DEMOGRAPHIC TRENDS IN CANADIAN ACADEMIC GEOSCIENCE

EQUITY SURVEY REPORT

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TABLE OF CONTENTS

SUMMARY

- There is a greater proportion of women than men among research students (both master's and PhD), but men still outnumber women among post-doctoral fellows (62.1% men) and staff/faculty (63.5% men).
- Men outnumber women among all tenured faculty positions (64.9%).
- The proportion of non-binary participants in our sample is significantly higher than that indicated in the 2021 Canadian Census (3.3% vs. 0.14%).
- LGBTQ+ individuals appear well-represented, particularly among master's (31.4%) and PhD students (23.7%), compared to 6.7% of faculty. All proportions are higher than the Canadian census estimate (4%).
- The majority of respondents were white (73.4%), higher than the 2021 Canadian census estimate of 67.4%.
- Tenured full professors had the lowest proportion of racialized respondents (8.2%).
- South Asian, Black, and FNIM (First Nations, Inuit and Métis) identities were most underrepresented in our sample compared to what would be expected based on the 2021 Canadian census.
- 9% of respondents indicated living with a disability, with a higher proportion among students (12% of PhD students and 8% of Master's students) than full professors (7%).
- Indigenous representation is low overall, with no Inuit respondents and only 2.3% identifying as either First Nations, Métis or Indigenous. This is lower than the 2021 Canadian census estimate of 5% of the population identifying as Indigenous.
- Students had higher representation across almost all categories than those in salaried research positions.

ACKNOWLEDGEMENTS

Land Acknowledgement

We wish to open by acknowledging that Canada resides on the traditional territories of the First Nation, Inuit and Métis peoples of Turtle Island. More specially, we acknowledge the land on which the University of Toronto operates. For thousands of years, it has been the traditional land of the Huron-Wendat, the Seneca, and the Mississaugas of the Credit. Today, this meeting place is still the home to many Indigenous people from across Turtle Island and we are grateful to have the opportunity to work on this land. Additionally, we acknowledge the University of Calgary is located on the traditional territories of the peoples of Treaty 7, which include the Blackfoot Confederacy (comprised of the Siksika, the Piikani, and the Kainai First Nations), the Tsuut'ina First Nation, and the Stoney Nakoda (including Chiniki, Bearspaw, and Goodstoney First Nations). The City of Calgary is also home to the Métis Nation of Alberta Region 3.

If you are interested in improving your understanding on which traditional territories you live or work, we direct you to Native Land Digital and their many online resources.

Personal Acknowledgement

This report would not be possible without the engagement of 482 members of the Canadian geoscience community. Sharing their demographic information has allowed us to better understand the modern landscape of this discipline in Canada and highlight those groups who are underrepresented.

Data Availability

The data collected as part of this project are confidentially held by the project's creator Scott Jess. To protect the identities of respondents, the metadata of this survey (i.e., list of all responses) will not be shared. Those interested in accessing this data for their own purposes should contact Scott Jess (scott.jess@wsu.edu0) with their specific request regarding processed data, provided the request does not allow the identities of induvial participants to be revealed.

BACKGROUND AND OBJECTIVES

Geosciences is currently witnessing a growth in studies aiming to improve our understanding of the demographics represented in the field and the barriers that exist for those within (e.g., Beane et al., 2021; Bernard & Cooperdock, 2018; Guhlincozzi & Cisneros, 2021; Marín-Spiotta et al., 2020). This growing body of work suggests that progress in racial and ethnic diversity has remained stagnant at all levels of academia, from undergraduate programs through to PhD candidacy, and that the geosciences may have lower racial and ethnic diversity than other physical sciences programs (Bernard & Cooperdock, 2018; Beane et al., 2021; Dowey et al., 2021). The lower representation of women in geosciences has also been highlighted, with those at the intersection of racial and gender identities experiencing even greater exclusion. These works have been important for understanding how the field has evolved and what improvements can be made to create a more inclusive space.

Despite this recent influx in studies, publicly available demographic data for academic geosciences do not exist in Canada. This means much of our understanding of the demographics of the field and the barriers researchers face are driven by data from the United States, where underlying social issues and demographics are different to those in Canada. This lack of data makes it difficult for those working to increase equity, diversity, and inclusion in geoscience departments across Canada to be informed about their workplace and what possible actions could be taken to improve these spaces.

