Geologist and Geophysicist

Snapshot

Career Cluster: Environment & Conservation; Natural Resources Development; Science & Technology
Interests: Seismology, hydrology, earth science
Earnings (Yearly Average): $108,420
Employment & Outlook: Faster Than Average Growth Expected

OVERVIEW

Sphere of Work

Geologists and geophysicists—also called geoscientists—study the composition, natural history, and other aspects of the earth. Geologists analyze rocks, plant and animal fossils, soil, minerals, and precious stones. They work for government agencies, oil and petroleum corporations, construction companies, universities, and museums. Geophysicists use physics, chemistry, mathematics, and geology to study the earth's magnetic fields, oceans, composition, seismic forces, and other elements. Most geologists and geophysicists

specialize in sub-fields such as mineralogy, hydrology, paleontology, seismology, and geochemistry. Geologists and geophysicists may be employed by organizations that intend to locate new oil deposits, predict earthquakes and volcano activity, or analyze environmental degradation.

Work Environment

Most geologists and geophysicists spend a significant portion of their time in the field conducting research. Fieldwork often involves traveling great distances into remote, rugged environments. Some geologists and geophysicists travel to foreign countries to pursue field research opportunities. Geologists and geophysicists must also work in all weather conditions. When performing field research, geologists and geophysicists typically work long and irregular hours. When not conducting fieldwork, geologists and geophysicists are at work in offices and laboratories, studying samples, writing papers, and analyzing and interpreting data.

Profile

Working Conditions: Work both Indoors and Outdoors
Physical Strength: Light Work, Medium Work
Education Needs: Master's Degree, Doctoral Degree
Licensure/Certification: Required
Physical Abilities Not Required: No Heavy Labor
Opportunities For Experience: Military Service, Part-Time Work
Holland Interest Score*: IRE, IRS

* See Appendix A

Occupation Interest

Geophysicists and geologists play an important role in protecting people from natural disasters – their work in seismology, hydrology, and other fields can help people avoid flood damage, prepare for seismic activity, or escape the impending eruption of a volcano. These geoscientists also help businesses, universities, and government agencies locate safe locations for construction, find dinosaur remains, and identify new areas in which to dig for oil, metals, or precious stones. The work performed by geophysicists and geologists changes frequently, and new research contributes to a growing body of knowledge about the history and characteristics of the earth. This occupation attracts inquisitive individuals with an interest in earth sciences and a desire to help others.

A Day in the Life—Duties and Responsibilities

The work performed by geologists and geophysicists varies based on their area of expertise. For example, some mineralogists prepare cross-sectional diagrams and geographic surveys of areas from which precious stones and metals may be located and extracted. Others set up and maintain seismic monitors in and around active volcanic areas. Some geophysicists and geologists spend a great deal of time in the laboratory, while others spend the vast majority of time in the field.

Most often, geologists and geophysicists plan and conduct geological surveys, field studies, and other technical analyses. They take small samples of stones, soil, and sediment, or use sensory equipment to sample magnetic waves, tremors, and subterranean water flows. Using these samples and data, geologists and geophysicists compile technical reports, academic papers, charts, maps, and policy recommendations. Geologists and geophysicists rely on computer modeling software, sensory data recorders, and other pieces of hardware and software to ensure that data is complete and organized. Scientists who study the compositions of rocks, minerals, and other resources must also conduct laboratory experiments using chemicals and other analytical tools.

Geologists and geophysicists employed by educational institutions may also need to write research proposals and grant applications in addition to performing their own research. Some geologists and geophysicists are also university professors, overseeing lectures and laboratory sections in addition to performing their own independent research.

Duties and Responsibilities

- **Examining rocks, minerals, and fossil remains**
- **Determining and explaining the sequence of the earth's development**
- **Interpreting research data**
- **Recommending specific studies or actions**
- **Preparing reports and maps**
- **Managing and cleaning up toxic waste**
- **Exploring for natural resources (e.g., oil and natural gas)**

OCCUPATION SPECIALTIES

Petroleum Geologists

Petroleum Geologists study the earth's surface and subsurface to locate gas and oil deposits and help develop extraction processes.

Mineralogists

Mineralogists examine, analyze and classify minerals, gems and precious stones and study their occurrence and chemistry.

Paleontologists

Paleontologists study the fossilized remains of plants and animals to determine the development of past life and history of the earth.

Hydrologists

Hydrologists study the distribution and development of water in land areas and evaluate findings in reference to such problems as flood and drought, soil and water conservation and inland irrigation.

Oceanographers

Oceanographers study the physical aspects of oceans such as currents and their interaction with the atmosphere. They also study the ocean floor and its properties.

