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Women in geoscience



GESSS wrap-up



Geotrails
Geology in society
Earth Futures Festival

Feature 1

The future of geology: why we lose women from geoscience

Walk into any undergraduate geoscience classroom in Australia and you will find that about 40% of the students are women. Anyone who has taught a final-year geology class knows how much students love geoscience and are excited about what lies ahead in their geology careers. But the gender split in industry and academia tells us that most female geology students do not end up with the dream career they initially pictured. We are letting them down and losing them, and it is about time we figured out why.

Truth in numbers

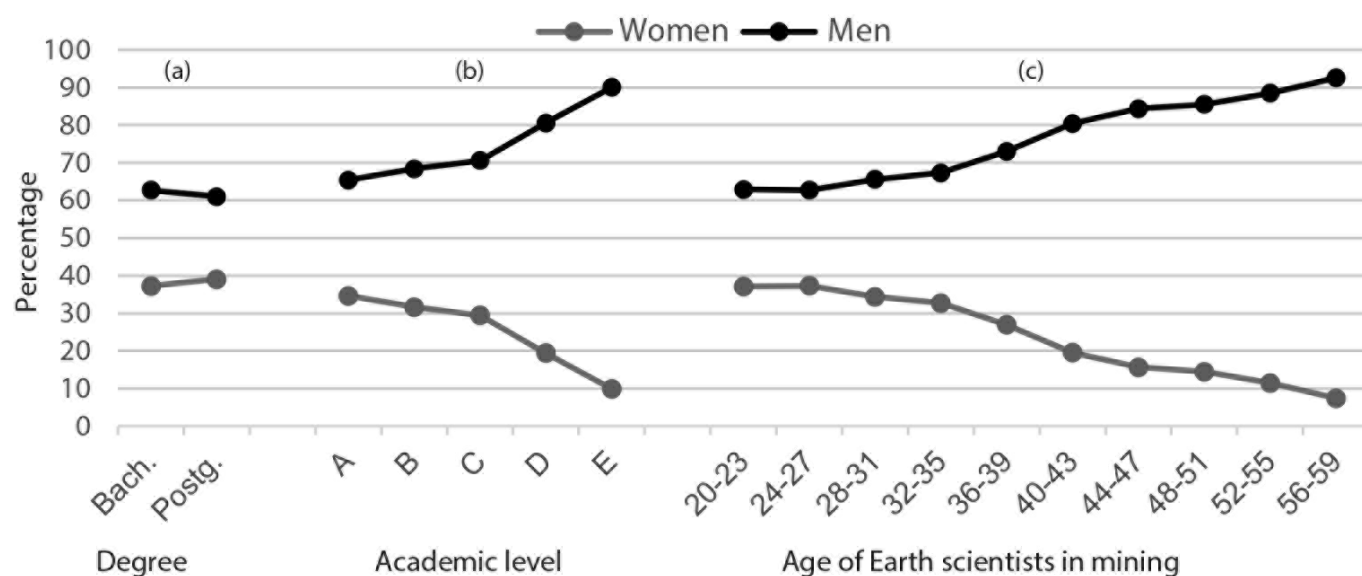
After an undergraduate degree, students pursuing a geology career either go on to further study (PhD, masters) or they find jobs in industry or government. For those that pursue the academic path, the attrition of women occurs gradually, as shown in the accompanying graph. At the PhD level, about 40% of candidates are women. The proportion of women drops to 35% at the postdoctoral fellowship level (Level A, Assistant Lecturer), 30% by Level B (~2–5 years later, Lecturer), and continues to decrease at every stage until Level E, where only 10% of professors are women.

Another, more common, career pathway for geology students is industry, predominantly in mining. Statistics on the gender split of graduates entering the mining industry are scarce. To get an approximate figure, we can look at the gender split of people aged in their 20s who are working in mining and have a Bachelor degree with Earth Science as the major field of study. These data

suggest that ~40% of 20 to 27-year-old geologists are women, which is about the same as the proportion of women in Earth Science undergraduate degrees. However, this gender split does not persist for long. The proportion of women begins to decrease from age 28, while the number of men stays roughly stable.

