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Reflections on a career in operational science: some lessons learned

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In this short essay, I reflect on my career and some of the inspirational scientists that have influenced the way I have chosen to work. I highlight some of my lessons learnt as a woman scientist in an environment that remains largely male-dominated at a senior level. Volcanology (and science more generally) as a profession has changed for the good over the last four decades, with many early and mid-career women aiming for, and achieving, senior roles. I look forward to seeing the next-generation of diverse volcanologists drive the science forward to keep communities safer from volcanic activity.

KEYWORDS

volcanology, career, women, reflections, lessons

1 Introduction

When I agreed to write a paper for this volume, I started to think “why on earth would anyone want to read what I have to say.” I’ve had an unremarkable career by the usual metrics of academic achievement. I have not won any major prizes; my H-index is fair to middling for a senior career scientist; I have not had dozens of research students. I’m also introverted by nature, so talking about myself is not comfortable.

What then are the insights I might have to share? One of my core values is to be authentic, so I did not need to try and be something I’m not: I decided to tell my story and pass on the lessons that I have learnt. This is a personal reflection of someone who has spent their career mostly in operational roles or as a science manager, rather than as an academic researcher. I hope that you find something in my experiences that will resonate with your own story.

2 The “bio”

As scientists we often get asked for a “mini-bio” so that a meeting convener can introduce you or for your communications people to slot into a website: “can you please summarize your career in 200 words”? And it is hard to do! This is a little longer than 200 words, but I thought it was important to give context to my reflections.

I was brought up in Sheffield, Yorkshire, in northern England. My parents did not have a university education, but they worked hard to give my brother and I the best possible start in life. My mum was from a coal-mining family, so I guess that gives me a geological genealogy. She was good with numbers and went straight into the workforce in the accountants’ office at a light engineering firm at age 17. My dad left school at age 15 and became an apprentice draughtsman. When he turned 18, he started to train as a pilot in the last few years of World

War II. Fortunately, the war ended before he saw action. He then continued with night school classes to get formal qualifications and became a mechanical engineer.

Mum and dad really loved the outdoors, and one of our family activities was to go hiking into the Derbyshire Peak District every Saturday afternoon. It was on these day trips that I became curious about the world around me and the environment in which we live: what were all the fossils in the drystone walls, why were there strange iron-rich rocks amongst the limestone (I learnt later that they were lavas, starting my life-long interest in volcanism).

I took geology 'O'-level at age 16, including my first multi-day field trips to North Yorkshire. I loved being out in the field and learning about the paleoenvironments that the fossil ammonites inhabited. But I decided to keep my options open and did the standard science combination of maths, physics and chemistry for my final year school subjects.

I was encouraged to apply for Cambridge University and went up to read Natural Sciences straight after leaving school. Initially I wanted to be a physicist as I loved space and astronomy, but I soon found the laboratory work was too constraining. And the first-year geology field trip to the Isle of Arran in Scotland was fun and interesting, despite the Easter weather being less than optimal.

I tentatively tested the idea of focusing on geology with my tutor, Prof Steve Sparks. Steve and I have continued to cross paths throughout my career, and he has been an inspiration to me in terms of his intellect, humility, and humor. He was very encouraging, and I chose geological subjects in my second and third years, eventually finishing with a degree in Geological Sciences.

At the time (mid 1980s), there were very few female science academics at Cambridge University. Dr Christine McKie was one stand out, although I did not attend any of her classes. I particularly admired her because she had co-authored one of the textbooks on crystallography—after all, I had never met someone who had written an actual published book before. There were a few female postgraduate and post-doctoral researchers, however, which gave me confidence that women could be successful in progressing a career in Earth sciences.

Steve had lectured on volcanology in my final year, and it had really fired my enthusiasm for all things volcanic. I started looking around for PhD topics and was offered a grant to study the rheology of lava flows under the supervision of Prof.s Harry Pinkerton and Lionel Wilson at Lancaster University, with Hawai'i as the field area. Wow—what an opportunity: a young lass from Yorkshire going to Hawai'i to study volcanoes!