Seismologists

Seismologists interpret data from seismographs and other instruments to locate earthquakes and earthquake faults.
Stratigraphers Stratigraphers study the distribution and arrangement of sedimentary rock layers by examining their contents.

WORK ENVIRONMENT

Physical Environment

Geologists and geophysicists spend much of their time in the field. Fieldwork is typically conducted in remote areas and may require long travel across rugged terrain to reach. These geoscientists must work outdoors in a wide range of climates and weather conditions. When not in the field, geologists and geophysicists work in offices and laboratories, which are clean, comfortable work environments.

Relevant Skills and Abilities

Analytical Skills
- Collecting and analyzing data

Communication Skills
- Editing written information
- Writing concisely

Interpersonal/Social Skills
- Cooperating with others
- Working as a member of a team

Organization & Management Skills
- Paying attention to and handling details

Research & Planning Skills
- Analyzing information
- Creating ideas
- Gathering information
- Solving problems

Technical Skills
- Applying the technology to a task
- Performing scientific, mathematical and technical work
- Working with machines, tools or other objects

Work Environment Skills
- Working outdoors

Human Environment

Depending on their area of specialty, geologists and geophysicists work with a number of different individuals. Among the people with whom they interact are engineers, other geoscientists, laboratory assistants, environmental scientists, oceanographers, chemists, geographers, business executives, and government officials.

Technological Environment

Geologists and geophysicists need to use a wide range of technology to complete their work. Geological compasses, electromagnetic instruments, water flow measurement instruments, soil core sampling tools, sonar, magnetic field measurement devices, geographic information systems software (GIS), global positioning systems (GPS), map creation systems, and scientific databases are only some of the tools and technologies used by individuals in this field.

EDUCATION, TRAINING, AND ADVANCEMENT

High School/Secondary

High school students should study chemistry, physics, environmental science, and other physical science courses. Math classes, such as algebra, geometry, and trigonometry, are essential in geology and geophysics. History, computer science, geography, English, foreign language, and photography courses can also be highly useful for future geologists and geophysicists.

Suggested High School Subjects

- Algebra
- Applied Math
- Chemistry
- College Preparatory
- Earth Science
- English
- Geography
- Geometry
- History
- Photography
- Physical Science
- Science
- Trigonometry

Famous First

The first woman geologist was Florence Bascom (1862-1945). Bascom was also the first woman to earn a PhD at Johns Hopkins University. She was appointed assistant geologist to the US Geological Survey in 1896. In addition to this work, she founded the geology department at Bryn Mawr College in Pennsylvania and edited the magazine *American Geologist*.

College/Postsecondary

Geologists and geophysicists generally need a master's degree in geology, paleontology, mineralogy, or a related geosciences subject for entry-level jobs. Those who wish to pursue a senior-level research position or employment at an educational institution will need to obtain a doctorate.

Related College Majors

- Geography
- Geological Engineering
- Geophysical Engineering
- Geophysics & Seismology
- Ocean Engineering
- Oceanography

Adult Job Seekers

Qualified geologists and geophysicists may apply directly to postings by government agencies and private business organizations. University geology departments may also have access to entry-level openings. Geoscience journals frequently post openings in this field, and professional geology and geophysics societies and associations create opportunities for job searching and networking.

Professional Certification and Licensure

Some states require geologists and geophysicists who work for government agencies to obtain state licensure. An examination and proof of academic and professional experience are typically required for these licenses. Geologists and geophysicists may choose to pursue voluntary certification in specialized areas of expertise.

Additional Requirements

Geologists and geophysicists should be physically fit, as they frequently work in remote and rugged areas and sometimes carry heavy equipment and samples. They should also have familiarity with computer systems, GIS, GPS, and other technologies. Strong communication and interpersonal skills, writing abilities, and a sense of teamwork are important for geologists and geophysicists, as are an inquisitive nature and the desire to spend time working outdoors.

Fun Fact

Landslides occur in all of the 50 states in the U.S. Washington, Oregon, and California's mountainous and coastal regions are the major areas where landslides occur. Eastern U.S. mountain and hill regions are also susceptible.

Source: http://geology.com/usgs/landslides

EARNINGS AND ADVANCEMENT

Earnings depend on the individual's particular position, occupational specialty, amount of experience and level of education. Although the petroleum, mineral, and mining industries offer higher salaries, changes in oil and gas prices result in less job security in this area. According to the National Association of Colleges and Employers,

starting annual salaries for graduates with a bachelor's degree in geology and related sciences averaged $47,243 in 2012.

