SO YOU WOULD LIKE TO BE A GEOLOGIST!

Since the beginning, man has always wondered about the earth: how was it formed? what changes have taken place? what types of life have existed here? and how important are the different types of rocks and minerals, fuels and water, upon which our society is so totally dependent? If you are interested in learning more about these things, and the kinds of opportunities that can lead to a satisfying professional career in Geology, you should consider the following information.

EDUCATION

There are more than 300 colleges and universities in the United States that offer Bachelor of Science or Bachelor of Arts degrees in Geology, and 160 of these offer opportunties for advanced study leading to Master's degrees and the Ph.D. For more specific information regarding their programs and who to contact, consult the "Directory of Geoscience Departments, United States and Canada" available in most large libraries, or contact the Department of Geology of any college or state university; or write the American Geological Institute, 5205 Leesburg Pike, Falls Church, Virginia 22041.

Most undergraduate geological programs provide students with a basic background of knowledge. Others offer more specialized instruction designed to prepare students for scientific or professional careers. The programs vary considerably, so students are advised to compare the curricula offered at different schools before enrolling.

Under normal circumstances a Bachelor's degree in Geology requires four academic years of lecture and laboratory instruction and one summer of field work. Previous high school level courses in chemistry, physics, mathematics, earth science, biological science, shorthand, typing, computer science, and english rhetoric will prove advantageous. Students who do well at the undergraduate level are generally encouraged to consider an additional 1½ to 2 years of training for a Master's degree that may be undertaken at the same or at a different school. The Doctorate (Dr. Sc. or Ph.D.) requires at least three more years of specialized study and extensive training in geological research. Financial assistance, in the form of education grants-in-aid, teaching assistantships or fellowships, is ordinarily available for well qualified students working toward the Ph.D.

Subsciences of Geology

Subjects of geological study range widely from investigations of the whole earth and even distant planets, to studies of the submicroscopic structure of sand grains, minerals and fossils. They include all of the chemical and physical phenomena that take place on the earth's surface and within the earth, and place great emphasis on the order of events and the record of the geologic past. Most standard undergraduate geology curricula require at least one semester of instruction in each of the following subjects.

Physical and Historical Geology — the studies of geological processes observable on and within the earth leading to interpretation of earth history.

Mineralogy — the study of the common rock-forming minerals according to their molecular structure, chemical composition, and physical properties.

Petrology — the study of the origin, occurrence, texture, structure, and history of rocks as determined by their mineral components.

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Stratigraphy — the study of the distribution and arrangement of layered sedimentary rocks in terms of geologic time and space, and the interpretation of their mode of origin and subsequent alteration.

Paleontology — the study of animal and plant fossils and the evolution and development of life through geologic time as observed in sedimentary rocks.

Structural Geology — the study of the mechanics and dynamic character, form and arrangement of rock masses in the earth's crust.

Geomorphology — the study of surface landforms, and sedimentary deposits, and the processes that created them such as erosion and glaciation.

Having been introduced to this general curriculum, a student may choose to expand his or her knowledge on one or more of these subjects through additional course work and field and laboratory investigation.

Related Earth Sciences

Many universities and colleges also offer degree programs at the graduate level that combine geological sciences with other fields of study. Here are just a few of the popular ones that attract many students. Students should inquire about others.

"Engineering geology" or "Geological Engineering" — the study of the properties of rocks and the mechanical and engineering aspects of the earth's surface and the processes (subsidence, erosion, etc.) that affect specific localities.

"Hydrology" — the study of the properties, circulation and distribution of surface and ground water on the continents.

"Marine geology or oceanography" — the study of the oceans and sea floors including their physical, chemical, biological and geological aspects.

"Geophysics" — the study of the earth's internal structure as determined by its physical, electrical, magnetic, gravitational, and radioactive properties.

"Geochemistry" — the study of the intricate chemical relationships of minerals, rocks, and fluids.

"Astrogeology" — the study of the shape and physical and chemical properties of geologic features on celestial bodies.

PERSONAL ATTRIBUTES AND SELECTION OF A PROFESSIONAL CAREER

Students considering careers in Geology should first take time to evaluate themselves in relation to lifetime aspirations and goals. Each of us has different personality traits and natural aptitudes that have a bearing on a career. Just having an interest in a particular subject is not enough. Students should attempt to understand the demands that will be placed upon them as a professional in order to more closely align their career goals with their personality, natural attributes, and desires in life.

Becoming a successful professional geologist requires a dedication to learning, self-motivation for study, a natural inquisitiveness about detail, and a desire to find out for oneself. Good health and physical stamina are important, and absolutely essential in certain kinds of geological work. A serious but patient temperament coupled with a cooperative attitude toward others can be most helpful. As in all scientific fields, a career geologist must develop a sense of personal integrity and be able to communicate effectively with others; and that includes the ability to write and speak clearly and concisely.

With these items in mind, consider the following types of general activity in which geologists may choose to become involved.

