Women Geoscientists at State Geological Surveys – A Status Update

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Introduction

State geological surveys are an important place of employment for geoscientists, yet we have limited data about the employment of women scientists at state geological surveys. This study was undertaken to improve the picture of how women geoscientists are faring at state geological surveys. Data collected over the past decade by the American Association of State Geologists (AASG) was supplemented with an online survey of women geoscientists at state geological surveys.

History

Every state except Hawaii has a state geological survey. However, in three states—Georgia, Michigan, and Rhode Island—the survey consists only of the state geologist. The structure within government of state geological surveys also varies among states. About 40 percent are part of a university system. Another 10 percent are free-standing state agencies, and about half are a division within a larger state agency. Many of the state geological surveys also have a director position. The state geologist or a different person may be the survey's director. We communicated only with the state geologists.

The AASG has collected gender data by broad job classifications since 2007. The most recent gender data from AASG, 2016–2017, indicated 272.5 full-time equivalent (FTE) women geoscientists and another 50.6 FTE "other" (than geoscience) women scientists were employed at the surveys (Allis, 2018).

To build on these data, a link to a short online survey was successfully emailed to 243 women geoscientists at state geological surveys with the permission of the survey's state geologist. In some cases, the email was undeliverable or the recipient was away during the survey period. At one survey, we did not have individual emails for the women geoscientists; instead, our request was shared so women who wanted to participate could contact us directly. We received 187 responses, a response rate of 77%. The majority of responses were anonymous; unless the respondent opted to provide contact information, the responder could not be linked back to a specific survey.

Findings

Out of 187 respondents, most have been at a survey for fewer than 10 years, have an MS/MA degree, have prior professional experience, and were not in a supervisory role at the time of our study (fig. 1). The majority of responders indicated that they were at a geological survey that could be considered medium to large (fig. 2). Beyond geology, the majority of respondents indicated that they worked on mapping, stratigraphy, hydrology, and outreach (fig. 3).

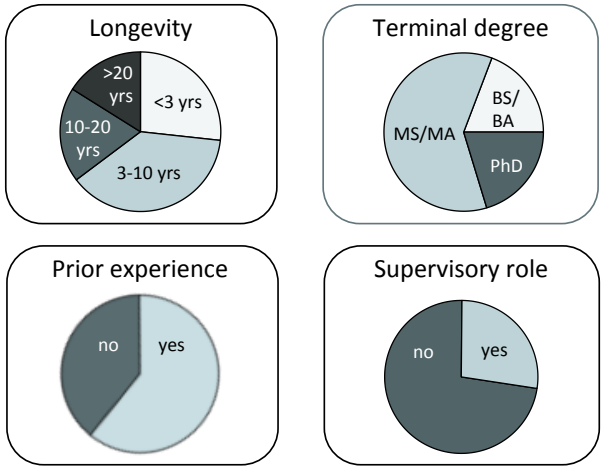

Figure 1. Characteristics of survey respondents (*n* = 187).

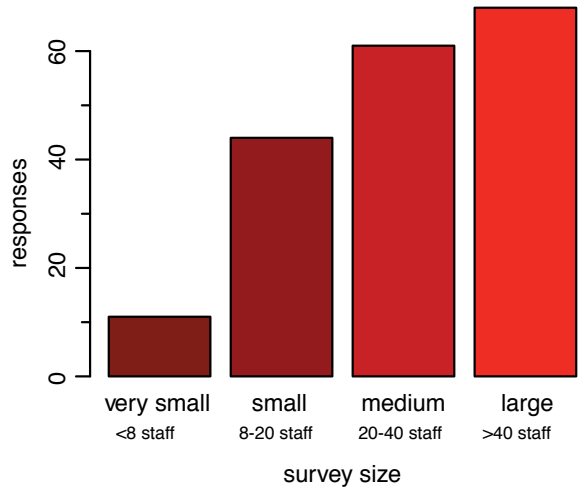

Figure 2. Number of respondents based on the number of full-time survey staff at the geological surveys. Based on these size categories, the AASG 2016–2017 data indicate there are 10 very small, 19 small, 13 medium, and 7 large state geological surveys.

Figure 3. Areas of research and work (terms scaled to reflect frequency of response).

