AN INTRODUCTION TO A LIFE IN SCIENCE

The quest for understanding some aspect of the natural world is what gets a lot of us bounding out of bed in the morning. Many of us love the "aha" moments when we've come a step closer to explaining our planet, field area, rocks or minerals, or when we figure out what is going wrong with our experimental or analytical set-up. Like the arts, science can be a satisfying, creative process as we strive to explain our findings in writing, diagrams and presentations. Solving geologic problems commonly requires long years of training and, unlike many of the sciences, a need to understand both the "big picture" (e.g. plate tectonics) and the "small picture" (atoms in minerals). Some days, we power through our work – solving problems left, right and centre – and other days, we muddle through – perhaps even taking a few steps backwards. In the midst of all of the "science to be done" and ever-growing "in boxes," it can be challenging to step back and look at where we are, where we plan to go, or how we fit into the global geosciences community.

This new *Elements* column – A Life in Science – is dedicated to supporting the career aspirations and progress of geoscientists, from students through retired professionals. It will focus on ways to make your life easier and to establish a satisfying career in the geosciences. For example, upcoming topics may include early-career issues, writing, laboratory science, science outside academia, teaching, industry–university collaborations, communication strategies, science around the world, science after retirement, work–life balance, and issues for minorities.

WHY SHOULD WE THINK ABOUT OUR LIVES IN SCIENCE NOW?

The Geological Workforce Is Changing or Has Changed

Since I was in high school, we've been hearing that "the old guys are going to retire," with the implication that many more jobs will become available in the geosciences. In some countries, this turnover is in progress. For example, some Canadian geoscience departments have experienced a ~50% turnover in the last ten years. In the USA, the American Geological Institute (AGI) has found that the supply of newly trained geoscientists falls short of the geoscience workforce demand and replacement needs (Gonzales et al. 2009). Their surveys indicate that the number of working geoscientists in USA academia, federal agencies, and industry reaches a peak between 51 and 60 years of age (Fig. 1). In contrast, the percentage of geoscientists between 31 and 35 years of age is very low.

These major shifts in geoscience demographics mean that most workplaces, including those in the geosciences, will undergo considerable change in the next 15 years. Succession planning has become one of the more critical workplace issues. Such transformation of our workplaces means that increasingly we will need to embrace change, career development, and mentoring (both giving and receiving).

Career Aspirations Change at Different Educational Levels

It should not be a surprise that geoscientists at different educational levels have different career aspirations and different views of geoscience careers. Indeed, one of the goals of an advanced degree is to develop new academics, while lower-level degrees have broader goals.

In 2006, the AGI and the American Geophysical Union surveyed current and recently graduated undergraduate and graduate students' attitudes to work (Gonzales et al. 2009). Although this survey may not represent current conditions, it gives a general idea of career aspirations among US students and recent graduates. Unsurprisingly, their study showed that US undergraduate students have a wide range of career aspirations, with interests in employment across a spectrum of geoscience fields. The highest citations were given for government, the environment, mining, petroleum and academia (Fig. 2). Master's students in US geoscience programs showed interest in a range of careers, with highly positive attitudes towards careers in academia and government, and positive attitudes towards industry. PhD students had more limited positive attitudes to different careers, with 81% interested in academia, significant interest in government and less interest in industry (Fig. 2). Small variations in attitude were observed with time beyond their degrees (Gonzales et al. 2009; their Figs. 3.1-3.3), which is consistent with the idea that student career aspirations are unrelated to faculty members' perception of employment and the finding that faculty gave very high ratings to most geoscience career options (Fig. 2).

An interesting aspect of the AGI survey results is that although master's students ranked industry careers lower than other areas, half of them obtained work in industry: 21% in the oil and gas industry, 20% in the environment industry and 9% in other industries. The remaining master's students found work in academia (24%), government (22%) and other areas (4%). In contrast, employment rates for US PhD graduates in the survey were 67% in academia (including postdoctoral fellowships), 18% in government and 11% in industry. Clearly, employment is related to job openings, and perhaps employment will change as "the old guys retire" (Fig. 1).