Mean annual earnings of geologists and geophysicists were $108,420 in 2013. The lowest ten percent earned less than $49,000, and the highest ten percent earned more than $175,000.

Geologists and geophysicists may receive paid vacations, holidays, and sick days; life and health insurance; and retirement benefits. These are usually paid by the employer.

Metropolitan Areas with the Highest Employment Level in This Occupation

Metropolitan area	Employment[1]	Employment per thousand jobs	Hourly mean wage
Houston-Sugar Land-Baytown, TX	7,070	2.57	$80.54
Denver-Aurora-Broomfield, CO	1,830	1.43	$55.31
Seattle-Bellevue-Everett, WA	800	0.55	$40.17
Los Angeles-Long Beach-Glendale, CA	790	0.20	$47.98
Santa Ana-Anaheim-Irvine, CA	710	0.49	$43.56
Dallas-Plano-Irving, TX	700	0.33	$68.12
Sacramento--Arden-Arcade--Roseville, CA	670	0.80	$44.78
Oklahoma City, OK	660	1.11	$65.30
San Francisco-San Mateo-Redwood City, CA	620	0.59	$53.07
San Diego-Carlsbad-San Marcos, CA	600	0.46	$39.80

[1] Does not include self-employed. Source: Bureau of Labor Statistics

EMPLOYMENT AND OUTLOOK

Geologists and geophysicists held about 38,000 jobs nationally in 2012. In addition, many more individuals held geoscience faculty positions in colleges and universities. About one-fourth were employed in architectural and engineering firms, and another one-fourth worked for oil and gas extraction companies. State agencies, such as state geological surveys and state departments of conservation, and the Federal Government, mostly within the U.S. Department of the Interior for the U.S. Geological Survey (USGS) and within the U.S. Department of Defense, also employed significant groups of these workers.

Employment of geologists and geophysicists is expected to grow faster than the average for all occupations through the year 2022, which means employment is projected to increase 15 percent to 20 percent.

In the past, employment of geologists and other geoscientists has been cyclical and largely affected by the price of oil and gas. In recent years, a growing worldwide demand for oil and gas and new exploration and recovery techniques have returned some stability to the petroleum industry, with a few companies increasing their hiring of geoscientists. Geoscientists who speak a foreign language and who are willing to work abroad should enjoy the best opportunities.

Employment Trend, Projected 2012–22

Geologists and Geophysicists: 16%

Total, All Occupations: 11%

Scientific Occupations (All): 10%

Note: "All Occupations" includes all occupations in the U.S. Economy. Source: U.S. Bureau of Labor Statistics, Employment Projections Program.

Related Occupations

- Geographer
- Metallurgical/Materials Engineer
- Mining & Geological Engineer
- Oceanographer
- Petroleum Engineer
- Surveyor & Cartographer

Related Military Occupations

- Oceanographer

Conversation With . . .
RON PYLES

Geotechnical Engineer
Principal Engineer, 15 Years
VP, Kim Engineering, Baltimore MD

1. What was your individual career path in terms of education/training, entry-level job, or other significant opportunity?

I first was exposed to construction, and went to a junior college in Upstate New York for construction management. Then I decided to go on to a four-year school where I took civil engineering. While there, I found the geotechnical discipline, which offered more of a challenge, and took as many courses in that area as I could. I went on to work for three years to make sure I was interested in geotech, and then I earned a Master's in Civil Engineering specializing in geology.

Being a geotechnical engineer is not being a geologist per se. My field merges geology and engineering, and I mostly deal with foundations that a specific building requires, or pilings, groundwater problems, retaining walls, and that sort of thing.

Geotechnical engineering, in my opinion, is more creative than other engineering disciplines. When you think of the different formations associated with the massive earth movements that formed some of this geology, it takes a lot of force. You need to know geology. For example, if a region is limestone, which creates sinkholes, you need to know that and recommend specific techniques to build within and/or explore the karst terrain. If you're in an area where massive erosion occurred in past geologic times, and everything is consolidated because it's overburdened, then bearing capacities for foundations or walls can be much higher. Areas of Maryland, Washington, DC and Virginia, for example, have specific types of clays. These clays have specific characteristics, with high plasticity, and they may swell or shrink with moisture changes. You need to know that.

To specialize in geotechnical engineering, you should pursue advanced degrees. In geology that's not necessary, although it's always good to have an advanced degree.

2. What are the most important skills and/or qualities for someone in your profession?

Good writing skills are critical, because we produce reports that other engineers and developers read. You need good verbal communications skills with clients. It can be a high-risk business if you're not careful with your quality of work, so you need to

be cognitive of legal aspects. Being organized is a plus. And, you need to be able to manage people if you are directing subordinates.