The purpose of this survey is to determine the demographic makeup of academic geoscience in Canada, to better understand whether certain communities are underrepresented, and to identify the geographic origins of the geoscience workforce (e.g., Canada, North America, Europe etc.). We aim to distribute this survey every 3 years to track changes to the demographics of Canadian Geoscience.

The research objectives are to:

1. Establish the demographic make-up of academic geoscience and identify communities that may be underrepresented.

2. Create a survey that will be redistributed every 3 years to track changes in the demographics of academic geoscience in Canada.

SURVEY METHODOLOGY

Between September and December 2022, we distributed the first-ever online demographic questionnaire to 35 academic geoscience departments across Canada.

The survey contained 22 questions that focused on a variety of topics included gender identity, sexual orientation, Indigenous identity, racial identity, disability, educational attainment, and employment. The survey was approved by the Social Sciences, Humanities and Education Research Ethics Board at the University of Toronto (Protocol #00043104). Participation in the survey was voluntary and every effort was made to protect the identities of respondents. All percentages in this report have been rounded to the nearest one decimal place, unless the percentage was less than 1% in which case it was reported as <1%.

In total, 482 eligible respondents completed the survey: 241 (50%) of participants were college or university faculty/staff, 29 were post-doctoral fellows, 114 were PhD students, and 89 were master's students. The remaining 9 participants either did not indicate their research position or held another position than was not listed. This sample is approximately 20% of the total research population of academic geoscience and may not reflect the absolute demographics of this population; however, we believe that these data provide valuable information from which to further equity and diversity efforts in geoscience.

Gender: Gender refers to current gender identity, which may be different from sex assigned at birth and may be different from what is indicated on legal documents.

Racialized Person(s): This term is used to describe all participants that racially identify as anything other than 'white' or Indigenous. This aligns with the federal government's definition of a 'visible minority' and is necessary to compare our results to federal statistics.

FNIM: This term is used to describe participants who identify as First Nations, Inuk (Inuit) or Métis.

LGBTQ+: Participants who identified as lesbian, gay, bisexual, trans, queer or any other identities that are not heterosexual or cisgender (e.g., pansexual, asexual, gender queer).

Disabled: A person with a disability is a person who has a long-term or recurring impairment that could be categorized into one of 10 types (vision, hearing, mobility, flexibility, dexterity, pain, learning, developmental, memory and mental health-related) and considers themselves to be disadvantaged in employment by reason of that impairment, or believes that an employer or potential employer is likely to consider them to be disadvantaged in employment by reason of that impairment. Persons with disabilities are also those whose functional limitations owing to their impairment have been accommodated in their current job or workplace.

Prefer not to say: All questions in the survey were optional to ensure those who did not wish to answer specific questions. This term is used to define those participants who did not provide an answer for a given question.

OVERVIEW

The mean age of respondents was 40 years, with a range of 22-79 years. The majority of participants identified as men (53.1%), white (73.4%), straight (82.8%), and Canadian citizens (66.8%). Indigenous identity was reported by 19 participants (3.9%), but only 4 participants indicated Indigenous as their only racial identity while others reported Indigeneity as one of multiple identities.

Respondents were located in all provinces except for Prince Edward Island, while the Yukon was the only territory with representation. Ontario had the largest proportion of respondents (36.7%), followed by British Columbia (23.2%), and Alberta (13.7%). Nearly half of our sample was born in a country other than Canada (48.8%). Participants were born in 49 countries excluding Canada, with the greatest representation coming from the United States (12%), the United Kingdom (6.2%), and China (5.6%).