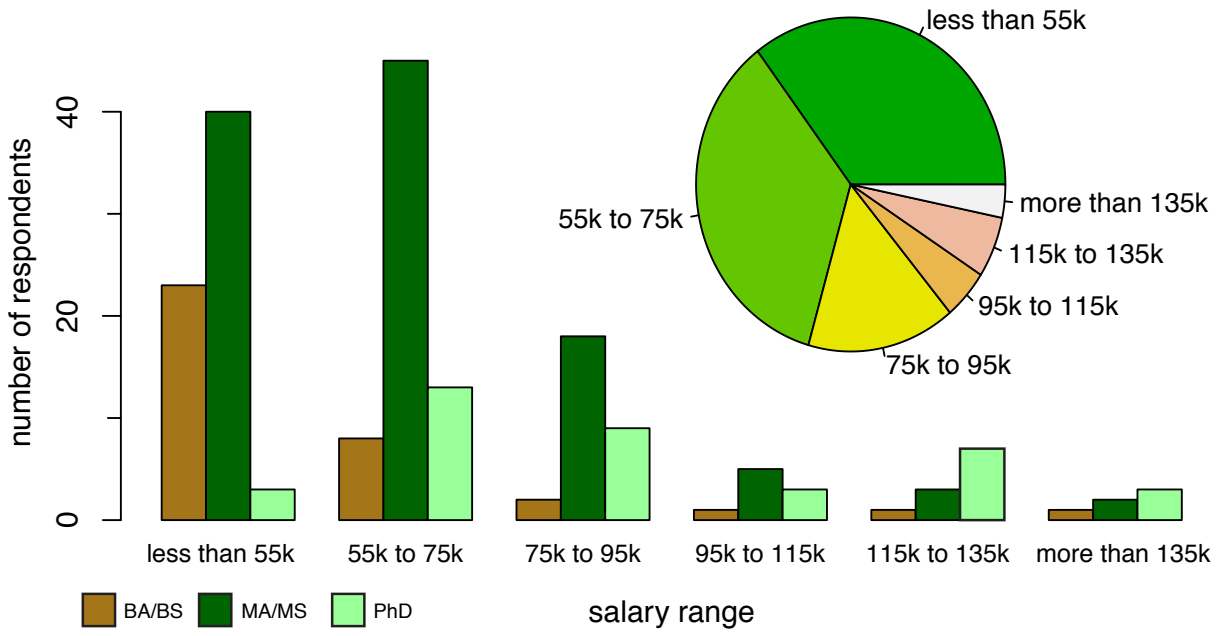

Figure 4. Salary range across respondents and by highest degree. Respondents were asked to identify their salary range.

Respondents were asked to identify their salary range (fig. 4). Across all respondents, the median salary was $55,000 to $75,000 (fig. 4, inset), which was also the median salary for respondents with a master's degree (MA/MS). The median salary for BA/BS respondents was less than $55,000, whereas the median salary for respondents with a Ph.D. was in the $75,000 to $95,000 range.

State geologists or survey responders indicated that a number of factors influence salary, including whether the position requires a professional geologist license or a Ph.D., the type of work, and cost of living for the area. Because the online survey responses were anonymous, in most cases the specific responder's state survey was unknown. Some states are transparent with state employees' salaries or tie salaries to the job grade, and women responders were aware of where they stood in relation to others in their survey. Other responders said they had no idea how their salary compared with their colleagues.

About two-thirds of respondents thought there was parity in both salaries and advancement opportunities when compared to male colleagues of similar seniority and experience (fig. 5). Responses were significantly more positive for women who had worked fewer than three years at a survey and had no prior professional experience.

