

In the Geosciences, Business Is Booming

Flat federal funding means tight times in academia, but jobs abound in the petroleum, mining, and environmental consulting industries

GEOLOGIST AMY SIMONSON LOVES HER work. She spends her days in the countryside around Charlottesville, Virginia, measuring stream flow and groundwater levels for the state's Department of Environmental Quality. The job, she says, is exactly what she wanted.

Simonson, 25, began her job hunt in 2007 after getting a master's degree in geology from the University of Delaware, Newark. She had one condition: She wanted to spend as much time as possible in the field,

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not in front of a microscope or a computer. Taking a scattershot approach, she applied for jobs in geophysics, engineering, environmental consulting, and geographic information system mapping. She didn't have to wait long. "I got offered a lot of stuff," she says.

Simonson's experience isn't rare. For many young geoscientists now embarking on careers, the job outlook is very good. The current federal research funding situation means it's less rosy for those on an academic research track. But for those in industry, the number of geoscience jobs will grow by 22% from 2006 to 2016, much faster than the projected total of a 10% increase for all occupations, according to the U.S. Bureau of Labor Statistics.

"In general, the market is hot," says Cindy Martinez, who analyzes geoscience workforce issues at the American Geologi-

cal Institute (AGI) in Alexandria, Virginia. "Functionally, there's no unemployment of geoscientists right now."

In the petroleum, mining, and environmental consulting industries, a desperate quest for new talent has sent companies scrambling to hire new graduates. Traditionally, a master's has been the professional degree of choice for industry employers. But the need for new hires within these fields is such that even graduates with bachelor's degrees are finding jobs, particularly in environmental con-

sulting—although a master's is generally needed to move up the ladder from fieldwork to the office.

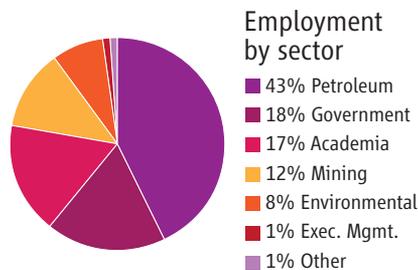
That intense competition for new hires has raised starting salaries in these industries, especially oil: Graduates now entering the petroleum industry earn \$82,500 a year, on average, according to AGI.

Geoscience salaries generally have also been increasing, AGI data show. In 2005, the average starting salary for a geoscientist in an industry, academic, or government position was \$74,000, a 9.7% increase over 2004. For later career scientists with more than 20 years of experience, the average salary was \$139,000 in 2005, an increase of more than 23% over the previous year.

The current hiring boom in the petroleum industry is a welcome change from the layoffs of the 1980s and 1990s; unemployment among geoscientists reached 11% in 1985. Those layoffs left a distinct gap in the oil industry workforce between new hires and senior managers, a 2007 National Petroleum Council report noted. And with many senior managers likely to retire within the next decade, there aren't enough midlevel managers ready to take the helm. This hiring and firing pattern is "totally cyclical," Martinez says. "The industry needs to work on fixing that."

Although industry jobs are readily available, the job market is tougher for students seeking careers in academia. One problem is a research-funding shortage, as primary funding sources such as the National Science

GEOSCIENCE STATS



Starting Salaries

| | AVERAGE (\$) | MEDIAN (\$) |
|---------------------------|--------------|-------------|
| Geoscience Masters | | |
| Oil and Gas | 81,300 | 82,500 |
| Environmental Firm | 47,500 | 45,500 |
| Any Government | 46,200 | 45,000 |
| Geoscience Ph.D.s | | |
| Postdoc—Academe | 43,100 | 42,000 |
| Postdoc—Gov't. | 55,200 | 53,000 |
| Permanent Academe | 51,900 | 52,500 |
| Private Sector | 72,600 | 71,000 |

Foundation have suffered from essentially flat research budgets for the past few years. That lack of research money contributes to another trend: When a venerated geology professor retires, some universities are choosing not to hire a replacement, filling the position with a scientist in a different, often environmental, field, or not at all. As of January 2008, the number of geoscience faculty members in U.S. colleges and universities was 12,354, down from 13,554 in 1999, according to a June 2008 report released by AGI.

The lack of available academic positions has left geoscientists who aspire to faculty jobs in limbo, often stringing together several post-doc positions as they wait for openings, Martinez says. The percentage of geoscience post-docs “has really gone through the roof,” with about 58% of Ph.D. graduates pursuing post-docs in 2005 compared with 40% in 1999. That trend may soon slow if a combination of strong industry salaries and weak academic opportunities pushes some students to leave graduate school early. “We’re seeing geoscientists in droves going into industry with master’s degrees and not staying on for Ph.D.s,” Martinez says.

