upon observation, careful deductive reasoning and interpretation of spare data. These types of skills are often critical for effective problem solving in real world situations, even outside of the geosciences.

With the growth of technology, the variety of analytical avenues for geoscientists have diversified. In the mid-twentieth Century the geosciences were dominantly a qualitative science, relying heavily upon observation and interpretation. Today these skills remain at the heart of most geoscience projects, but for those who are more quantitatively-minded, the geosciences are rapidly becoming heavily quantitative, particularly in the fields of geophysics and hydrology. As you proceed in your training and career development, understand what your analytical strengths are and strive to apply those strengths in the projects you encounter.

Spectrum

The following is an overview of the five main career areas in Geology.

Education

One career pathway for geoscientists is education. Geoscience education is a professional pursuit for some, such as teachers in middle-schools or as a professor at a university. However, education is not limited to formal classroom settings, nor the training of new geoscientists. All people need to understand the basic processes and properties of the world they live in. Through this understanding, they can make better informed decisions which lead to a better quality of life of themselves and all of society.

General awareness not only comes through formal geoscience classes, but also through the public outreach efforts of practicing geoscientists to their community, whether through Earth Science Week activities or advising civic groups on an earth science issue. Many geoscientists, particularly those in local and state governments, pursue public outreach as part of their job. So even though we many not consider them having followed a traditional geoscience education career path, education is a major part of their professional effort.

Petroleum

The petroleum industry is focused on the exploration and production of oil and gas. The petroleum industry employs the largest number of geoscientists, with nearly 40% of geoscientists working in the field.

The petroleum industry historically experiences cyclical boom and busts. Employment levels fluctuate with this boom and bust cycle, normally driven by the price of oil. However, technology has helped to temper the severity of this boom and bust cycle by dramatically lowering the costs to produce oil. However, as with any commodity, lowered production costs are often coupled with lower market prices. Additionally, the petroleum industry often leads in the development and deployment of new technological applications to the geosciences. Also, as the economy has become more global, the petroleum industry has as well, with substantial efforts in South America, the North Sea, Africa, and Southeast Asia, along with the traditional focus on the Gulf of Mexico, Alaska, and the Middle East.

Mining

The mining industry has been a traditional employer of geoscientists. Though mining efforts have expanded greatly in parts of the world, especially South America, employment of geoscientists in the mining industry has remained stable. Geoscientists work in all aspects of the mining industry, from exploration, to mine design, to evaluating ore quality. More recently, many geoscientists working in the mining industry are also focusing on the environment, particularly in reclamation and groundwater management issues in an effort to minimize the impact of mining on the local environment.

Environment

Since the 1970's the environmental industry has seen a strong growth in the number of geoscientists employed. As public awareness grew and the associated increase in environmental regulation, the need for environmental geoscientists has increased. Many geoscientists working in the environmental fields deal with issues of water, both surface waters and groundwater. These efforts with water deal both with management issues as well as water quality issues - giving the geoscientist a unique role as steward of our water resources. Other geoscientists work with soils, managing this critical resource for the sustainability of agriculture. Natural hazards, such as landslides, are another major area of concern for environmental geoscientists. Though many environmental geoscientists work in private industry, particularly in environmental consulting firms, many work in all levels of government.

Government

Geoscientists work at all levels of government. Opportunities in government are quite varied and cover all fields of the geosciences. Geoscientists work in nearly all capacities of government, from the military to basic research to policy development to regulatory capacities.

Opportunities exist for oceanographers, solid Earth scientists, and atmospheric scientists. Many oceanographers pursue research in the military and with scientific agencies such as NOAA. Atmospheric scientists are also found in a wide variety of government agencies. From forecasting offices for the military and NOAA to developing global climate models at government research laboratories, most atmospheric scientists work to protect people and resources through early warning and detection of atmospheric conditions which may affect our society.