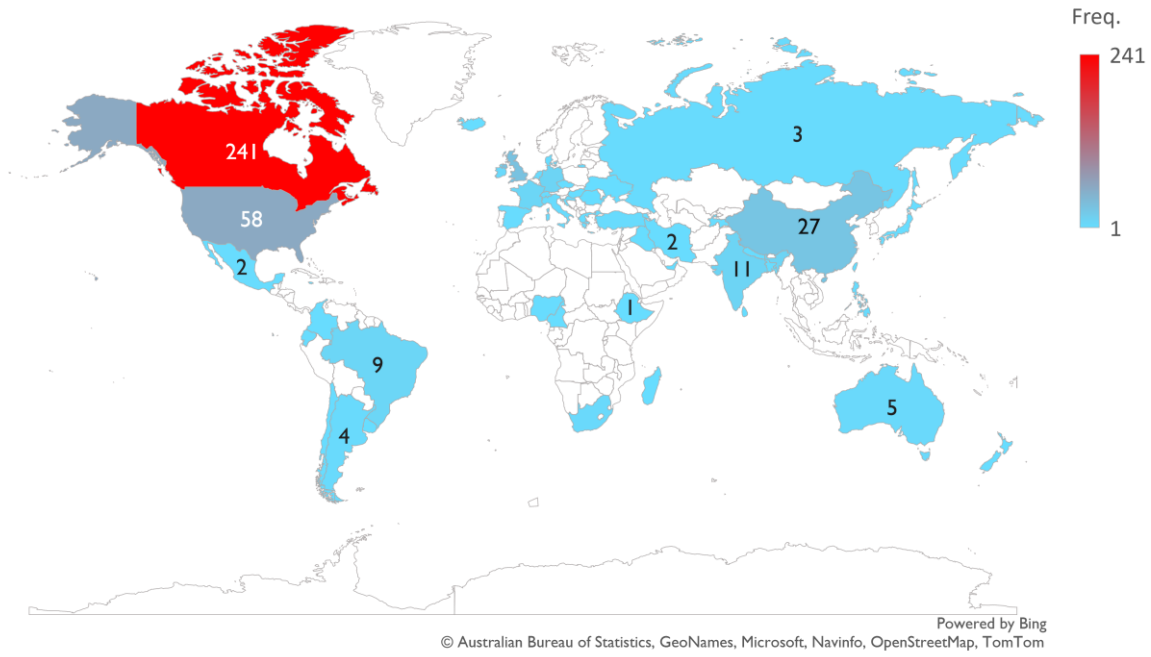
Age	n	%
20-29	161	33.4%
30-39	110	22.8%
40-49	83	17.2%
50-59	45	9.3%
60-69	55	11.4%
70-79	10	2.1%
Prefer not to say	18	3.7%
Gender identity		
Man	256	53.1%
Woman	202	41.9%
Non-binary	16	3.3%
Two-spirit	2	<1%
Other	1	<1%
Prefer not to say	5	1%
Sexual orientation		
Straight	399	82.8%
Gay/lesbian	17	3.5%
Bisexual/pansexual	44	9.1%
Other	12	2.5%
Prefer not to say	10	2.1%
Disability status		
Yes	39	8.1%
No	440	91.3%
Prefer not to say	3	<1%
Legal status		
Canadian citizen	322	66.8%
Permanent resident	46	9.5%
Work/study visa	102	21.2%
Other	1	<1%
Prefer not to say	11	2.3%