“My perception is indeed that there are many more applicants for jobs than there are positions,” says Joseph Colgan, a Mendenhall Postdoctoral Research Fellow at the U.S. Geological Survey (USGS) in Menlo Park, California. Colgan, who studies the geologic setting of mineral deposits in the western United States, has considered academic jobs but would like to stay in a more permanent job at USGS. However, the agency, like many universities, has tightened its belt after years of flat or declining budgets, which means fewer hires.

Geoscience graduates will have training that qualifies them for jobs outside of their home field. Scientists with training in multidisciplinary specialties such as isotopic tracers, mineral commodities, and geotechnology are successfully venturing into fields that aren’t considered geologic, including medicine, law, and finance. In fact, only 50% of people with geoscience degrees currently work in the geosciences, according to AGI.

Ultimately, for geoscientists who want to work in industry, job opportunities abound. “The earth sciences are in a somewhat unique situation at the moment because we’re in one of the biggest commodity booms ever,” Colgan says. So if he doesn’t get a permanent position with USGS, he adds, “I’ll come up with something else.”

—CAROLYN GRAMLING

Carolyn Gramling is a geosciences writer in Washington, D.C.



In the field.
Sally Serenyi joined Schlumberger for “a bit of adventure.”

GEOSCIENTISTS IN HIGH DEMAND IN THE OIL INDUSTRY

The next generation of petroleum geologists will face unique challenges in meeting the world’s energy demands

SIX YEARS AGO, WOULD-BE LAWYER KIRA DIAZ-TUSHMAN HEARD A NATIONAL PUBLIC Radio program about the impending retirement of senior U.S. Geological Survey (USGS) geologists. “I thought, ‘That sounds fun. I want to do what they’re doing and play around in the field.’” So she double-majored in geology and political science at Bryn Mawr College in Pennsylvania and did a summer internship at USGS.

Watching researchers scramble for dwindling federal funding turned her away from government work. But her interest in geology persisted, so she studied for a master’s degree in structural geology at the University of Texas (UT), Austin. While there, she interned with the technology group at Apache Corp., an oil exploration company based in Houston, and learned the basics of seismic mapping. She began to seriously consider a job in oil exploration.

Diaz-Tushman, now an operations geologist for BP, is part of a fast-growing global cadre of scientists and engineers building careers around unlocking more of Earth’s energy reserves. Those in the field repeat the mantra that the “easy oil is gone”; this new generation faces the challenge of finding oil in remote locations and of pioneering new ways to tap into unconventional reserves in existing oil fields.

Mind the gap

The cyclical nature of oil prices has left a historical footprint on the existing pool of human resources. Low prices in the 1980s and 1990s meant that many major companies recruited less or not at all, leaving them top-heavy and in need of young talent.

The hiring gap “is more of a driver than the price” of oil today, says Laura DeMott, a Houston-based senior petroleum geologist at ExxonMobil. Regardless of the cause, demand for people with geological and geophysical training is high in the oil industry, and experts predict it will stay strong for the next 5 to 10 years.

People entering the industry will have their choice of a great diversity of companies, locations, and career paths. In North America, family-owned single-drill outfits work alongside multinational

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Pumped up. Traylor Kulshan tests a new well north of Kabul, Afghanistan.



HYDROGEOLOGISTS TAP INTO DEMAND FOR AN IRREPLACEABLE RESOURCE

Cross-disciplinary collaborations and a steady stream of new environmental problems give groundwater experts plenty of work to do

WHEN HYDROGEOLOGISTS TALK ABOUT their field, one word keeps coming up: “recession-proof.” While geologists in the energy and mineral industries face roller-coaster hiring-and-firing cycles, those who study the movement and chemistry of water seeping through rocks and sediment find demand for their expertise almost as steady as the flow of groundwater itself.

“I can’t think of any unemployed hydrogeologists,” says Roy Haggerty, an associate professor of hydrogeology at Oregon State University, Corvallis. It’s easy to see why. Water is essential, irreplaceable, and, as populations and economies grow, increasingly in demand and endangered.

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). Government regulatory agencies, national laboratories, and mining and oil companies also need them. 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. And signs are that the future will hold more of the same. As Richelle Allen-King, a hydrogeology professor at the University at Buffalo in New York, puts it, “Water problems are not going away.”

A steady flow

Kurt Zeiler, 32, works in the Denver, Colorado, office of the global environmental-services company AMEC Geomatrix. After 5 years as a hydrogeologist, he says: “It’s going well. I definitely love this field. There’s a lot of

opportunities to do really interesting science.”

