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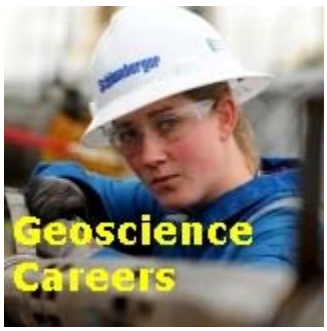

Hydrogeologists Tap into Demand for an Irreplaceable Resource

Robert Coontz
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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.

"Water problems are not going away." - Richelle Allen-King, University at Buffalo

"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.

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Taking data. Kurt Zeiler logs core samples.

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 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.

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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."

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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.

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

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 is the deputy news editor for physical sciences at *Science.*	Comments, suggestions? Please send your feedback to our editor.
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