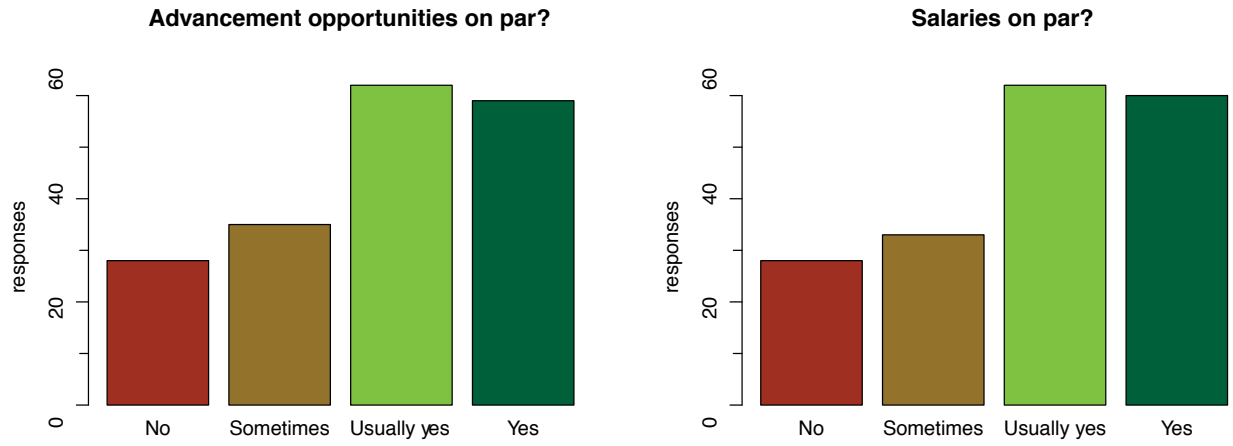

Figure 5. Perception of gender equity at state geological surveys.

An American Geosciences Institute (AGI) survey of recent geoscience graduates at all degree levels asked the relative importance of factors considered when offered a job (Wilson, 2017). Overall, the respondents to the AGI survey indicated the most important factors were salary, intellectual challenge, and location, with benefits as the least important factor. Our 2019 online survey of women geoscientists at state geological surveys also asked this question. State survey respondents ranked each factor (fig. 6). Although all factors trended toward “important” or “very important” to respondents, the largest number of respondents indicated that intellectual challenge, contribution to society, and work/life balances were most important, with salary the least important factor when they accepted the position.

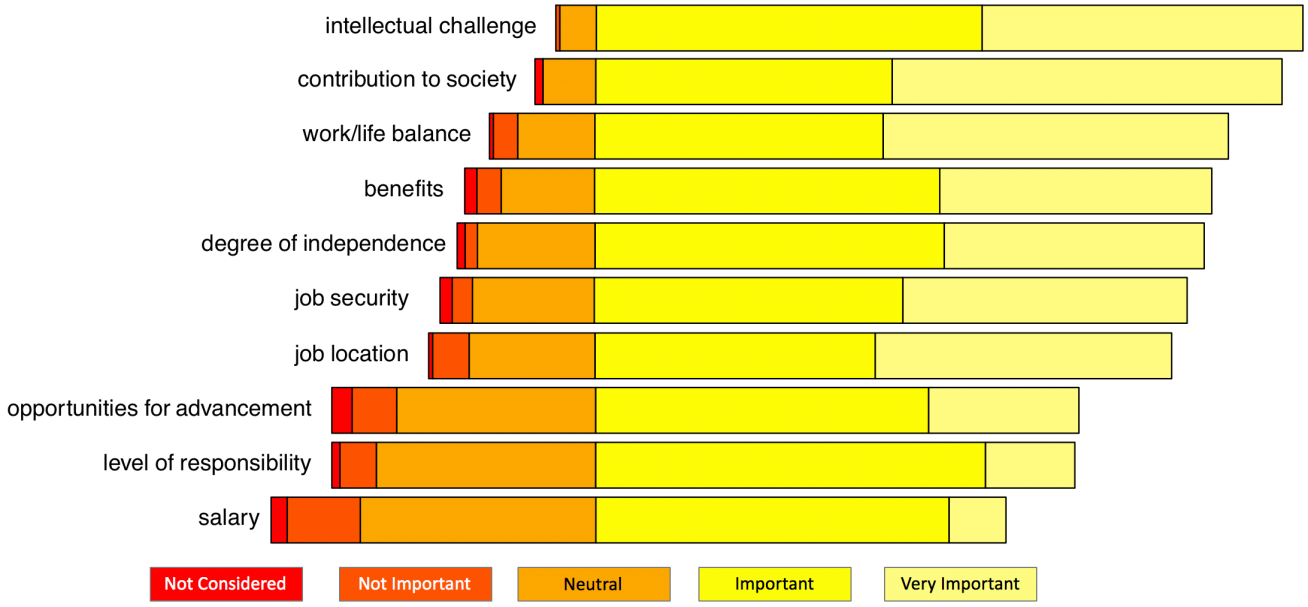

Figure 6. Relative importance of factors considered when accepting a job at a state geological survey.