As scientists, we know that to understand why women leave geoscience, we need to look beyond the limits of our own experience (and Twitter feeds). We need to examine the data. Research in this field highlights that women in geoscience face unique challenges that men do not experience as commonly. These adverse experiences can appear to be relatively minor: for example, a thoughtless comment or a sexist joke. However, each experience chips away at a woman's sense of belonging, safety and job satisfaction, contributing significantly to an eventual decision to leave. In this article, I summarise the research that tells us what some of these challenges are, and how we can change our discipline to provide women with a long and satisfying career, doing geoscience jobs they love.

Staff gender profile in major Earth Science careers: (a) The percentage of men and women enrolled in a Bachelor degree (Bach.) and Postgraduate degree (Postg.) with Earth science as the field of study (Census of Population and Housing, 2016). (b) The percentage of men and women at each academic level in Earth science (FoR 04; Australian Research Council, 2019; academic level in 'teaching and research' roles: A=Assistant Lecturer, B=Lecturer, C=Senior Lecturer, D=Associate Professor, E=Professor). (c) The percentage of men and women from 20 to 59 years of age with an Earth Science degree working in mining (Census of Population and Housing, 2016). Image courtesy Melanie Finch



Undergraduate education experiences

While geoscience classrooms have an approximately equal gender split, male and female students do not have equal experiences at university.

Field trips tend to create issues for women that are sensitive in nature, and therefore rarely reported. One major issue is a lack of consideration about the differing toilet needs of women and men. When no private facilities are available, female students tend to try to avoid the awkwardness of public nudity in front of their peers. They either avoid field trips altogether, or drastically control their fluid intake, leading to dehydration, bladder infection or worse on multi-day field trips. Greene *et al.* (2020) describe the difficulties for both male and female students, and how staff organising field trips can eliminate these issues through better planning and communication with students.

Female students also experience higher levels of harassment and assault during field work. A survey of academics showed that during field work, 71% of women and 41% of men experienced harassment (inappropriate comments) and 26% of women and 6% of men experienced assault (unwanted physical contact) (Clancy *et al.* 2014). For most respondents, these experiences occurred when they were students or trainees (~85% of women, ~72% of men). Harassment and assault can be reduced by a clear code of conduct for field trips that outlines the behaviour expectations and consequences for poor behaviour, as well as the

availability of anonymous methods for reporting an assault to field trip staff and staff outside the field trip (Handley *et al.* 2020).

Beyond field work, evidence suggests that female students in Australian science classrooms face discrimination from their peers, particularly during group work (Fisher *et al.* 2020). In that study, students reported feeling ignored or discriminated against when working with male peers, even when there was an equal gender split in the classroom. While students typically brushed off these encounters, the data shows that these sorts of incidents make female students feel like they don't belong in geoscience as much as their male peers. Staff can prevent this from happening by addressing discriminatory or non-inclusive behaviour in the classroom and training their teaching assistants to do the same. The same research also suggests that creating groups that are gender balanced or have a majority of women improves inclusivity of female students (Fisher *et al.* 2021).

Finally, it is worth considering the effect of the lack of female educators on students, since the proportion of women in academic teaching staff is so low. The research suggests that female students are more likely to choose to continue in geoscience if they have a female lecturer (Bettinger and Long 2005). Female students who are taught by female faculty also do not believe gendered stereotypes, see women as leaders, speak up more in group settings, and have increased feelings of empowerment (Dasgupta and Asgari 2004, Bettinger and Long 2005, Latu *et al.* 2013).

GSA Neo

*Shaping Neo-Earth
Scientists for
today and the future*

Coming in Autumn 2022

*After the success of last year's event
GSA Neo will be back again with
new workshops, presentations
and panel discussions.*

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info@gsa.org.au for more information.