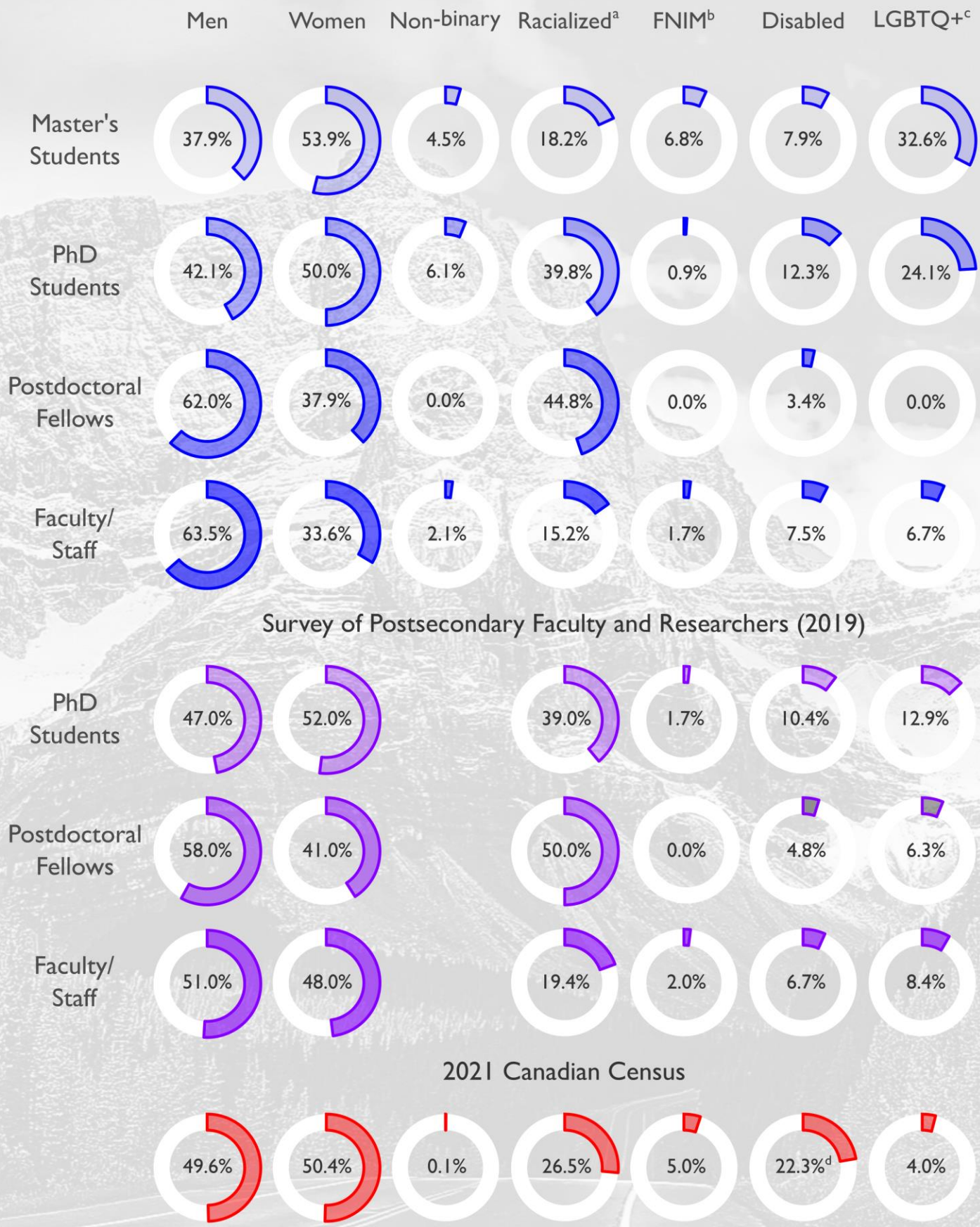
Highest degree achieved	**n**	**%**
Bachelor's degree	101	21%
Master's degree	114	23.7%
Doctorate	267	55.4%
Research position		
Master's student	89	18.5%
PhD student	114	23.7%
Post-doctoral fellow or scholar	29	6%
Professor at a university or college	241	50%
Other	5	1%
Prefer not to say	4	<1%
Type of employment		
Part-time	27	5.6%
Full-time	450	93.3%
Prefer not to say	5	1%
Did you move to Canada for this position?		
Yes	177	36.7%
No	295	82%
Prefer not to say	10	2.1%
Prov/Terr of work or study		
Alberta	66	13.7%
British Columbia	112	23.2%
Manitoba	5	1%
New Brunswick	4	<1%
Newfoundland & Labrador	28	5.8%
Nova Scotia	23	4.8%
Ontario	177	36.7%
Quebec	47	9.8%
Saskatchewan	16	3.3%
Yukon	1	<1%
Prefer not to say	3	<1%

Indigenous status		
No, not an Indigenous person	460	89.2%
First Nations	10	2.1%
Métis	1	<1%
Other Indigenous	8	1.7%
Prefer not to say	3	<1%
Race		
Indigenous	4	<1%
White	354	73.4%
South Asian	18	3.7%
Chinese	32	6.6%
Black	5	1%
Filipino	2	<1%
Arab	4	<1%
Latin American	14	2.9%
Southeast Asian	4	<1%
West Asian	5	1%
Other	5	1%
Multiple responses	30	6.2%
Prefer not to say	5	1%

Tenure status		
Tenured, assistant professor	14	2.9%
Tenured, associate professor	48	10%
Tenured, full professor	112	23.2%
Leading to tenure, probationary	45	9.3%
Non-tenured staff or non-tenure track	163	33.8%
Prefer not to say/NA	100	20.7%
Country of birth		
Canada	241	50%
Other	235	48.8%
Prefer not to say	6	1.2%

Country of Birth





[a] *Those participants who are not First Nations, Inuk (inuit), Métis or White, based on the 'visible minority' classification of the Canadian Census.*

[b] *Participants who are First Nations, Inuk (Inuit) or Métis.*

[c] *Participants who identified as lesbian, gay, bisexual, trans, queer or other identities that are not heterosexual or cisgender.*