"Exploration" — careers involve the use of geological knowledge in the never-ending search for new deposits of economic minerals and energy resources. Day-to-day activities move at a rapid pace because the work is highly competitive, and ordinarily involves above average stress. Assignments require a high level of self-reliance, a natural inquisitiveness, astute observation, and accurate communication. Operations frequently require extensive travel in this country and abroad that is often different and exciting because of the constantly changing circumstances and the variety of working and living conditions that are encountered. Persons involved in exploration must develop self-confidence and be capable of handling responsibility within fixed deadlines under administrative pressure. The petroleum and mineral industries are the chief employers of exploration geologists. Career success depends largely on the individual's initiative, personal integrity, technical ability, and business acumen.

"Development" — geologists are involved with investigations of established mineral or petroleum production sites that have already been discovered. Day-to-day activities move at a more modest pace. Individuals in this line of work must learn to accept responsibility for on-site decisions regarding expensive drilling and mining operations comparable with the investor's economic objectives. They are frequently on call, and must be able to adjust to difficult or changing work schedules. Residency is more permanent and work is more ordered than exploration work. Students considering careers in development geology should consider supplementing their geological training with additional university courses in engineering, business, and labor relations, that are appropriate to their field of interest.

"Research" — careers involve field and laboratory investigation of specific geological subjects and ordinarily require advanced degrees beyond the Bachelor's. The principal employers of research geologists are the major petroleum and mining companies, agencies of state and federal government, and private research companies operating under contract to industry. Individual investigations are ordinarily of long-term nature, but have the advantage of offering more permanent residency. Most research is conducted on a personal basis or as part of a team effort with minimal administrative supervision. Students interested in research careers should consult with knowledgeable university faculty members for help in arranging visits to research facilities and/or personal interviews with experienced research geologists.

"Teaching" — careers in geology involve educational aspects conducted at the university, college, junior college, and high school levels. The teaching field generally requires a strong sense of dedication coupled with an inherent desire to help others. University and college faculty are usually expected to combine their teaching responsibilities with research effort of some kind. Most teaching positions allow for part-time consulting work for industry and government agencies. Salary is determined by annual contract with the institution and is usually less than can be earned in other types of geological work. Students considering teaching careers should supplement their geological training with additional university course work in education, scientific writing, psychology, statistics, and other programs that seem appropriate.

EMPLOYERS AND CAREERS

Employers

Depending on your specific interests, and on what you choose to emphasize in a course of study, there are opportunities for careers through a variety of employers.

In fact, there is no limit to the application of geology as it is practiced in commerce and industry, and certainly no limit to the breadth and scope of geological research.

There are more than 27,000 professional geologists employed in the United States. Two-thirds of these individuals are employed in private industry, mostly by petroleum companies or in related technical service organizations. The National Petroleum Council estimates that approximately half of the nation's oil and gas is still to be discovered, and, therefore, petroleum companies continue to hire geologists for exploration, development and research. Other private industries that hire geologists include: the vast complex of mining companies; chemical, cement, and ceramic industries; large land-grant railroads; and consulting firms of all kinds.

Colleges and universities employ between 7500 and 8000 geologists as teachers and research specialists.

The federal government employs between 2500 and 3000 geologists. Over 65% of these are in agencies that are a part of the U.S. Department of Interior — in the U.S. Geological Survey, the Bureau of Mines, the Bureau of Reclamation, or the Bureau of Land Management. Others work in the offices of Coastal Zone Management, and the U.S. Army Corps of Engineers.

Other important employers of geologists are: state geological surveys, highway departments, (and other state agencies), consulting firms, research institutes, museums, and high schools. In addition, many geologists are self-employed as independent businessmen and consultants.

Careers

Most geologists consider themselves specialists in one or more types of geological work. Here are a few of the more common career specialties along with comments regarding the nature of their educational background and responsibilities.

> "Petroleum geologists": — use their knowledge of general geology, sedimentation, stratigraphy, structure, engineering, geophysics and occasionally paleontology to identify possible sites of oil and gas accumulation; provide economic assessments of traps or reservoirs known to contain oil or gas: evaluate the results of drilling activity by other companies; and investigate new and improved methods of exploring for petroleum.

Some petroleum geologists work on drill sites; others devote most of their time to gathering and interpreting geological information that is utilized in formulating specific recommendations for their employers with regard to leasing, geophysical work, or drilling operations.

The principal employers of petroleum geologists are domestic and international petroleum companies whose prime objective is exploration for and development of new reserves of oil and gas. Many other petroleum geologists function as independent consultants to the industry as specialists in exploration techniques and reservoir analysis.

> "Economic geologists": — use their knowledge of mineralogy, petrology, structural geology, geochemistry and stratigraphy to understand mineral deposits; gather information on the processes by which minerals are formed and concentrated; develop exploration programs and recommend techniques that could prove helpful in locating new mineral discoveries; determine the economic potential for commercial development.

Economic geology is a broad field, so individuals tend to specialize in certain types of deposits or even in certain minerals such as gold, uranium, lead, or copper, or in rocks such as building or decorative stone, or in precious and semi-precious gemstones.

The principal employers of economic geologists are domestic and international mining companies, chemical companies, and land-grant railroads. Some are self-employed and function as consultants to other parts of the minerals industry.