GSA Neo will again be two half day, online sessions of workshops, presentations and panel discussions designed to give Early Career Geoscientists the competitive edge, increase confidence and strengthen networks.

GSA Neo is an initiative from the **Geological Society of Australia** to provide Early Career Geoscientists with new skills, new knowledge, and new confidence for the workplace.

The message is clear: if we want more female students to choose and stay in geoscience, we need to give them greater access to female role models during their university education.

Cognitive biases

A minority belief persists that biases against women simply do not exist. However, we have known of bias in science for a long time. More than 50 years ago, the 'Matthew effect' was coined to describe the over-recognition of those at the top of the scientific profession and the misallocation of credit to those men at the expense of more junior colleagues (Merton 1968). More recently, the 'Matilda effect' was coined to describe the under-recognition of female scientists (Knobloch-Westerwick and Glynn 2011, Knobloch-Westerwick *et al.* 2013).

So how do we know this over-recognition and under-recognition actually exists? It is not enough to simply show that the excellence of men is more widely recognised than that of women, since it may be argued that men are just better than women(!). Rather, it must be shown – through well-designed experimental studies – that the judgements themselves are mediated by gender. The gold standard in these studies follows a particular formula: participants (academic staff) are asked to assess the quality of a scientist from a piece of written information (eg, CV, conference abstract, grant application). The

same information is given to every participant, but in half of the writing samples, the author has a female name and in the other half, a male name. These studies find that both male and female academics rate male scientists as significantly better than female scientists (eg, Steinpreis *et al.* 1999, Knobloch-Westerwick and Glynn 2011, Moss-Racusin *et al.* 2012, Knobloch-Westerwick *et al.* 2013). As such, we can be certain that bias against female scientists exists – and that it can cause deserving women to miss out on promotions, jobs and awards.

Biases for or against certain groups can be conscious and deliberate, or they may be unconscious and activated automatically (implicit). Individuals who believe themselves to be free of bias against women in science are often surprised that tests such as the implicit association test (Project Implicit, 1998) reveal the opposite. In Australia, as in many nations, women do more household and caring work, and science, technology, engineering and mathematics (STEM) fields are generally male dominated. Our expectations of the roles of each gender are influenced accordingly, creating implicit bias against women in science (Role Congruity Theory; Knobloch-Westerwick and Glynn 2011).

Until our social structure changes so that men and women have more equal roles, we must be aware that an implicit bias against women scientists is common. However, it need not affect our decisions if we take steps to ensure we are fair, equitable

Mines & Wines 2022

"DISCOVERIES IN THE TASMANIDES"

MINES & WINES EVENT Orange, NSW. 9-13 May 2022

This will be the 8th incarnation of this iconic and unique event and will attract about 250 registrants including project geoscientists in the mining and exploration industry, service providers, plus government and academic specialists.

This conference is renowned as a forum for exploration and mine case studies as well as scientific advances in understanding the tectonics and metallogenesis of the Tasmanides.

Mines and Wines is about presentations by geoscientists for geoscientists.

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and objective. Organisations can reduce the effect of bias by making selection procedures less reliant on subjective judgements and educating staff about cognitive biases, since people who are aware of the effect of bias on decision-making are less likely to make biased decisions, even though they still have those biases (Uhlmann and Cohen 2007, Régner *et al.* 2019).

Barriers to awards and jobs

Beyond cognitive biases, several other factors result in the disproportionately low number of women who receive prestigious opportunities such as awards, promotions and job offers. When jobs or awards are advertised through informal networks, the diversity of the pool of people who know about the opportunity is limited, which disadvantages women (Bell *et al.* 2003). A wider and more diverse audience can be reached when advertising through formal channels. Additionally, organisations that aim to increase the proportion of women in geoscience, such as Women in Earth and Environmental Sciences Australasia (WOMEESA) and Women in Mining, can be approached to advertise positions and awards to their members. This ensures that a large number of women see the opportunity. Online databases of women in our field can also be searched to find appropriate candidates to approach to apply for jobs (eg, www.womeesa.net/database and www.stemwomen.org.au).

