CAREERS

TURNING POINT Hydrodynamics award leads biophysicist to wind energy **p.245**

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Geoscientists are needed in areas such as Ethiopia's Danakil Depression to study tectonic plates.

GEOSCIENCES

Earth works

There's good news for aspiring geoscientists. Job opportunities at all career stages are on the rise.

BY SID PERKINS

Mention geoscience and people often imagine trekking to far-flung regions to hammer rocks. But the discipline offers a wide range of opportunities beyond this. "There's room for those who love field work, and there's room for those who don't," says Eric Calais, a geophysicist at Purdue University in West Lafayette, Indiana, who has spent time in the field studying the movements and deformations of Earth's tectonic plates in Ethiopia, Siberia and Indonesia. Calais recently left the lab again — this time as science adviser to the United Nations Development Program's mission to quake-torn Haiti, where he is helping to develop public-safety policy and working with local scientists, government officials and international aid workers to build a national agency for seismic risk reduction. "Data analysts, computer modellers — geoscience needs all types of researchers," he notes.

Some geoscientists — a term encompassing geologists and geophysicists — study the composition, structure and other physical aspects of Earth, and its geological past and present, to search for and extract natural resources such as oil, gas and minerals. Others help to preserve and clean up the environment. Yet others are expert in fields such as atmospheric chemistry, oceanography and deep-earth mineralogy. Geoscientists find jobs in environmental services, scientific and technical consulting, government and academia — and even in high finance, where insurance companies rely on them to help assess long-term risk due to climate change, earthquakes, hurricanes and other natural disasters.

And while a few jobs in geoscience — particularly those in the private sector — require only a bachelor's degree, for most positions, education to master's-degree level or higher will be needed. According to the American Geological Institute (AGI), headquartered in Alexandria, Virginia, more than two-thirds of geoscience PhDs find their first jobs in academia, with the remainder landing positions in government and industry (see 'Where geoscientists work').

Despite the recent economic downturn, job prospects for geoscientists are excellent and are set to get even better. The latest data from the US Bureau of Labor Statistics (BLS; www.bls.gov) suggest that in 2018 there will be some 323,000 positions for geoscientists in the United States, about 23% more than in 2008. "If you have a degree, you'd have to be dead or dead lazy to not get a job," says Christopher Keane, AGI's director of technology and communications.

Yet there's even more room for optimism, says Leila Gonzales, a workforce analyst with the AGI. The BLS data only project changes in the number of jobs, she notes. They don't account for increased opportunities in the United States due to retirements, which will strike government, academia and the private sector alike during the next 10–15 years. This window of opportunity is the result of a collapse in commodity prices in the mid-1980s that was followed by a precipitous decline in geoscientists' salaries, which in turn triggered a drop in academic enrolments. In the next decade or so, many of those graduates from the early 1980s will be nearing the ends of their careers, boosting job availability upon their retirement.

And the number of retirements could be substantial, says Gonzales. About 12% of today's geoscientists are expected to retire by 2018, meaning that net job availability for geoscientists in the United States should have increased between 2008 and 2018 by around 35%, she says.

GOING GLOBAL

Demand for geoscientists is expected to rise worldwide, not just in the United States. Statistics compiled by the AGI for the International Union of Geological Sciences indicate that the three regions that produce the most geoscience graduates each year — the United States; Europe and Russia combined; and China — aren't even meeting their own domestic needs, much less global requirements.

The number of geoscience degrees granted in the United States each year (about 1,060 master's and 650 PhD degrees) has remained relatively stable for the past 15 years or more, says Gonzales. That steady, yet inadequate, pace of new entries into the field, paired with the wave of retirements during the next 10–15 years, almost ▶

guarantees that demand for skilled geoscientists can only increase.

In the past, about half of the global demand for geoscientists has come from the United States. But now and in the near future, rapid economic expansion in India, China and the rest of the developing world is expected to boost international demand for geoscience graduates. Highly skilled geoscientists will be needed to help identify and develop oil, gas and mineral resources, as well as to help recognize and ameliorate natural and man-made environmental hazards in these developing markets.

Until now, the United States and Europe have been able to import geoscientists from other countries to meet demand, while emerging economies have typically struggled to retain their own talent. Areas with a desperate need for geoscientists — South Africa, Nigeria, and central and eastern Europe, among others — continue to lose new graduates in search of higher wages and additional education in North America and western Europe.

By contrast, the export of geoscientists from the developing world provides incredible opportunities for fledgling geoscientists from developed countries to gain experience in those regions — especially if they are willing to work under difficult conditions in remote areas that may be politically unstable.

"There's room for those who love field work and there's room for those who don't."
Eric Calais

If recent trends continue, many of the new positions will be outside the United States. Between 2007 and 2009, the proportion of geoscience PhDs working outside the United States rose from 10% to 12%. The key to career success may indeed be mobility, Keane, Gonzales and their colleagues contend. "If you're willing to move around, there's great opportunity," says Keane.