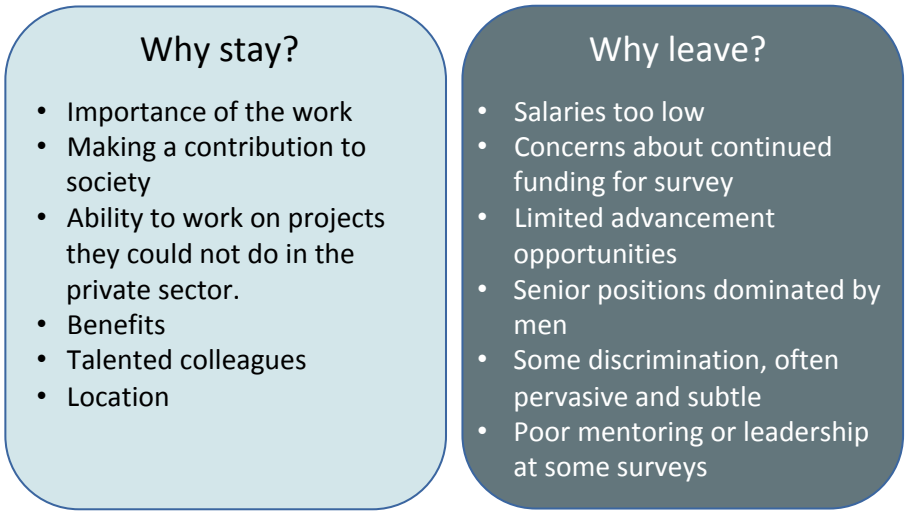

Figure 7. Influences of continued work at a survey. Overwhelmingly, women geologists at state surveys are passionate about their work, but leadership and survey culture played a strong role in longer-term plans to continue working at or leave a survey.

To assess factors that influence continued employment at state geological surveys, the online survey asked respondents a short-answer question about what keeps women geoscientists at a state geological survey and why they might leave (fig. 7). There was a range of answers (Appendix A provides an abbreviated response list). The strong majority of women cited the value and importance of their work at state surveys, even if they were planning to leave for other reasons. Many responders noted they thought their survey was supportive of them, they thought they were treated fairly, and they often noted the progress that had been made toward inclusion of women scientists. Several gave very positive reviews of their state geologists.

Two of the most commonly cited reasons that responders might leave—low salaries and concerns about future funding of their positions—could be concerns for men geoscientists, as well. Although salary wasn't a high priority when accepting the position, it did matter to respondents considering leaving state surveys. Limited advancement opportunities, another commonly cited reason for why respondents might leave their geological survey, can be a challenge at any smaller organization. However, many responders noted that at their surveys, men dominate the senior positions. This creates a perceived additional barrier for advancement. Discrimination, gender bias, and poor leadership were also noted by some responders. Sexism and gender bias in the sciences is widely documented and an area of concern (Wu, 2017; Johnson et al., 2018; Stover and Kryc, 2018). Leadership skills and culture also appear to vary significantly among state geological surveys.

Over the past decade, the trends for women geoscientists at state geological surveys show an overall increase, but it's a slow gain (fig. 8). Female student scientists employed at the surveys had the greatest variability, which roughly reflects the ups and downs of enrollment in geoscience degree programs (Keane, 2018). There are seven women state geologists. If the upward momentum since 2011 continues, it will be 2039 before women hold half the state geologist positions. The trend of women scientists on staff is an even slower gain. If the current rate continues, it will take another 28