Zeiler’s training—a B.S. in earth science from Montana State University in Bozeman and a double-M.S. in water resources and hydrogeology from the University of Wisconsin, Madison—exposed him to the whole gamut of hydrogeologic work. He learned to monitor the water levels in wells for the differences in hydraulic potential (“head”) that drive water through porous rock or sediments, analyze well-drilling cores to get a picture of underground rock and sediment layers, perform pump tests to determine how readily the water can flow through the strata, and probe water samples for their geochemistry and contamination.

His forte, though, is running the computer models that hydrogeologists use to integrate their knowledge of a groundwater system and plan its future. Zeiler’s modeling work has covered sites in California, Montana, Alaska, and Ghana. His biggest project is an aquifer east of Los Angeles where groundwater contaminated with fuel and industrial solvents is being pumped out and treated for use as drinking water. Zeiler says he leaves most of the



Taking data. Kurt Zeiler logs core samples.

data gathering to other scientists. “I enjoy being outside—working on a drill rig, getting my hands dirty, all that stuff,” he says. “But modeling is where I’ve ended up.”

Of the 15 hydrogeologists in the Denver office where Zeiler works, only three have Ph.D.s. That’s typical of the field as a whole: AGI estimates that university programs graduate five times as many M.S. students as Ph.D.s. Its figures show that about 18,000 hydrologists and hydrogeologists now work in the environmental industry, a few thousand in the mining and petroleum industries, and about 850 in academia, the only sector for which a doctorate is required.

Despite high demand, salaries for hydrogeologists in government and in the private sector remain about 15% to 20% below those of other geoscientists. Low payoffs go hand in hand with high security, Haggerty says: “I know of people in their 50s who have been fabulously successful in the petroleum industry, but there are boom-and-bust cycles. In hydrogeology, the boom and bust is not there. It’s much more level. But I don’t know of many multimillionaire hydrogeologists, either.”

If the field doesn’t surge, it does at least ebb and flow. “Ten to 20 years ago, it was all cleanup—contaminant work,” Allen-King says. The profession’s cleanup phase waned in the late 1990s and early 2000s as changing political priorities, soaring cleanup costs, and some noteworthy environmental successes led to cutbacks in remediation.

Now, the focus has shifted to supply, the problem of finding and managing water resources while protecting their quality. Techniques such as artificial recharge (reinjecting water into the ground for storage) and carbon sequestration (keeping carbon dioxide emissions from combustion out of the atmosphere by forcing them underground) raise new water-related environmental issues that scientists are just learning to tackle.

In the realm of research, academic hydrogeologists are broadening their time horizons to help forecast and mitigate the effects of climate change, and they’re stretching the traditional boundaries of their field to explore questions such as how groundwater interacts with the surface water of lakes and rivers. Collaborations with scientists from other disciplines are proliferating. “More and more, hydrogeologists are no longer working alone,” says John Wilson, a hydrology professor at the New Mexico Institute of Mining and Technology in Socorro. “The subsurface is part of it but no longer the whole thing. Other parts of the cycle—biology, chemistry, ecology, and climate—that is where research is going, I think.”

Shades of green

The broadening of academic research has filtered down to the training of M.S. students. Some graduate programs, such as New Mexico Tech's and the double-M.S. program at the University of Wisconsin, now require interdisciplinary courses in topics such as surface water, ecology, and economics. Some hydrologic consulting companies, however, complain that versatility isn't what they need. "We're having difficulty finding traditional hydrogeologists," says Daniel Stephens, founder and head of a 110-employee environmental consulting company with offices in New Mexico, Texas, and California. "The people we're seeing are fewer in number, and their qualifications are thinner." Instead of giving students a smorgasbord of skills, Stephens says, universities should equip them to start work on real projects.

But Wilson, whose department at New Mexico Tech embraced the multidisciplinary approach a decade ago, says his students are well-prepared to learn anything they need to know. "At some point, the employer is responsible for training students in the details of the jobs," he says. Oil companies, he notes, are happy to recruit promising hydrogeologists and train them in petroleum exploration.

If money were the only lure for earth scientists, fossil fuels might be the only fluids in town. But hydrogeologists say a strong undercurrent of environmental idealism pervades the field as well. Just as many senior scientists drew their inspiration from the first Earth Day, some young water experts are pursuing activist agendas of their own—and carving out new career paths to do it.