But I was not destined to go to Hawai'i - yet. Harry phoned me before I even started at Lancaster, explaining that there was a chance to visit Oldoinyo Lengai volcano in northern Tanzania and would I be interested in joining? I did not need a second offer—I had just returned from playing netball in Australia and my appetite for exploring new countries in far off places was well and truly whetted.

Oldoinyo Lengai was my first active volcano, and the East African Rift Valley totally blew me away with the scale of the tectonics, volcanism and the environment. It was also on this two-week trip to Tanzania and Kenya that I met a remarkable woman—Prof. Celia Nyamweru. Celia was a geographer who had worked extensively in East Africa including documenting the eruption history of Oldoinyo Lengai. Her dedication, empathy, and the strength of her relationships with the African people was an exemplar for how I might aspire to work in the future.

After that first field trip, I was then largely confined to the laboratory for the remainder of my PhD—somewhat ironic, given I had moved away from physics so I could avoid lab work! I was hugely fortunate to be guided by Harry and Lionel. They instilled both a sense of excitement and achievement about the science results, as well as ensuring that I had a clear goal and commitment to finish writing up in a timely fashion.

After completing my PhD, I got my first job at the British Geological Survey (BGS). At that time, BGS had a policy of “new blood” hires. Recent graduates were recruited into parts of the organization that had vacancies, but not necessarily in the discipline in which they had trained. So, I became a part of the “Minerals Group” and was tasked with learning about mineral exploration. This was all completely new to me, as we had not touched on economic geology at Cambridge at all, and magma rheology did not really have much relevance when panning for gold in farm streams in Southwest Wales!

The change of subject matter expanded my skillsets into areas that I had not previously imagined: 3D computer modelling of structural geology, environmental geochemistry, exploration geophysics and a first introduction to large European projects and overseas development work.

Although I enjoyed the work, I was starting to wonder whether a long-term career at BGS was where I really wanted to be—volcanology remained my real passion. But then, a volcano in the Caribbean started to erupt and it happened to be on a British overseas territory: Soufrière Hills Volcano on Montserrat.

My friend and colleague Simon Young—with whom I had shared a post-graduate office at Lancaster—was the first BGS person to work on Montserrat and he drafted me in to help with UK-based logistics: arranging rotations of staff and getting involved in early hazard assessment meetings. Then my opportunity came: I was on my way to the island in late 1996.

As I flew into the island on the evening of 17 September 1996, I peered out of the plane's window to see ash clouds and pyroclastic flows tumbling down the side of the volcano at dusk. Having only seen the small lava eruptions of Oldoinyo Lengai, it was exciting to see a different style and scale of volcanism.

This was the start of a nine-year life-changing journey for me at the Montserrat Volcano Observatory (MVO). Through this time, I was involved with monitoring tasks, took on Deputy Chief Scientist and then Director roles, fronted up to public meetings, was a regular on ZJB Radio Montserrat giving volcanic updates, provided science advice to senior government officials, and most crucially saw first-hand the heart-breaking impacts of volcanic activity on people. I was privileged to work with an amazing group of professional people, sometimes in incredibly difficult circumstances during uncertain and life-threatening volcanic activity. And happily, I met my future husband, Art.

After two breaks for maternity leave, my next career step was a big leap into the unknown. I had returned to the United Kingdom when I was pregnant with my second child and the tasks that I was doing seemed mundane compared to the high pressure, but highly rewarding, work in Montserrat. The challenge—as with many professional couples in very specialist fields—was how to find an environment that enabled two rewarding careers whilst raising a young family.

Fortunately, we found a solution: Aotearoa New Zealand. We made the move Down Under in August 2006 “sight unseen”—neither of us had been to Aotearoa and we had not previously worked with our future colleagues at GNS Science.

Juggling part time work with two children under aged five as well as moving to a new country and a new workplace was challenging, but I had very supportive managers and a collaborative and welcoming team. I became the Head of the newly formed Volcanology Department, and was heavily involved in working with key stakeholders, mentoring and managing staff, and re-inventing my science career as a risk assessment specialist.