IN HIGH DEMAND

Despite the growing desire of many countries to shift to renewable sources of energy, economic growth in the foreseeable future will continue to bolster demand for fossil fuels and for the geoscientists needed to find them. Even in the oil and gas companies, which typically offer some of the highest salaries, the projected supply of new talent won't come close to meeting demand. By 2030, the petroleum industry is likely to have at least 13,000 unfilled jobs, according to data compiled by the AGI.

One of the geoscience employment sectors poised for growth is consultancy, according to the BLS, which includes it in the "professional, scientific and technical services" sector. Geoscience research consultants in the United States can work either independently or as employees of private contractors. The BLS predicts that between 2008 and 2018 the sector will grow by more than 50%, even without counting retirements. This growth will provide opportunities for geoscientists equipped with a strong set of fundamental skills, particularly postdocs with several years' experience who elect to leave academia, and mid-career researchers who choose to leave government positions. Projected growth in this sector is largely driven both by increased demand in the private sector and by the US government's increasing inclination to outsource work rather than hire new employees.

There will be some jobs for geoscientists in government, however. The number of geoscience posts across federal, state and local government in the United States is expected to have risen by about 7.7% by 2018, says the BLS. Growth will be less at the federal and local levels (around 6.9% and 7.1%, respectively) but stronger at the state level (about 8.7%), with many of the positions arising in agencies tasked with implementing regulations on environmental issues such as water quality.

Many of today's senior geoscientists were trained as specialists in relatively narrow disciplines, but in future, most demand will be for researchers who have been trained to appreciate the interdisciplinary nature of the Earth sciences.

For example, a geoscientist studying toxic algal blooms in coastal waters will need to understand how rivers, streams and groundwater become tainted by fertilizer, how quickly those pollutants reach the sea, how quickly the algae grow under different environmental conditions and how those growth rates might vary under climate change — an understanding that would come from training in geology, oceanography and biogeochemistry.

Geoscientists who find employment in the private sector are likely to work in teams of people with diverse backgrounds, which means that a broad education and experience — as well as good interpersonal skills and the ability to communicate effectively — must-haves in the workplace.

Devising solutions to many of today's most pressing problems will require knowledge spanning several fields, says Jeff Gaffney, an atmospheric chemist at the University of Arkansas in Little Rock. To evaluate the potential costs and benefits of switching from fossil fuels to biofuels, for example, researchers must consider issues such as air quality, water quality, agricultural development and the effects of fertilizers and pesticides needed to grow the crops that produce the biomass feedstock. At a minimum, researchers must be familiar with the jargon used by team members of other disciplines. "Otherwise, everyone's talking a different language," Gaffney notes.

But in addition to becoming more interdisciplinary, geoscience is becoming more technical, especially in certain subdisciplines such as atmospheric chemistry and climate change, where computer modelling has become a mainstay. A strong background in mathematics, particularly in statistics and in computer simulation techniques, will enable researchers to understand and interpret models used to simulate the behaviour of everything from ocean currents to the material properties of minerals deep in Earth's mantle.

COMPLEX SYSTEMS

"Many earth-science systems are very complicated," Gaffney says. "Researchers need to understand not only the mathematics of the models they're using but the basic fundamentals of the physical and chemical processes that they're trying to simulate," he says. And that's especially true for models used in analyses that could have substantial effects on public policy, such as those related to climate change or to the potential costs and benefits of alternative fuels.

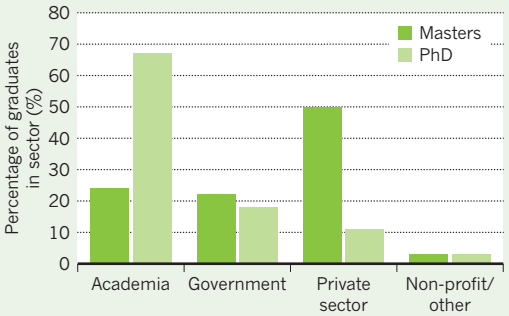
Computer skills will be indispensable for almost all positions in geoscience, and students who have acquired experience in data analysis, digital mapping, remote sensing and the ubiquitous Global Positioning System and geographical information systems will be best prepared to enter the job market. Computer programming skills will also be essential, not only for developing or enhancing detailed computer models but for designing sensors, equipment and data-collection networks. Geoscientists will either need to develop these skills or know enough about them to work with specialist colleagues carrying out those tasks.

For those willing to get interdisciplinary training, the future looks bright. Someone entering an undergraduate geoscience programme today and then pursuing a master's or PhD degree will enter a job market flush with opportunities — especially if they are willing to relocate. ■

Sid Perkins *is a freelance science writer based in Crossville, Tennessee.*

WHERE GEOSCIENTISTS WORK

Percentage of recently graduated geoscientists with advanced degrees in different employment sectors.



SOURCE: AGI