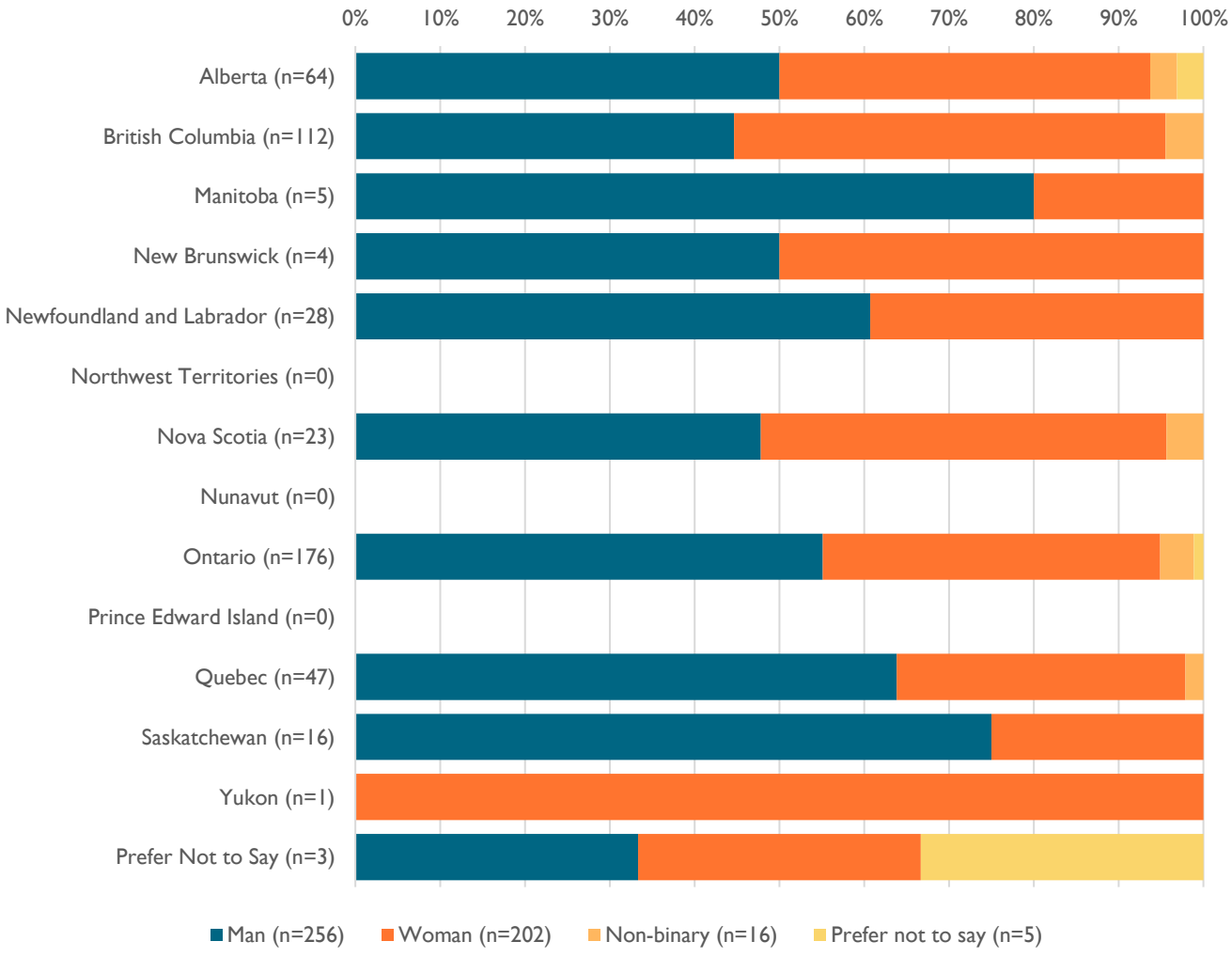
[d] *Based on the 2017 Canadian Survey on Disability*