Over the next 8 years, the GNS team responded to eruptions of Ruapehu, Tongariro and Whakaari/White Island, which required co-ordination across stakeholders, scientists, and the public. I also became involved in leading wider natural hazards research including earthquakes, tsunami, landslides, risk, and social science.

During this time, I was humbled to support responses to eruptions in Vanuatu where I met another inspiring woman scientist—Esline Garaebiti. Esline was the head of the Government of Vanuatu Geohazards Department. I was impressed at her ability to work incredibly hard to keep the communities on the volcanoes in Vanuatu informed about activity, whilst also engaging at the highest government levels to advocate for funding to build her small team of scientists and specialists.

In 2014, the opportunity arose for an Executive position to lead the Natural Hazards Division at GNS and, although nervous about my ability to lead a group of globally recognized scientists in topics way beyond my technical expertise, I gave it a go.

What followed was a rollercoaster ride of responding to earthquakes, tsunami and volcanoes as well as managing myself and my team through a period of organizational change. It was challenging to keep motivated at times, when it was unclear what my role might be in 6 months or a year's time, whilst trying to adjust to the ever changing—and generally increasing—expectations of the science advice we were providing.

The main highlight of this period was that I was co-opted onto the Chief Science Advisor Forum as a specialist in hazards and risks. Led by Prof. Dame Juliet Gerrard, I learned a huge amount from her and the other Chief Science Advisors about how science interacts with policymakers and the political establishment, especially in times of crisis.

Since 2020, the most recent step in my career has been back towards science leadership, rather than people management. It means I am closer to the science, and it is very rewarding to see the increased number of early and mid-career women driving natural hazard science forward.

I have always enjoyed working with a combination of passionate scientists and dedicated end users of our science to identify and deliver hazard and risk information that is useful, useable, and used. I hope that I can continue to contribute to mentoring the next-generation of Earth scientists to succeed.

2.1 Pivotal moments

If I were to look back over the last 35 years and pick moments in time that significantly influenced my career direction, two stand out.

Firstly, I can remember my first “Eureka” moment as if it were yesterday. I had spent a long day in the lab at Lancaster and, as I

walked home that evening, I pondered the results in my head. I suddenly realized that I was the first person ever to see and interpret lab data on the rheology of carbonatites. That exhilarating feeling of discovery has stayed with me throughout my career and fuels my love of science.

Secondly, Montserrat. I could write several pages of significant moments relating to my experiences on Montserrat, but perhaps the most pivotal for my career was the eruption of 25 June 1997.

I was en route back to the island after a period of leave. I heard the news of the eruption when I tried to check into the short flight from Antigua to Montserrat. The immigration officials in Antigua relayed that W.H. Bramble airport was closed. There were likely to have been fatalities.

That immediate sinking feeling in my stomach will stay with me forever.

All the staff at MVO were greatly impacted by the losses. Personally, a whole swathe of emotions rose to the surface. Grief: losing 19 people from a community of less than 10,000 meant we all knew someone who had died. Guilt: I should have been there to support my colleagues. Shock: how could this have happened when we had worked so hard to understand the volcano?

But strongest of all, it deepened my resolve to work with at-risk communities and appreciate their diverse perspectives, so that together we can reduce the risk of future tragedies. This has been the main motivation for my career ever since.

3 Reflections

Overall, throughout my career I have been privileged to work with dedicated and talented people who are focused on improving the world in which we live: to reduce the risks to individuals, communities, and nations from the hazards that nature throws our way. I have mostly had operational or management roles, although the foundation of what I do is built on my excitement in discovering how the earth works whilst supporting people to do incredible science.

So, what would I say are the top four things I have learnt along the way?

- Be(lieve in) yourself. This is the most important learning for me—and something that I need to keep re-iterating to myself. On more than one occasion, I have been told to be something I'm not, or would not aspire to be. I was told “Be more aggressive.” I was also told I was not good enough for roles and that a male counterpart was a better fit because they were more “forceful.”

Being aggressive and being assertive are two different things. I continually need to work on being more assertive (as an introvert). But I do not believe that being more aggressive would ever work for me, so I made a deliberate choice not to change that aspect of my behavior.