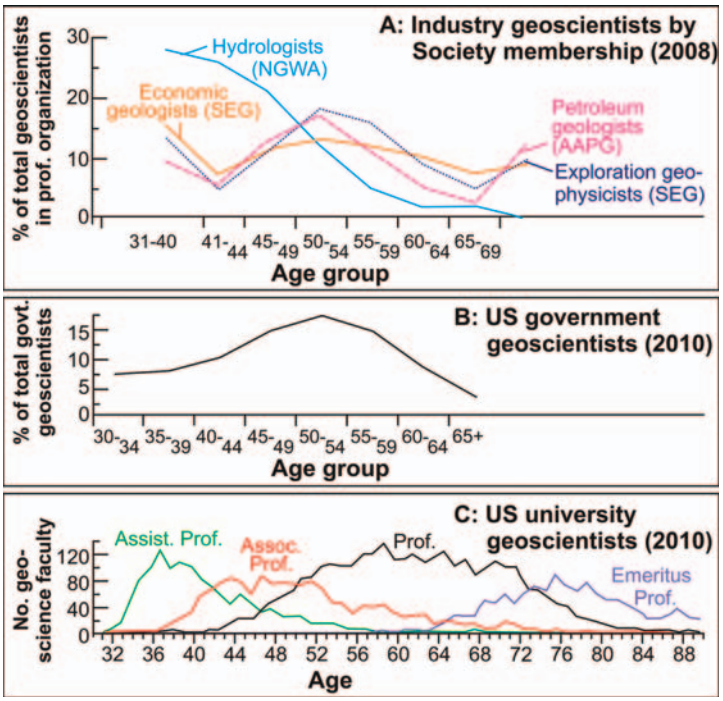

Figure 1 (**A**) Demographics of geoscientists in different professional associations from the AGI Geoscience Workforce Program; data provided by the Society of Exploration Geophysicists (SEG), American Association of Petroleum Geologists (AAPG), Society of Economic Geologists (SEG), and the National Ground Water Association (NGWA) (adapted from Gonzales et al. 2009) (**B**) Demographics of US government geoscientists (adapted from Gonzales 2011) (**C**) Demographics of US university geoscientists by rank (adapted from Gonzales 2011)

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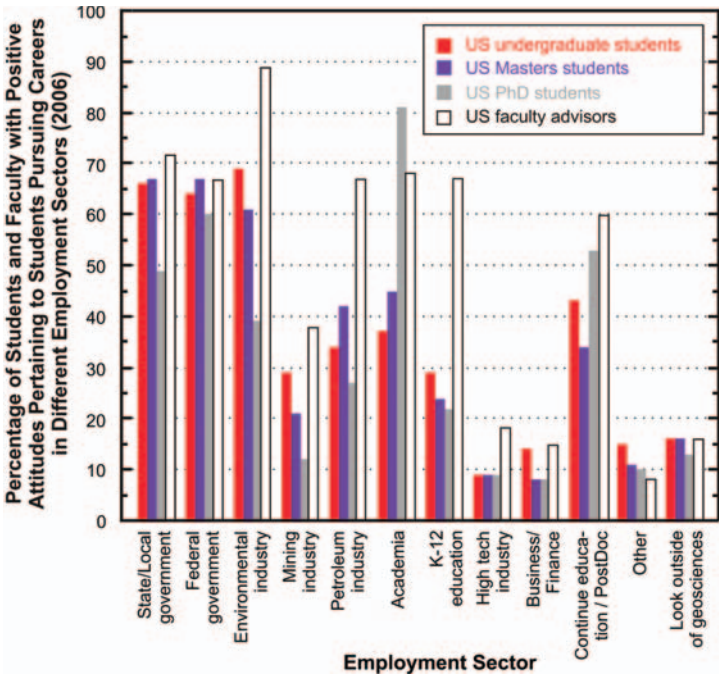

FIGURE 2 Percentage of students and faculty advisors with positive attitudes about students pursuing careers in different employment sectors. SOURCE OF DATA: GONZALES ET AL. 2009

Career Aspirations Change as a Function of Education Experiences and Career–Life Issues

While the AGI survey was centred on geoscientists, another survey focused on PhD students and postdoctoral scholars in sciences in the University of California (UC) system (Goulden et al. 2009). The latter study garnered substantial press coverage when it showed that both PhD students and postdoctoral scholars had a high initial interest in professorships but that their interest decreased during their training. The reason most highly reported for this change in focus for the PhD students was negative experiences in graduate school. In addition, women PhD students in science cited career–life issues as having a 44% influence on their decision, compared to 20% for men. Career–life issues include considerations related to children, other life interests, the time-consuming nature of professional activities, and geographical location preferences.

The UC postdoctoral fellows showed a similar shift in career aspirations away from professorships with research emphasis. For women, career–life issues were the most important reason for shifting their career goal, whereas men were statistically more likely than women to cite career advancement and monetary-compensation concerns. In sum, these changes in career aspirations provide insight into recruitment and retention, not only for universities, but also for government and industry employers who are interested in personnel who have been trained in critical thought in a PhD program.

Impetus for Thinking about Our Lives in Science

As described above, major demographic changes are ongoing or expected in geoscience workplaces over the next 15 years. For some of us, these changes mean retirement, while others may be left with a different work environment and possibly rapid learning curves as more senior geoscientists retire. These demographic changes, as well as changes in the global economy and increased resource management needs (e.g. in developing nations), also mean that geoscience career opportunities will continue to change. At the same time, each of us has different life experiences that influence our career trajectories. Experiences during our education – and how we respond to them – may have a strong influence on our career choices (Goulden et al. 2009). Finally, career–life issues and career advancement opportunities may influence our early-career choices (Goulden et al. 2009). We hope to address some of these topics in future A Life in Science columns.

AN EXTENSION OF A LIFE IN SCIENCE

Although A Life in Science will be reviewed by several geoscientists before it is published, it is likely to be written with some cultural bias – our attitudes are strongly influenced by where we live. Each country has its own economic basis and social structure, which influence our "lives in science" by providing different opportunities and career–life issues. In addition, there is no defined right or wrong way to approach one's career – what works for one person may not work for another. To address these matters, readers are invited to comment on this column on *Elements'* brand new Facebook page (www.fecebook.com/elements-magazine). Please visit and give us your opinions so that we can better address your needs!

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