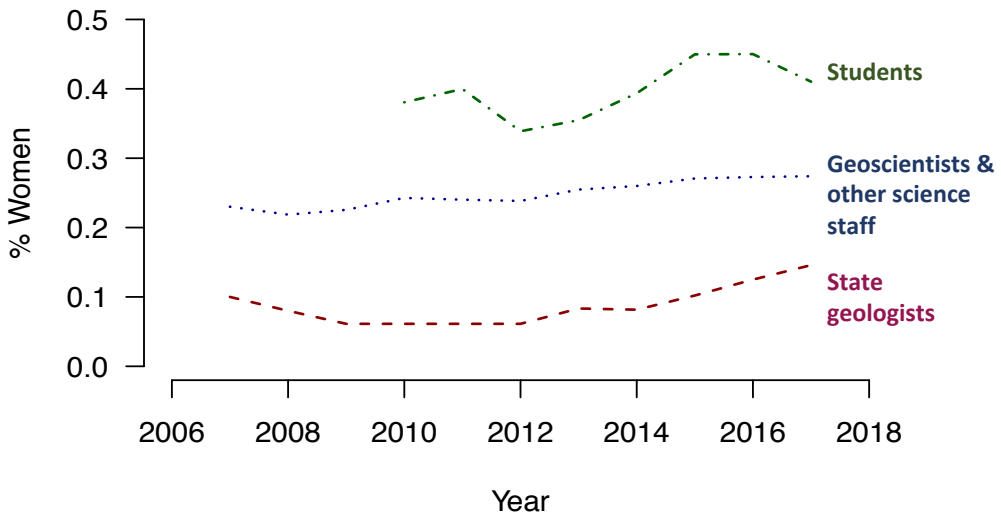

Figure 8. Number of women employed at state geological surveys. Women currently comprise about 28% of state geological survey scientific staff, despite ranging from 35% to 45% of geological students. Data from the AASG 2016–2017 job classification data on gender.

years to reach 45% of the scientific staff; 45% is roughly the highest level of women graduating in geosciences. Women were earning 28% of the U.S. master of science degrees in geosciences in the mid-1990s; in 2017, women earned 40% of them (Keane, 2018).

The employment of women geoscientists at state geological surveys lags behind U.S. Geological Survey levels, where women make up 31% of staff scientists (table 1).

Table 1 – Women employed at the U.S. Geological Survey. From, P. Ford, personal communication, February 2019 data

Occupation	Number of Women (permanent)	% Women Scientists
General Physical Science	119	38%
Geophysics	63	31%
Hydrology	290	28%
Chemistry	48	43%
Astronomy & Space Science	1	25%
Geology	139	36%
Oceanography	14	49%
Cartography	37	32%
Physical Science Student Trainee	32	19%
Total	743	31%

Using the AASG 2016–2017 gender data, we ranked the surveys by the percentage of women geoscientists and percentage of women scientists (includes geoscientists and others) on staff. Surveys with fewer than eight full-time equivalent (FTE) scientists were not ranked. The percentage of women geoscientists on staff ranges from zero to 50%, with a mean of 26% of the ranked surveys. For all women scientists on staff, the percentage ranges from 7% to 50%, with a mean of 29%. Appendix B contains a full ranking of the surveys, with the recognition that the data are a couple of years old and

may include reporting errors or reflect survey differences in how staff members are categorized. However, it is a measuring point for how well a survey is progressing toward achieving gender balance in its scientific staff.

We also looked at whether surveys headed by women state geologists had a higher percentage of women scientists (fig. 9). Though the sample size is small—five surveys (the two very small surveys were not included)—surveys headed by women have a slightly higher percentage of women scientists on staff than the mean from state surveys headed by men. This may reflect the importance of role models for retention of women in the sciences (Hernandez et al., 2018).

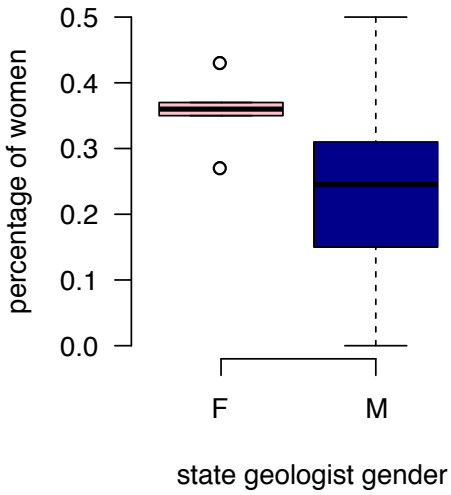

Figure 9. Percentage of women at a state geological survey based upon the gender of the state geologist. At surveys where the state geologist was a woman, women comprise a statistically significant greater percentage of the scientific staff (p = 0.008).

Gender data for broad job classifications have been useful to mark the gains, or lack thereof, for women scientists at state geological surveys. How well women are moving up the ranks is another important measure and is not captured in this work. That would be a valuable addition to the statistics collected by AASG.