Research by Gaucher *et al.* (2011) has also suggested that the wording of job advertisements is important. The inclusion of words that are commonly associated with male stereotypes, such as 'leader', 'competitive' and 'dominant', tend to make women feel like they would not fit well into the department and make the job less appealing to them. The researchers' gender decoder website provides a full list of words to avoid (gender-decoder.katmatfield.com).

Another consideration is finding the time to apply for the opportunity. Since, on average, women shoulder a higher proportion of household work and service roles than men, they have less time available overall (Guarino and Borden 2017). Therefore, jobs or awards with onerous application procedures or short deadlines tend to receive fewer female applicants.

Selection processes can be put in place to increase equity. The selection panel should be diverse and have a degree of open mindedness about the evaluation of merit. For example, in a university setting, it is relatively common for selection panels to be impressed by prestigious universities or particular fellowships. But these may not be accessible for people from all demographics; for example, it is harder for people with disabilities or caring responsibilities to move interstate or overseas for opportunities. Furthermore, female postdocs receive less favourable reference letters than male postdocs, and in student assessments of teaching, men are rated more positively than women (eg, Boring 2017, Mengel *et al.* 2018, Özgümüs *et al.* 2020). An awareness of these factors can help selection panels evaluate merit more equitably.

Policies that support parents

I've asked people in geoscience why they think we lose women from academia and mining. A common reply is that it's because women have children and geoscience careers are incompatible with raising a family. Obviously, men also have families. However, in Australian heterosexual couples, women tend to shoulder the bulk of the childcare and household work (Baxter 2019).

This is perhaps in part because men are not ordinarily given equal access to parental leave and flexible working arrangements (Duffy *et al.* 2021). For example, at Monash University, the birth mother is entitled to 52 weeks of paid parental leave, whereas the non-birth parent is entitled to eight weeks if they are the primary carer (and five days if they are not). The birth mother can take leave flexibly, but the non-birth parent must take their leave full-time in a single block. This lack of flexibility is not consistent with the requirements of modern families, who might want both parents working part time, or two days at home with one parent and three days at a childcare centre, for example. When both parents are provided with equal access to parental leave, it allows families to structure home and outside work in an equitable manner. In contrast, when birth mums are given vastly more leave, it can incentivise inequality, since families may be better off financially or otherwise by not using childcare.

For a while now, universities and mining companies have recognised that providing parents with flexible working hours and conditions could increase retention. BHP, Rio Tinto and Fortescue have policies that allow any employee to work flexibly, even in fly-in fly-out (FIFO) roles, but it is unclear whether there are limits on this flexibility in practice. Several other companies have 'family friendly' FIFO rosters. However, this often involves prescription of the roster that they believe to be family friendly, without consultation with the individuals involved. For some families, a two-weeks-on, one-week-off roster might work best, whereas others might prefer the FIFO worker home most weekends. Employee-driven flexibility is key.

Universities and industry have been slower to act on other aspects that are essential in the return of women to work after parental leave. For example, many women returning to work continue to breastfeed and will need to pump milk at work. Unlike breastfeeding, pumping milk is not a practice that women would want to do in public. A private room is needed with a power point, a table or shelf (for the pump), a comfortable chair, access to water to clean the equipment, and preferably a fridge for milk storage. These rooms are still not widely available, which results in women having to pump milk in cars, toilets, shower cubicles or storage cupboards. A woman needs to be extraordinarily motivated to return to work if she is forced to spend lunchtimes in a broom cupboard! Another issue in some locations is access to childcare, which is oversubscribed in some locations and non-existent in others.

Sexual assault and harassment

Working remotely seems to foster higher incidences of sexual assault, as highlighted earlier for undergraduates during field work and from anecdotal reports of poor behaviour at conferences and other types of remote work. Although we don't yet have data on this, we are beginning to see statistics on sexual assault and harassment emerge from the mining industry. What has been revealed is shocking.