Solid Earth scientists work in all fields, from petroleum to minerals to the environment, working on pure research, policy formulation, regulatory enforcement, and public safety. The expertise of geoscientists is strategically placed throughout the government to provide critical input about our understanding of the Earth and how it will affect our society.

Day in the Life

So what is it like to work as a geoscientist? What are the issues faced by geoscientists on a daily basis? These are complex questions for a discipline which is so diverse. Geoscientists work on a range of issues, from natural resource management, to hazard mitigation, to environmental assessment, to name a few. Geoscientists work at all levels of employment,

from technicians monitoring wells to chief executives of multi-national firms. With this diversity of employment situations, geoscientists face a myriad of issues, many of which are not dissimilar to those seen in many of the other sciences and engineering. Some of the issues include diversity of the work force to working within the context of a corporation or even the geoscience community as a whole.

Teams and Coworkers

Everything starts with people. The need to work with and through others will always be a part of your career. To have a successful career requires that you learn how to work effectively with others. Even people who are self-employed find it difficult, if not impossible, to do all phases of all work independent of other people. Most work today is highly integrated, requiring the cooperative and collaborative work of teams. You will become a part of a team as soon as you join any organization.

The goal is to share information effectively and to integrate your expertise with the expertise of others to solve problems. You will work with managers, subordinates, support staff, clients, customers, politicians and concerned members of the lay community.

Corporate Cultures

It is a mistake to think that all organizations are alike. Organizations are very different from one another. Every organization has a distinctive personality, its own culture. It is a reflection of the methodologies, the history, vision, values and priorities of the particular organization. Your job is to discover whether or not there is a good "fit" of your needs and values with the organization's. You can do that by asking questions, reading reports and observing what people -- especially leaders -- say and do in a particular organization. Critical to this, of course, is to understand your own personal values about work and your career.

Career Self-management

Career management does not end once you secure a job; it is a life-long effort. Once you are on the job, take control of your career. Seek advice from managers, mentors, peers and colleagues, but keep control of your own career. Only you can decide what paths and choices are best for you. You need to discover what training and education will increase your value and your satisfaction. You will need to discover if the scientific career path or the management career path is best suited to your skills and talents.

Selling Yourself

Science rarely sells itself. You will learn that in most business enterprises there are many more ideas than the available funding will support. You need the courage of your convictions to sell your ideas. And you need to be persistent in selling the ideas that you have. In many cases, selling your ideas is the life-blood of your job. You may be selling yourself and your ideas to the management of your company to get an oil or gas well drilled or a project approved. You may need to sell your idea to a client if you are working for an environmental consulting firm, or you may need to sell your ideas in the form of grant proposals. Be aware that many times you will need to sell your ideas and yourself to people who do not have the same technical background or expertise. To be effective you need to develop effective communication skills and take the time to understand your audience.

Gender
As in many other fields, women have historically experienced career obstacles in the geosciences. Today, experienced women feel that there is less prejudice than in the past and that in the competitive business world the issue is more competence than gender. Women represent about 20% of the workforce in the geosciences and a higher percentage of geoscience majors in the colleges and universities. Problems of balance between work and family, childcare and maternity leave are issues that are being addressed throughout the workplace. It is important to research the organizations you are interested in and to find out what their policies and actions are on these issues. As today's society changes, these are issues not solely of interest to women, but to men as well as families rely on two-incomes and non-traditional family situations develop.

Diversity
We live and work in a multi-cultural world. To be a part of a profession that is truly global in perspective requires that we understand people different from ourselves. This effort can and should begin in school and continue throughout one's life. The workforce is increasingly diverse, and although this requires challenges in understanding one another, it offers a rich source of new ideas and new perspectives on geoscience issues. The richness of diversity can be a major tool in collaborative, creative problem-solving, particularly when you may be the "outsider" in a project that is in a foreign country.