Take aways

1. Overall, respondents reported doing well. They believe in the value of their work and appreciate the benefits of a state geological survey career.

2. Work is needed to improve the percentage of women geoscientists employed by state geological surveys. Only modest gains have been made over the past decade and employment is far behind the historical levels of women graduating in the geosciences. A concerted effort is needed to attract, hire, retain, and promote women scientists.

3. Leadership matters. The state geologist sets the vision and culture for inclusion, can actively promote opportunities for women, and can be clear that the survey will not tolerate sexual discrimination.

Recommendations

1. AASG: Collect gender data for supervisory roles as part of annual statistics.

2. Individual surveys: Establish an *ad hoc* committee to propose actions a survey can take to improve recruitment and retention for a diverse scientific workforce.

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Appendix A

Table A1. A selection of comments about why women geoscientists stay at their state geological surveys.

1	I love my job; I make a difference to society and the state
2	I enjoy the opportunity to be in an educational/learning environment and to be able to provide scientific information to a wide range of individuals.
3	I have a high degree of independence and, as part of a university; my job offers a lot of variety and a large level of impact on my community…. Job security and good benefits…also help.
4	I love my job. I get paid to map!
5	[This Survey] is a family and is truly making an impact on the world around us.
6	Work environment is great; forward thinking, minimal politics.
7	What keeps me here is interest in my projects, great benefits and working on a campus with a lot of resources.
8	[My job] needs to be intellectually challenging, [and have] importance to society… Fair compensation.
9	I love the civil service aspect of my job and the people I work with. I… have grown to love this state and want to work to protect its natural resources.
10	Working for the state in a union job provides a higher level of security and stability than comparable private jobs.
11	I like working for the public rather than a client, and I value making a contribution and trying to be as effective as possible.
12	Working for a state survey offers opportunities for professional growth and development not readily available in the private sector.
13	I love that I'm constantly learning new things and gaining new responsibilities. I feel valued at [this survey] and my work feels important.
14	I enjoy working here and love the collaborative spirit, limited bureaucracy, connection with state and federal agencies and industry.
15	Great colleagues, good job location, interesting work.
16	I am never bored by the geology in our state. Research questions are endless.
17	I love working at the state geological survey because it allows me to work with many different entities. I feel good about doing work in the interest of the people of my state, and I have a lot of flexibility with my research…
18	Fieldwork keeps me here.
19	I love working for the Survey and I feel like I'm contributing a lot to protect the environment.
20	The job security and benefits keep me here.
21	I am able to conduct applied research as field geologist, work independently to develop research topics, have a high degree of autonomy, and was not subject to tenure process.
22	I was attracted to the state geological survey because of its reputation and the opportunity to produce products and shape policy to improve public safety with respect to geologic hazards.

23	…my work directly benefits the people of my state.
24	The people keep me here, the variety of projects keeps me here, and the flexibility keeps me here.
25	The work/life balance that my position provides me is one of the main reasons why I am here and not at a private company. Additionally, … my work makes me feel as though I am contributing something meaningful to society.
26	The survey ends up selecting folks who are not driven by money… folks stay here because they like the work and environment.
27	Highly competent, professional colleagues who take pride in their work.
28	Rewarding work, opportunities to mentor staff, and continuing to provide the public with important geologic information for land-use and public safety decisions.
29	I thoroughly enjoy the work I do and it is right in line with my education. It's a dream job…
30	Intellectual challenge and freedom of research.
31	I love working with the public and educating them about geosciences.
32	I love geologic mapping, working independently, outdoors, intellectual challenge.
33	I came from the private sector. I wanted the higher degree of independence and greater ability to ask and answer scientific questions. I also enjoy the switch from reactive remediation to proactive natural resource protection.
34	Stimulating research with good funding and great colleagues.
35	When in a research role, the excitement and challenge of my scientific research as well as the nearly complete autonomy that I enjoyed kept me at the survey. In my current role as State Director, loyalty to the survey and a deep belief in our mission keep me here.
36	Real contribution to society and a lot less stress than the consulting work or academia.
37	There is a great amount of flexibility; I'm able to attend online grad school and teach a course during non-work hours. Great group of like-minded young women work here.
38	I took a big pay cut to work at the survey; it was worth it as less stress, much more interesting work. I was able to take the pay cut as spouse is primary breadwinner.
39	I stay because of the freedom to work on (and usually choose) projects that I think will have a long-term benefit to the state.
40	Our state and deputy state geologists are great scientists and a great management team.
42	Last year, the first woman was hire as the State Geologist of [the survey]. In addition one of the division supervisors is a woman and there is almost equal numbers of women project geologists as men. [This survey is] doing pretty well!
43	Despite continuing disparities, our survey has provided opportunities for women that perhaps exceed the opportunities in academia or even industry.
44	What keeps me here is idealism, wanting to help people and the environment.
45	I am very fortunate to be at a survey with a woman state geologist.