1.0 GENDER IDENTITY

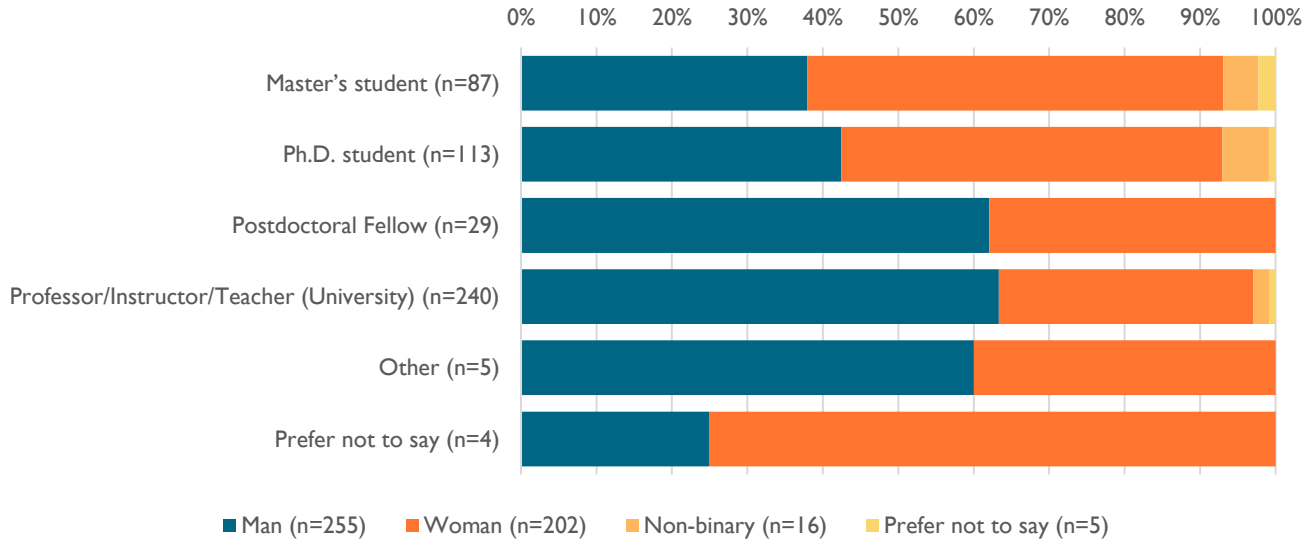
For our question regarding gender identity, we provided the following definition: "gender refers to current gender identity, which may be different from sex assigned at birth and may be different from what is indicated on legal documents." Participants could respond with one of the following options: man, woman, non-binary, or Two-spirit. Additionally, participants could choose not to answer the question or write in another option if their gender was not represented by one of the options.

Out of 482 respondents, the majority of participants identified as men (53.1%), followed by women (41.9%), and non-binary (3.3%). A very small proportion of respondents did not provide a gender identity (<1%). Only one participant provided a different gender identity, and only two participants identified as Two-spirit. To protect the identity of these three respondents, we have removed their responses from this section.

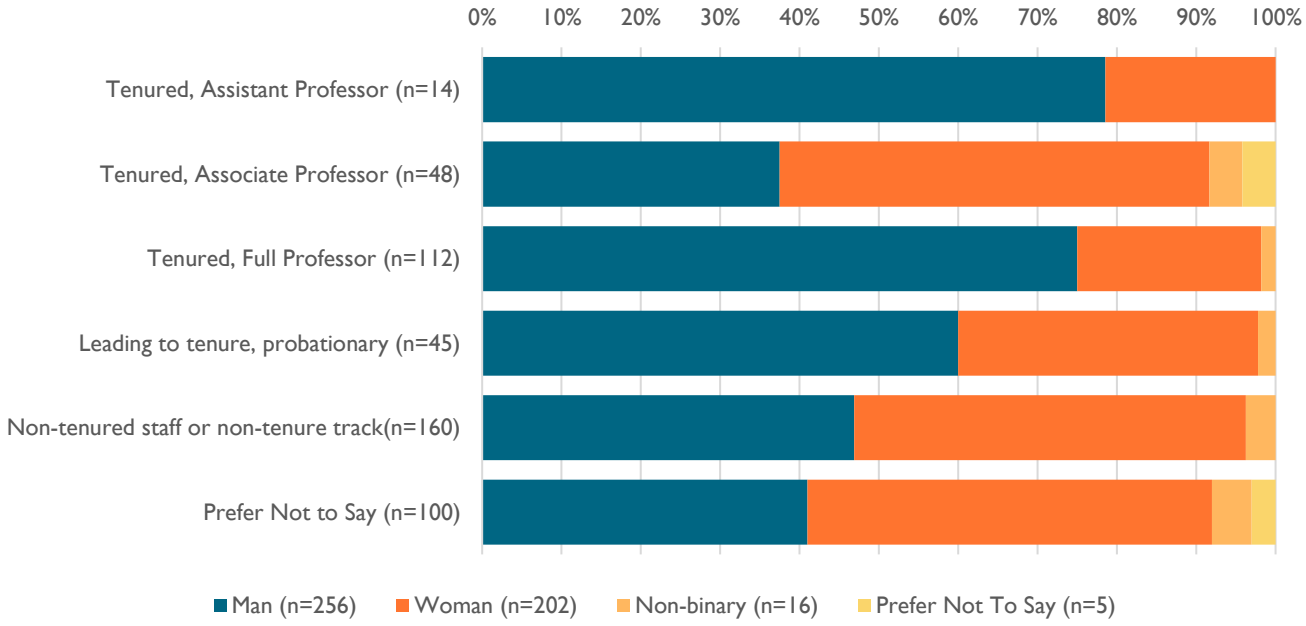
Out of provinces with >20 respondents, all provinces except British Columbia and Nova Scotia had a higher proportion of men than any other gender. Women made up 50.9% of respondents in British Columbia, 44.6% identified as men, and 4.5% as non-binary. In Nova Scotia, an equal proportion of respondents identified as men and women (47.8%), with the remaining 4.3% identifying as non-binary. Quebec had the greatest gender disparity across respondents, with 63.8% identifying as men. Among provinces with non-binary representation (Alberta, British Columbia, Nova Scotia, Ontario, and Quebec), the proportion of those who identified as non-binary was similar (2-4%).