Like Best
Everyone's career has highs and lows as do the organizations and industries that employ them. At times downsizings and organizational restructuring caused job loses, representing career lows for some. However, employment expansion occurs as well, and many times, with some flexibility, new and exciting opportunities are encountered. The key to weathering the peaks and valleys of one's career is a focus and understanding of one's personal goals, flexibility in the means to achieve those goals, and an attitude of continued learning.

Earnings

A major component in the decision of which jobs you will chose to take during your career will be money. Money is the primary compensation for work in today's society. It is also often a baseline metric for the apparent "value" of your efforts. However, not all potential employers can offer the same earning potential for the same job, you must reflect on the total compensation and professional package offered by an employer. Issues such as benefits, leave, professional development, and opportunities for advancement can often balance a compensation package which may not have the same monetary offer.

Starting Salary
Median annual earnings of geoscientists were $68,730 in May 2004. The middle 50 percent earned between $49,260 and $98,380; the lowest 10 percent earned less than $37,700, the highest 10 percent more than $130,750.

According to the National Association of Colleges and Employers, beginning salary offers in July 2005 for graduates with bachelor's degrees in geology and related sciences averaged $39,365 a year.

In 2005, the Federal Government's average salary for geologists in managerial, supervisory, and nonsupervisory positions was $83,178 for geologists, $94,836 for geophysicists, and $87,007 for oceanographers.

The petroleum, mineral, and mining industries are vulnerable to recessions and to changes in oil and gas prices, among other factors, and usually release workers when exploration and drilling slow down. Consequently, they offer higher salaries, but less job security, than other industries.

Industry Options

Salaries in the geosciences vary across industries, disciplines, and economic cycles. Historically, the geosciences have experienced cycles of hiring with peaks and valleys often directly tied to the price of oil, and more recently, the trends in environmental regulation. Salaries vary between different industries such as energy, environment, and mining. Geoscientist supply and demand in each of these areas is driven by different factors. The energy industry is strongly driven by the price of oil and gas, global opportunities for exploration activity, and new technologies that affect the economics of exploration and production.

In the environmental field, career opportunities and salaries depend largely on the level of enforcement of environmental codes and on new legislation developed by the government. In the natural hazards area, business is fueled by the level of new construction both in the U.S. and worldwide.

The mineral resources industry is largely driven by the price of commodities on the open market. However, like the oil industry, the rapid aging of the existing population of geoscientists is fueling demand for new professionals to maintain current employment levels.

You need to track events that affect the geosciences. By developing your own network and by being involved in professional organizations and activities, you can remain current on employment and salary trends in fields in which you are interested.

Employment

Geoscientists held about 28,000 jobs in 2004. Many more individuals held geoscience faculty positions in colleges and universities, but they are classified as college and university faculty. About 25 percent of geoscientists were employed in architectural, engineering, and related services, and 20 percent worked for oil and gas extraction companies. In 2004, State agencies such as State geological surveys and State departments of conservation employed about 3,600 geoscientists. Another 2,900 worked for the Federal Government, including geologists, geophysicists, and oceanographers, mostly within the U.S. Department of the Interior for the

U.S. Geological Survey (USGS) and within the U.S. Department of Defense. About 5 percent of geoscientists were self-employed, most as consultants to industry or government. Geoscientists are employed throughout the United States. The largest concentration of geoscientists are in the South-Central region, where they work in the petroleum industry. Cities such as Houston, Dallas, and New Orleans are major centers of employment for industry geoscientists. Other areas of the country also see fairly large populations of geoscientists, namely Washington, D.C. with its large government and related contractor workforces, Denver and Boulder, Colorado with a number of government facilities, a number of independent oil companies, and a large number of consultants, and the Pacific Coast with a growing number of environmental geoscientists working on natural hazards.

Employers

The following is a partial list of employers of geoscientists. In addition, the American Geological Institute hosts a Guide to Geoscience Careers and Employers that addresses issues in choosing, maintaining, and advancing a career specifically in the geosciences, and provides useful geoscience-employer information.