Table A2: A selection of comments about why respondents might leave their state geological surveys or other concerns.

1	I enjoy my job but fear that I won't last more than a few years for several reasons: 1) I am expected to do all field work alone, which is not safe for anyone; 2) the future of many small surveys is questionable these days; 3) due to lack of funding, I am limited in the scope and depth of my work.
2	I may leave because…. I would like more fieldwork.
3	I learned that there is no parental leave; that mothers (and fathers) have to take their vacation allowance… Are we joking here?
4	Low salary and state government bureaucracy…
5	What might make me consider leaving (before my project end date) is my commute, salary or the fact I am unsure about opportunities for career advancements (lack of communication from higher ups).
6	If state funding for my agency continues to decline, job prospects look grim, or we're unable to perform the scientific research that I feel is critical to the state.
7	All senior scientist positions are held by men. There is no clear path for advancement in our university system and no pull from the top to advance our driven female staff members.
8	Generally, gender imbalance is not discussed out in the open at our state survey.
9	Lack of funding (both for competitive salary compensation and for project-based research) has been an issue
10	No advancement opportunities and everything that comes with that (responsibilities and salary).
11	Lack of opportunity for advancement. So while the geology is interesting, the organizational structure and responsibilities are not.
12	Advancement in a government setting… is always limited, and females still seem to have to work harder to prove themselves than their male counterparts.
13	Women here have the typical issue of saying something in a meeting that won't be heard, after which a man will say the same things five minutes later and be heard. Women who contribute substantially more than their male counterparts are not noticed…
14	There are a lot of women who work at my Survey's department. However, a majority of the high responsibility roles are given to men because they have seniority.
15	[There continues to be] institutional discrimination against women, where we are not provided the same level of support to do our jobs easily and efficiently.
16	Organization and lack of communication are reasons I would look elsewhere.
17	I have been the target of gender harassment from my male supervisor. I have repeatedly sought assistance from the geological survey leadership and … my concerns are ignored and [I have been] verbally reprimanded…
18	Almost all supervisory and senior positions are filled by men, including the newest hires. We are experiencing a lot of turnover at the top… it remains to be seen if they will fill leadership positions with women.
19	I might leave because the pay is too low.

20	[Women are faring at the geological survey] better than we did in my early years.
21	Gender discrimination with a male director; not being adequately valued for skill set.
22	At first, I thought this was the ideal job….Administrative leadership has been poor. There have been multiple times when I have been discriminated against.
23	All higher grades here are men, lower grades are women. Salary follows [the grade]. … Few women have worked here, and the ones that have worked here have not stayed.
24	Have to work twice as hard to be noticed.
25	I will likely have to leave soon because the salary is so very low that I'm having trouble making ends meet. I'll likely be forced to find something different, possibly even outside the geosciences field.
26	[Women] outnumber the men now, but have lower salaries and are not in supervisory roles.
27	There is much greater parity here than I experienced in the private sector…[although] some issues of credibility gap and need for awareness and allies still exist….
28	The benefits keep me at the survey, but the pay may make me leave.
29	The pay does not cover the cost of living in this major city and I don't see a way to advance as a scientist in this organization.
30	There is a high level of workplace sarcasm, and a lack of women in supervisory positions.
31	In process of leaving. Lack of/bad mentoring and support.
32	I may leave due to terrible pay, lack of resources for fieldwork, experiments and analyses.
33	Subtle gender discrimination, pervasive with men in charge. As the only female scientist at the survey, it is isolating.
34	Benefits are good, but we have no budget.
35	The overt sexists are gone…
36	Misogyny definitely exists occasionally…
37	The salary is not attractive and I am sometimes tempted to go back full-time to industry.
38	Workplace morale is very low with worsening conditions and high turnover. Management doesn't listen to or incorporate our concerns, doesn't seem connected to what we're doing daily and doesn't adequately acknowledge our work.
39	We need more representation and more women geoscientists working here. We also need the support and opportunities that men are given. The misogyny runs deep.
40	Would leave if administration continues with current lack of communication and lost sight of vision.
41	We have no women in supervisory roles here at our Survey and very little room for advancement.
42	My only serious discrimination was from another older female.