In 2021, the Parliament of WA launched an inquiry into sexual harassment against women in the FIFO mining industry, with submissions from individuals and organisations. The Western Mine Workers Alliance reported that a survey of 425 FIFO workers showed nearly a quarter of women had experienced physical acts of sexual assault, and two-thirds had experienced verbal sexual harassment. Women reported being fearful of men and avoiding social situations because they "cannot take the risk of any more harassment".

Men and women both said that when women try to report sexual harassment to management, the women are ostracised from their work group (or worse), and fear they will be fired. A submission from the Construction Forestry Maritime Mining Energy Union reports that: "Despite mining companies like BHP and Rio Tinto making statements of commitment about the need to tackle sexual harassment, the truth is they have been

doing exactly the opposite of accepting responsibility in this area for a long time now".

It is astounding that mining companies continue to ignore this shocking behaviour. If a quarter of employees were physically harmed in any other way on a mine site, it would be considered a safety emergency. Why should it be any different, just because the victims are women and the weapon is sexual assault?

Intersectionality

This article's scope was limited to women, without consideration of the barriers faced by other groups of people. This is not to discount the experiences of other groups who are discriminated against, often to a greater degree than women. These groups include people who identify as non-binary, Indigenous, BAME (black, Asian, and minority ethnic), LGBTIQ+ or neurodivergent, as well as people with disabilities or with caring responsibilities. While some initiatives discussed here could increase fairness and inclusivity for everyone, this is certainly not the case across the board.

Geoscience is one of the least diverse scientific disciplines (Bernard and Cooperdock 2018, Dowey *et al.* 2020). To increase equity and inclusion, the experiences of people and groups who differ from the Australian majority need to be carefully considered.



16TH BIENNIAL MEETING
SGA 2022



Rotorua, New Zealand • 28 – 31 March 2022 • www.sga2022.org

WHEN: 28 – 31 March 2022, plus pre- and post- conference field trips and short courses.

WHERE: Rotorua Energy Events Centre in Rotorua, New Zealand.

WHO SHOULD ATTEND?

Delegate representation includes academia, industry, government research organisations, consultants and service providers.

CALL FOR ABSTRACTS

The Organising Committee invites submissions to the conference for consideration and inclusion in the technical programme. The main theme for the conference is *The Critical Role of Minerals in the Carbon Neutral Future*. Submissions are encouraged on topics related to mineral deposit research, exploration, sustainable development and environmental and social aspects related to mineral deposits.

Abstracts must be submitted via the official website link at www.sga2022.org where a full list of themes and guidelines for submission can be found.

Abstract Submission Deadline – September 2021

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Rotorua Caldera



Mt Tarawera 1885 rift crater



The road ahead

If the only reason that women left geoscience was because of the arrival of children, then the solution would be relatively easy. Over the past few years, universities and mining companies have made a decent effort to improve conditions and flexibility for parents. But these efforts have not dramatically changed the proportion of women staying in academia or industry. More needs to be done in that space, but the research tells us that having children is not the only reason women leave.

The data tell us that women face unique, additional challenges preventing them from having long, fulfilling careers in academia and mining. In Australian geoscience, some women and men are pushing for change and equity, but the problems are widespread and can be difficult to detect. As a result, there have not been recent significant improvements in the retention of women.

We need organisation-wide, systemic change. This must be brought about by thoughtful and insightful leadership at our most senior levels, guiding new policies and procedures to make workplaces more women-friendly. We're asking our leaders to create environments where women feel like they belong and where they are valued, accepted, respected, hired, awarded and promoted.

Change also comes from within organisations. So we're also asking for geoscientists of both genders and at all levels to call out behaviour that is not inclusive or otherwise harmful, and to be more aware of nominating women when job, promotion and award opportunities arise. We have the data — now is the time for action.

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