"Engineering geologists": — use their knowledge of general geology, hydrology, geomorphology, rock mechanics, structural geology, engineering and mathematics to evaluate suitable sites for construction of highways, airfields, tunnels, dams, buildings and other complex structures; they assess potential geologic hazards such as flood plains, earthquakes, landslides and surface subsidence; they provide economic analyses on project assignments and frequently are called upon to serve as expert witnesses on legal matters.

Engineering geologists are very much in demand for employment by mining and construction companies, railroads, and especially consulting firms and government agencies.

"Groundwater geologists" (or geohydrologists): — use general geological knowledge, geomorphology, stratigraphy, chemistry, fluid mechanics, engineering hydrology, and water law to find, monitor or develop ground water resources; they conduct field investigations of water availability and provide economic analyses on acquifers, and determine the quantity and quality of water that can be extracted from an acquifer without causing damage or interfering with the rights of others.

"Marine geologists": — use general geological knowledge, sedimentation, erosion, chemistry, geophysics, biology, paleontology, and oceanography, to investigate submarine geology, potential hazards, and shoreline processes; design methods and programs for sampling and analyzing bottom material in the search for economic mineral deposits, construction sites, and for new scientific information.

Employment of marine geologists is largely by mining companies, government agencies, university research institutes, and consulting firms specializing in marine operations.

"Environmental geologists": — use their composite knowledge of geology, biology, climatology, and engineering, in order to investigate potential geologic hazards such as landslides, land subsidence, erosion, floods, toxicity, etc.; they specifically utilize geomorphology, hydrology, stratigraphy, and structural geology.

Environmental geologists are hired in relatively small numbers by government agencies, and consulting firms involved with land management and construction.

"Astrogeologists": — utilize all aspects of general geology dealing with stratigraphy, structure, mineralogy, and geomorphology, to interpret the geology on other planets based on a knowledge of earth processes.

Astrogeology ordinarily requires extensive specialized graduate study and research and a wide range of field experience. Federal agencies and a few universities are the principal employers.

EMPLOYMENT OUTLOOK AND SALARIES

The employment opportunity for capable and competent geologists is always good. In the early years of employment it may not be possible for a geologist to find a preferred position in an area or location of his or her choice, but the opportunities and alternatives toward these goals increase with maturity and experience. Those geologists with only Bachelor's degrees will always face stiff competition from others who have had advanced academic training. Most professional positions, at least in the larger corporations and agencies, require a Master's degree at the outset. Students considering lifetime careers in geology should anticipate this requirement and plan their education accordingly.

There is really no way to adequately classify salaries that graduating geologists can expect to receive upon completion of their academic training. Salary scales vary depending upon location and working conditions and on the policies of the company, agency, or school that is the employer. Some employers maintain salaries at a modest level, but provide additional benefits through insurance and retirement, or other means. On the other hand, some employers provide higher salaries but few benefits.

For general comparative purposes, geologists graduating (in 1980) with a Bachelor's degree are being offered annual salaries that range from $12,000 to $14,500; those with Master's degree, $13,500 to $15,500; and those with Ph.D.'s, $15,000 to $19,000. Geologists who have acquired on-the-job training or other practical experience while attending school, can expect $1,000 to $2,000 per year in addition to the salaries shown.

The majority of employers consider geologists as professional employees and hire them on an unlimited-hour basis, which means that they are expected to work whenever the occasion demands. Salary payments are ordinarily made at the end of each month based on a prearranged monthly rate minus deductions for Income Tax, Social Security, and Retirement. Most employers also provide compensation for travel and operating expenses that are incurred in carrying out the assigned duties.

During the first year of employment the geologist should attempt to learn as much as possible, and execute all assignments to the very best of his or her capability. After a year or two of experience, salaries can be expected to increase rather substantially if a geologist shows promise. Increases in salary normally include increased responsibility. Position advancement within companies depends largely on the opportunities that present themselves, personal initiative and dedication, and productivity. Average salaries of geologists with 3-5 years' experience in major petroleum and mining company operations are $19,000 to $27,000 per year (in 1980). Self-employed geologists with 7 to 10 years' experience can expect to earn $30,000 to $50,000 per year; and geologists in administrative and management positions may have salaries in excess of $50,000 per year.

CONSIDER YOUR CAREER NOW

Begin to think about your personal attributes and career goals, and discuss the matter with others who have had experience. Consult the local telephone directory, or other sources, that can assist you in contacting professional geologists in your local community. Discuss the matter with teachers or guidance counselors, or with friends and relatives who have personal knowledge of the subject. Consult the local library and browse through whatever literature or publications may be available. All states have professional geological associations or societies that meet frequently, and their members are always willing to answer inquiries or help provide information whenever they can. If possible, join them for lunch or dinner at their weekly or monthly meetings.

Write or call the Department of Geology at nearby colleges or universities, and solicit their help in obtaining additional information.

Above all, think for yourself and do not be overly influenced by others who may seem overly optimistic or pessimistic on specific aspects of geology as a career. Plan your own future, and you will be pleasantly surprised at the number of professional geologists who will help you achieve your goals.