Petroleum Industry

- Amerada Hess Corporation
- Anadarko Petroleum Corporation
- Apache Corporation
- BP Global
- Chevron Corporation
- Conoco Inc.
- El Paso Corporation
- ExxonMobil
- Fairfield Industries Incorporated
- Marathon Oil Company
- Occidental Petroleum Corporation
- Royal Dutch/Shell Group
- Schlumberger
- Texaco, Inc.
- TGS-NOPEC Geophysical Company
- Veritas DGC Inc.

Environmental Consulting

- Delta Environmental Consultants, Inc.
- Kleinfelder, Inc.
- P.E. LaMoreaux & Associates, Inc.
- RMT, Inc.
- S.S. Papadopulos & Associates, Inc.
- URS Corporation

Mining Industry

- Battle Mountain Gold Company
- Copper Development Association
- Freeport-McMoRan Copper & Gold, Inc.
- McMoRan Exploration Co.
- Noranda Inc.
- Newmont Mining
- Phelps Dodge Corporation

U.S. Federal Government and State and Local Affiliates

- Army Corps of Engineers
- Department of Energy
- Department of the Interior
- Department of Defense
- Environmental Protection Agency
- Los Alamos National Laboratory
- NASA
- National Oceanic and Atmospheric Administration
- Natural Resources Conservation Service
- State Agencies

Other Employers

- Professional Associations
- K-12 Schools
- Colleges and Universities

Career Path Forecast

According to the U.S. Department of Labor, Bureau of Labor Statistics, although employment growth will vary by occupational specialty, overall employment of geoscientists is expected to grow more slowly than average for all occupations through 2014. However, due to the relatively low number of qualified geoscience graduates and the large number of expected retirements, opportunities are expected to be good in most areas of geoscience.

Graduates with a master's degree may have the best opportunities. Those with a Ph.D. who wish to become college and university faculty or to do advanced research may face competition. There are few openings for graduates with only a bachelor's degree in geoscience, but these graduates may find excellent opportunities as high school science teachers. They also can become science technicians, or enter a wide variety of related occupations.

Few opportunities for geoscientists are expected in Federal and State Government, mostly because of budgetary constraints at key agencies, such as the USGS, and the trend among governments toward contracting out to consulting firms. However, departures of geoscientists who retire or leave the Government for other reasons will result in some job openings over the next decade. A small number of new jobs will result from the need for oceanographers to conduct research for the military or for Federal agencies such as the National Oceanic and Atmospheric Administration (NOAA) on issues related to maintaining healthy and productive oceans.

Many geoscientists work in the exploration and production of oil and gas. Historically, employment of petroleum geologists, geophysicists, and some other geoscientists has been cyclical and affected considerably by the price of oil and gas. When prices were low, oil and gas producers curtailed exploration activities and laid off geologists. When prices were higher, companies had the funds and incentive to renew exploration efforts and hire geoscientists in larger numbers. In recent years, a growing worldwide demand for oil and gas and for new exploration and recovery techniques -- particularly in deep water and previously inaccessible sites in Alaska and the Gulf of Mexico -- has returned some stability to the petroleum industry. Growth in this area, though, will be limited due to increasing efficiencies in finding oil and gas. geoscientists who speak a foreign language and who are willing to work abroad should enjoy the best opportunities, as the need for energy, construction materials, and a broad range of geoscience expertise grows in developing nations.

Job growth is expected within management, scientific, and technical consulting services. Demand will be spurred by a continuing emphasis on the need for energy, environmental protection, responsible land management, and water-related issues. Management, scientific, and technical consulting services have increased their hiring of many geoscientists in recent years due to increased government contracting, and also in response to demand for professionals to provide technical assistance and management plans to corporations.

Moreover, many of these workers will be needed to monitor the quality of the environment, including aquatic ecosystems, issues related to water conservation, deteriorating coastal environments, and rising sea levels -- all of which will stimulate employment growth of geoscientists.