Trayle Kulshan is one of them. After getting her M.S. in hydrogeology from Stanford University in Palo Alto, California, in 2002, she spent 2 years in the Peace Corps in Guinea. Now, as water, sanitation, and hygiene coordinator for the humanitarian nongovernmental organization Action Contre la Faim (Action Against Hunger), she plans and oversees projects to build wells, latrines, and water networks in developing countries as far-flung as Afghanistan and the Democratic Republic of the Congo. She currently is working in Kenya. Although she is now as much a public-health worker as an earth scientist, Kulshan says her graduate training gives her a quick grasp of hydrologic conditions as well as skill in collecting, analyzing, and interpreting other kinds of data and communicating the results. "In grad school, we are all [teaching assistants] and develop skills as teachers. Every day I am teaching," she wrote by e-mail from Nairobi. "And I have to say I am still a student learning every day as well." —**ROBERT COONTZ**

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exploration companies such as Schlumberger and companies that integrate the entire process from exploration to production to distribution, such as BP and ExxonMobil.

Recruitment and preparation

Sally Serenyi didn't set out to join the oil industry. But not long after she graduated with her bachelor's degree in physics from the University of Exeter in the U.K., she walked past a glossy recruiting display at a career fair with pictures of exotic landscapes. The display was for Schlumberger; now, just under 2 years later, she works for the company as a field engineer. "I joined for a bit of adventure," she says, and the "opportunity to go all over the world." Serenyi works with a crew of a half-dozen engineers and equipment operators near exploration sites in Austria and Hungary, collecting and preparing data for client companies.

Recruiters generally encourage students interested in the oil industry to obtain master's degrees, and industry-sponsored scholarships provide some incentive. But the current demand for new talent means that companies are "happy to have people with a strong bachelor's," says Charles Groat, former USGS director and now a professor of energy and mineral resources at UT Austin. Groat tells students that oil companies still prefer graduates who have fundamental training in geology and geophysics and who are comfortable with quantitative analysis, perhaps through classes in economics, statistics, or computer science. There are also jobs available to people in related fields including physics and engineering, as Serenyi found.

Companies use internship programs as recruiting tools and as extended interviews, says Eric Lyons, a geophysicist at BP. Lyons did three internships with Marathon Oil Corp. en route to earning a geophysics master's degree. Such programs give companies "a chance to look at the students and vice versa," Groat says. But internships are "a long way from being required," he adds.

The daily grind

New recruits to large companies typically spend a significant part of the first couple of years completing in-company training and gaining experience with different parts of the company. Lyons, who has worked on North American oil fields, now works on fields in the Gulf of Mexico and will be assigned elsewhere next year. For DeMott, who earned her master's degree in geology in 2007, training at ExxonMobil will involve three 8-month placements.

As companies bring in green staff, they are also trying to bring experienced staff back from retirement, or retain baby boomers as part-time consultants, to train the young recruits. Even so, the workforce is expected to be bottom-heavy—which could work to the advantage of younger employees. "In a few years, there will be the option to go up the ladder faster," Diaz-Tushman says.

In large companies, young geoscientists often have a choice of pursuing a managerial track or a parallel technical career ladder, with comparable compensation and recognition. In smaller companies that have just one or two geologists on staff, that may not be possible, and the work can be "more mundane, since they don't have the resources for more exotic stuff," says Groat. Still, smaller companies can have a different culture that may suit some geoscientists, he adds.

Lyons warns students who "love being outside" that at most oil industry jobs, "you're gonna be sitting inside all the time." Diaz-Tushman says that even though some of her work is in the field, ultimately, "I have an office job." It is possible to find fieldwork-focused jobs, such as Serenyi's, but fieldwork can mean giving up sleep when a well needs attention or a client suddenly needs data. "[The lifestyle] wouldn't fit someone who wasn't particularly energetic," Serenyi says.

Challenges

Plenty of technical challenges await this new generation of geoscientists. "The hottest area right now is unconventional reservoirs," says Groat. These include tight reservoirs of traditional hydrocarbons that have no natural fractures for engineers to exploit as conduits. Oil companies are also exploring other hydrocarbon sources such as heavy oils, coal-bed methane, and oil shale.

"There's a lot of stuff out there," DeMott emphasizes, "but what's there is not easy and not cheap to get out; ... that's the problem that everyone is facing."

It's hard to forget the price crashes, layoffs, and hiring freezes that swept the industry during the 1980s and 1990s. But analysts predict not just stability but strong growth in jobs in the field in the near future.

"Maybe the hiring rate will slow in 5 or 10 years," DeMott says, "but I'm not concerned with losing my job. There's still not that many people to hire."

—**LUCAS LAURSEN**

Lucas Laursen is a freelance science writer in Cambridge, U.K.