43	Ageism is more of an issue than sexism.
44	The culture varies in different sections at our Survey. I currently have supervisors that have never made me feel like my gender is related to my scientific knowledge or ability. However, I have worked under supervisors in the Survey that don't have the same mentality.
45	At our survey there are a lot of women. However, the women tend to be in the lower paid positions and don't advance as quickly. Also, it seems the managers and directors do not listen to the opinions of women nearly as much as men.

Appendix B

Table B1. State geological survey ranking based on percent of geoscientists that are women. American Association of State Geologists 2016–2017 reported data. Student data removed, and surveys with fewer than eight full-time equivalent (FTE) scientific staff were not ranked.

Relative Ranking	Geoscience Staff	% Women Geoscientists
Alaska	32	50%
Maryland	18	50%
Minnesota	29	45%
Virginia	9	44%
Oregon	27.5	44%
Pennsylvania	23	43%
Wisconsin	14.2	39%
Colorado	13.5	37%
Wyoming	11	36%
Montana	50	36%
New Mexico	34	35%
Washington	26	35%
Illinois	78.4	31%
Oklahoma	10	30%
South Dakota	14	29%
Nebraska	10.6	28%
Indiana	25	28%
West Virginia	20.75	28%
Arkansas	15	27%
Delaware	12	25%
South Carolina	8	25%
Texas	121	25%
Florida	17	24%
Arizona	8	22%
Idaho	8.08	21%
Missouri	66.4	21%
New Jersey	34	21%
North Dakota	11	18%
California	62	16%
Utah	46.4	16%
North Carolina	13	15%
Alabama	28.5	14%
Ohio	24	13%
Maine	8.5	12%

Kentucky	34.5	12%
Kansas	17.75	11%
Iowa	11	9%
Nevada	13	8%
Mississippi	14	0%
Georgia	1	
Louisiana	4	
Massachusetts	3	
Michigan	1	
Tennessee	6	
Connecticut	1	
New York	4	
Vermont	4.25	
New Hampshire	6	

Table B2. State geological survey ranking based on percent of scientific staff that are women, from American Association of State Geologists 2016–2017 reported data. Student data removed, and surveys with fewer than eight FTE scientific staff were not ranked.

Relative Ranking	Scientific Staff	Percent Women
Alaska	32.0	50%
Maryland	18.0	50%
Wisconsin	18.2	47%
Oregon	27.5	44%
Pennsylvania	23.0	43%
Minnesota	32.0	41%
Virginia	10.0	40%
Wyoming	15.0	40%
New Mexico	39.0	38%
Arizona	13.8	36%
Nebraska	13.4	36%
Washington	31.0	35%
Montana	57.0	35%
Colorado	16.0	34%
Illinois	97.4	31%
Idaho	9.1	30%
Delaware	17.0	29%
New Jersey	63.0	29%
South Dakota	14.0	29%
Indiana	25.0	38%
Arkansas	18.0	28%
Texas	121.0	28%
Missouri	71.4	25%
Kansas	35.0	24%
Florida	17.0	24%
West Virginia	28.8	24%
Alabama	36.0	23%
South Carolina	9.0	22%
Oklahoma	14.0	22%
Maine	10.5	21%
Utah	50.4	19%
North Carolina	26.9	19%
Kentucky	39.5	18%
North Dakota	12.0	18%
California	62.0	17%
Ohio	26.0	16%

Iowa	11.0	12%
Nevada	14.0	9%
Mississippi	15.0	7%
Connecticut	2.0	0%
Georgia	1.0	
Louisiana	6.5	
Massachusetts	4.0	
Michigan	1.0	
New Hampshire	6.8	
New York	6.0	
Tennessee	6.0	
Vermont	4.3	