

JOBS, JOBS, EVERYWHERE, BUT NOT ENOUGH PEOPLE TO FILL THEM

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This has been a vintage year for the health of the geoscience workforce in the United States. Overall enrollments and degrees in geoscience programs increased 5 to 10 percent — as they've been doing for the past four years — this year reaching nearly 25,000 undergraduate majors and 10,000 graduate students across the country. Employment opportunities for geoscientists continue to be widespread, with more jobs available than people to fill them. Despite these sunny prospects, there are clouds gathering on the horizon: After years of talking about it, what has been termed the "Great Crew Change" — when a large cohort of retiring geoscientists will vacate positions that will need to be filled by younger colleagues — is now upon us. This year marks the first time that the crew change is no longer an event on the horizon, but an immediate situation we must recognize and deal with. And that is both good and bad.

The challenge upon us is that the baby boomers are retiring at a rate faster than they can be replaced. In almost all technical fields, especially in the geosciences, the remaining (and incoming) workforce is not nearly large enough to fill the void.

In 2011, the American Geosciences Institute (AGI) Geoscience Workforce program measured the first wholesale attrition of geoscience professionals, due to retirements. It has started in the federal geoscience workforce, especially in the nonregulatory agencies like the U.S.

Geological Survey and NOAA. However, the demographics of the oil and gas industry, as well as the mining industry, indicate that this same phenomenon will start affecting these industries within the next two years. It will also soon start affecting academia, where it would have already taken effect were it not for the tendency of faculty to work beyond the normal retirement age.

Of course, in this time of a troubled economy, the prospect and current reality of a strong geoscience job market is welcome news. It becomes a problem,

INNOVATION

Beyond a massive injection of new human capital, another major way to close the gap between retirees and remaining and incoming geoscientists is through innovation driven by entrepreneurial effort. Today, the best estimate is that entrepreneurial geosciences account for about \$10 billion of economic activity — a bit more than 20 percent of the current geoscience contribution to the U.S. GDP. The individuals who can innovate in the geosciences and who can make the profession increasingly effective and efficient will measurably close the human capacity gap and stand to reap great rewards.

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though, when the number retiring is so much larger than the number of remaining and incoming workers. By 2021, we expect to have seen 125,000 U.S. geoscientists retire. The next-generation workforce is only about one-third the size of the retiring population. Add the fact that forecasts by the U.S. Department of Labor suggest that by 2021 we could add 72,000 new geoscience jobs to the current 250,000 geoscience positions, and you can see the magnitude of the problem: We're facing a deficit of 150,000 geoscientists by 2021!

The reality is that we won't have enough educated geoscientists to fill these positions. But those 150,000 jobs will not be left unfilled. Free markets excel at solving problems like this. The most likely solutions will be substitution: Individuals with nongeoscience backgrounds take on the necessary work. That opens up a whole other can of worms. There are other solutions to the gap, and one that poses great opportunities is innovation making the geosciences substantially more efficient.

THE GEOSCIENCE WORKFORCE AT A GLANCE

- There are more than 250,000 working geoscientists in the United States today.
- Outside of the U.S., there are about another 250,000 geoscientists working today.
- Most of the geosciences research that makes headlines and is published in the literature is performed by just 5 percent of geoscientists — the 5 percent who are university faculty or full-time researchers.
- The geosciences contributed about 0.3 percent to the U.S. GDP in 2010.
- In 2010, the total compensation of all geoscientists in the U.S. was \$21.2 billion.
- Every year in the United States, about 3,000 new geoscience bachelor's degrees are awarded, and 1,500 geoscience graduate students earn their master's or doctorate degree.

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IMMIGRATION

Some people have proposed that perhaps we can just bring in educated geoscientists from outside the U.S. to fill the necessary jobs over the next decade. But in reality, filling our demand gap by 2021 will be nearly impossible solely through immigration because the demand for geoscience skills outside of the United States

— especially in critical areas such as hydrocarbons, mining and water resources — continues to accelerate with economic growth in China, India and other emerging economies. These countries are struggling to meet their own growing domestic demand for geoscience talent.

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It's one thing to fill a position in a consulting firm or oil company where teams with diverse expertise are harnessed to solve problems, but hiring in narrowly specialized areas such as academia is challenging. Faculty embody a great specialized pool of expertise and replacing those individuals is not a simple task, but it is critical to make the future development of the workforce sustainable.

This is particularly challenging in specific disciplines such as mining. Oft-derided as a dead area, mining-related geoscience graduates are in high demand, in both industry and academia. However, the number of programs and faculty to teach the next generation of mining-related geoscience graduates are dwindling, as are specific specialties such as underground ventilation. If the appropriate faculty are not available to educate students, then not only will it be difficult to produce the graduates needed, but also our society risks losing entire swaths of pertinent knowledge — knowledge that will only be available in the archives of journals or a few books, or lost forever as professionals retire and pass on without disseminating their knowledge. Most of our institutions lack robust inter-generational knowledge transfer. With these changing demographics, will some geoscience skills and knowledge need to be rediscovered?

This was a good year overall for geoscientists, but it also marks the start of a decade of great change. In that change will come great opportunities for those workers who are nimble, innovative and focused, but we will also see the geosciences needing to embrace new sources of human capital: Evolution is not only necessary, but inevitable.

Keane heads the AGI Geoscience Workforce program and is also editor of EARTH.

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U.S. Geoscience Workforce Today and in the Next Decade

47% of high school seniors have taken earth science courses...



...but these students score below average on the SAT, and thus are not ready for university geoscience programs.

2010 Geoscience Enrollments

Highest undergraduate enrollments in 10 years
Graduate enrollments up 15% from 2009
Undergraduate: 23,983
Graduate: 9,054

2010 Geoscience Degrees

Change from 2009:
+3% (BS), +7% (MS), +6% (PhD)
Bachelor's: 3,037
Master's: 1,078
Doctorates: 668

Graduates Pursuing Geoscience Careers

30% Bachelor's degree recipients
43% Master's degree recipients
66% Doctorates



262,627 geoscientists working today...

...only 130,000 will be still working in 2021

Half of the current geoscience workforce is within 10 years of retirement age.
45% of current federal government geoscientists are at least 50 years old.

322,000 geoscience jobs in 2021...

Given current geoscience graduation rates, and if 100% of graduates were hired into geoscience jobs...

...the maximum production of new geoscientists by 2021 is 63,000...

...which translates into
145,000 to 202,000 unfilled geoscience jobs by 2021

Challenges Ahead

More than 50% of the mining geosciences workforce is eligible to retire by 2012. There are now only five university programs with a focus on economic geoscience. 90% of the mining and economic geoscience faculty are nearing retirement.

Who will train the next generation?