Equally, when you get knocked down, get back up and have the courage to try, try and try again. I've been through situations when I've had to move between roles, adapt and accept new challenges, whilst being told I'm not good enough. This is tough and really tests your personal resilience but being clear about your core values and

understanding the qualities that you bring as a person helps to map a path through rocky times.

- Everyone is human—be empathetic to others and kind to yourself. When you are talking to people whose lives have been turned upside down by a natural hazards event—perhaps they have been evacuated from their home or their livelihood has been ruined—or you are engaging with someone who has to make a tough call about the impact on a community, the range of emotions displayed can be very wide. Try to put yourself in their shoes, even though at the time it might seem hard or even impossible to do.

Listen, learn, and be considered in forming a response. It is reasonable to say you do not know the answer.

Be very mindful of boundaries in accountability. Ideally, those accountabilities will have been defined and well understood ahead of a crisis, but often they are not, so test them and aim to come to a shared understanding of who does what and when. If there are still contested areas, look for ways to bridge the gap in understanding.

Be aware that you too are not a robot and can be affected by the weight of a difficult situation. Often in the thick of a response, you are driven by adrenalin, only then to have a very abrupt crash when you pause and consider what you've been doing. If a situation becomes overwhelming, give yourself time to rest and recover, and do not be afraid to ask for help. You cannot be as effective as you would want to be if you're not on top of your game.

- There is great power in reflection. One thing that I have learnt late in my career is that regularly and frequently looking back on what you've done, and what is coming up, is helpful. In a senior leadership role, I'd often fall into the trap of running (sometimes literally) between meetings, engagements with stakeholders, reviewing reports or talking to staff. If I'm super-busy, then I'm doing my job, right? Well, no. Are you using your time most effectively, are you giving yourself time to plan, recharge and identify what you consider to be the most important tasks, not forever being beholden to your calendar and what other people think your priorities are?

I have found that setting aside reflection time once a week allows me to take stock, give myself a pat on the back for something well done or think what I could have done better, and then plan for the next week or two. Once you develop a habit of a regular reflection, it becomes easy to ensure that it does happen.

- Learning from mentors and “de-mentors”: the value of role models. Throughout my career, I have worked with many inspirational scientists and been in roles where I have had a variety of experiences interacting with a wide range of stakeholders, managers, politicians, and the public.

In my “bio,” I have mentioned some of the people who have positively influenced how I aspire work: Steve Sparks, Harry

Pinkerton, Lionel Wilson, Celia Nyamweru, Simon Young, Eslie Garaebiti, Juliet Gerrard. There are many more colleagues and friends who have been influential or supportive or both, but I do not have enough words in this article to list them all. Thank you to all those people!

On the flipside, there have been people with whom I have had a less positive experience, where I may have felt bullied, belittled, unsupported or unvalued. Although this behavior is unacceptable, I would like to thank those people too. I may have come away from some of those interactions battered and bruised (metaphorically), or I may have observed the devastating impacts of their actions on other people. But in all cases I have grown as a person and those experiences have required me to constantly re-examine my values and add to my internal catalogue of learning moments.

4 Discussion

I have had an exciting and rewarding career as a woman in volcanology over the last 35 years. I have seen some marked, and positive, changes in the demographics of the volcanology workforce over that time, although there is still work to be done to ensure that all young people who aspire to become volcano scientists can fulfil their dreams.

I have been inspired and supported by many different people and I would encourage scientists of any level to both mentor others and be mentored—it is never too late to learn!

I hope that my own reflections help to inspire the next-generation as well as help middle career and senior researchers pause and reflect on their own contributions to the growth of the profession.

I will finish with a Māori whakatauki or proverb.

Ehara taku toa i te toa takitahi, engari he toa takitini.

Success is not the work of an individual, but the work of many.

Volcanology—especially in an operational setting—is a major team effort and we cannot reduce the risk from natural hazards without everyone's contribution.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

The author confirms being the sole contributor of this work and has approved it for publication.

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Conflict of interest

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