An expected increase in highway building and other infrastructure projects will be a source of jobs for engineering geologists.

During periods of economic recession, geoscientists may be laid off. Especially vulnerable to layoffs are those in consulting, and, to a lesser extent, workers in Government. Employment for those working in the production of oil and gas, however, will largely be dictated by the cyclical nature of the energy sector and changes in government policy.

What is the Future of the Geosciences?

As one considers their career, or even reconsiders their current career path, the key question is "What will the future be?" No one can predict the future, but much can be learned by understanding the history of the discipline, including employment trends and the impacts of technology and new ideas. You also must consider what issues on the horizon may be catalysts of change, based both on the historical perspective and an understanding of the current state of the geosciences. These issues take research, and as you manage your career, you must continue this research to effectively direct your career path to meet your personal goals.

The need for geoscientists is linked to the needs of society, now and into the future. This includes the need for energy, clean water, productive soils, healthy and productive oceans, weather prediction, understanding global climate change, hazard-free development of human structures, and the beneficial interaction of humankind and the environment.

The needs for expertise in the geosciences are increasingly global, especially in developing nations. As nations industrialize, their needs for energy, construction materials and a broad range of geoscience expertise will grow.

The future always includes the need to explore new horizons. Geoscientists are on all the teams exploring space -- from the surface of Mars to the atmosphere of Jupiter. Improved technology in remote sensing will allow geoscientists to explore and understand planets throughout the solar system long before manned missions are even contemplated. Missions like the Mars Pathfinder will provide geological data from planetary bodies far in advance of any manned missions.

The future of the geosciences is limited only by the imagination, drive, and the need to solve problems of humankind's effort to live in harmony with nature. What is the future of the Geosciences?

Professional Associations

Active involvement in professional societies has proved to be a good strategy for building a complete professional career. Professional societies provide contacts when you need them, a continuing source of vital information and education, the opportunity to publish and gain recognition of good work, an opportunity to develop skills that augment your on-the-job responsibilities, and provides a satisfying means to give back to the profession that has nurtured your career.

Professional organizations and associations provide a wide range of resources for planning and navigating a career in the geosciences. These groups can play a key role in your development and keep you abreast of what is happening in your industry. Associations promote the interests of their members and provide a network of contacts that can help you find jobs and move your career forward. They can offer a variety of services including job referral services, continuing education courses, insurance, travel benefits, periodicals, and meeting and conference opportunities. A broader list of professional associations is also available by clicking here.

American Geological Institute (www.agiweb.org)

The American Geological Institute is a nonprofit federation of 44 geoscientific and professional associations that represents more than 100,000 geologists, geophysicists, and other earth scientists. Founded in 1948, AGI provides information services to geoscientists, serves as a voice of shared interests in our profession, plays a major role in strengthening geoscience education, and strives to increase public awareness of the vital role the geosciences play in society's use of resources and interaction with the environment.

Geological Association of Canada (www.esd.mun.ca/~gac/)

On February 14th, 1947, a group of geologists met at the Engineers' Club in Toronto with the objective of creating the Geological Institute of Canada, an association of geologists which would, among other things, promote, discuss and disseminate geological knowledge.

Association for Women Geoscientists (www.awg.org)

The Association for Women Geoscientists is an international organization devoted to enhancing the quality and level of participation of women in the geosciences and to introducing girls and young women to geoscience careers.

Australian Institute of Geoscientists (www.aig.asn.au)

The Australian Institute of Geoscientists (AIG), established in 1981, is the leading professional association exclusively representing geoscience professionals employed in all sectors of industry, government, education and research throughout Australia.

European Union of Geosciences (http://eost.u-strasbg.fr/EUG/)

The European Union of Geosciences (EUG), started in 1980. Its aim is to develop co-operation among scientists in different fields of earth and planetary sciences such as geology, geophysics, geochemistry, planetology, oceanography, hydrology etc. Its membership is strictly individual and no one may represent any national organization, institution or laboratory.