3. What do you wish you had known going into this profession?

In our work we deal with the substrate but once they build a foundation, they cover up the substrate. You can't stand there and appreciate your work.

4. Are there many job opportunities in your profession? In what specific areas?

There is very good demand relative to employment. Geotechical engineering is good, and geologists interfacing with the geotechical field have pretty good overall demand as well.

5. How do you see your profession changing in the next five years, what role will technology play in those changes, and what skills will be required?

Many of our theories have not changed a lot over the years. As technology has progressed we've obtained newer advanced equipment to assess the soils. An example would be the geophysical device that sends electrical waves to measure the resistance of those waves as they pass through the earth. We use that to find sinkholes and rock levels.

6. What do you enjoy most about your job? What do you enjoy least about your job?

Most enjoyable is exploring new areas from a geology viewpoint and soils aspect relative to proposed construction. Each site offers sort of a surprise because you don't know what's under the ground. You have the ability to assess and confirm the geology of the site, then look forward to the lab analysis.

This is a pretty demanding business, and there can be demanding turnaround. Unfortunately, sometimes clients can be hard to deal with.

7. Can you suggest a valuable "try this" for students considering a career in your profession?

Visit construction sites and field trips with a geologist or engineer. There are a lot of areas where you can get exposed to geologic formations; field trips are obviously an excellent way to get some exposure. Also, consider interning. Each summer my company has an intern program. We bring in 3-4 interns from colleges who are taking engineering and they can learn more about what we do.

SELECTED SCHOOLS

Most colleges and universities have bachelor's degree programs in geology or related subjects. The student may also gain an initial grounding in the field at an agricultural, technical, or community college. For advanced positions, a master's or doctoral degree is commonly obtained. Below are listed some of the more prominent graduate schools in this field.

California Institute of Technology
Division of Geological and Planetary Sciences
1200 East California Boulevard
Mail Code 170-25
Pasadena, CA 91125
626.395.6123
www.gps.caltech.edu

Massachusetts Institute of Technology
Earth, Atmospheric, and Planetary Sciences
77 Massachusetts Avenue
Cambridge, MA 02139
617.253.2127
eapsweb.mit.edu

Penn State University
Geosciences Department
503 Deike Building
University Park, PA 16802
814.867.4760
www.geosc.psu.edu

Stanford University
Geological and Environmental Sciences
450 Serra Mall, Building 320
Stanford, CA 94305
650.723.0847
pangea.stanford.edu/**departments/ges**

University of Arizona
Department of Geosciences
1040 E. 4th Street
Tucson, AZ 85721
520.621.6000
www.geo.arizona.edu

University of California, Berkeley
Earth and Planetary Science
307 McCone Hall
Berkeley, CA 94720
510.642.3993
eps.berkeley.edu

University of Colorado, Boulder
Department of Geological Sciences
UCB 359
Boulder, CO 80309
303.492.8141
www.colorado.edu/geolsci

University of Michigan, Ann Arbor
Earth and Environmental Sciences
2534 C.C. Little Building
1100 North University Avenue
Ann Arbor, MI 48109
734.763.1435
www.lsa.umich.edu/earth

University of Texas, Austin
Department of Geological Sciences
2275 Speedway Stop C9000
Austin, TX 78712
512.471.5172
www.jsg.utexas.edu/dgs

University of Wisconsin, Madison
Department of Geoscience
1215 West Dayton Street
Madison, WI 53706
608.262.8960
www.geoscience.wisc.edu

MORE INFORMATION

American Association of Petroleum Geologists
P.O. Box 979
Tulsa, OK 74101-0979
800.364.2274
www.aapg.org

American Geosciences Institute
4220 King Street
Alexandria, VA 22302-1502
703.379.2480
www.americangeosciences.org

Environmental and Engineering Geophysical Society
1720 South Bellaire, Suite 110
Denver, CO 80222-4303
303.531.7517
www.eegs.org

Geological Society of America
P.O. Box 9140
Boulder, CO 80301-9140
303.357.1000
www.geosociety.org

Paleontological Society
P.O. Box 9044
Boulder, CO 80301
855.357.1032
www.paleosoc.org

Seismological Society of America
201 Plaza Professional Building
El Cerrito, CA 94530
510.525.5474
www.seismosoc.org

Society of Exploration Geophysicists
P.O. Box 702740
Tulsa, OK 74170-2740
918.497.5500
www.seg.org

United States Geological Survey
12201 Sunrise Valley Drive
Reston, VA 20192
703.648.5953
www.usgs.gov

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