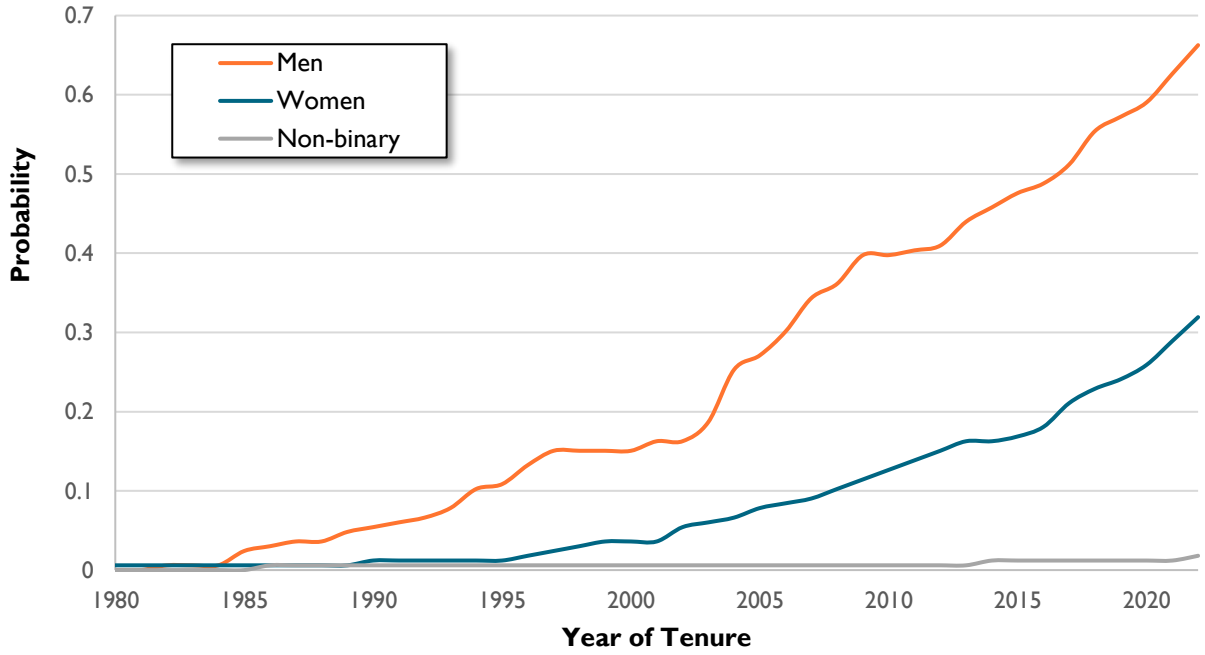
Both post-doctoral fellows and staff/faculty at a university were predominately men (62.1% and 63.5%, respectively), while women made up the majority of PhD and master's students (50.4% and 55.1%, respectively). Non-binary persons had greater representation among master's and PhD students than in any other position, making up 4.6% and 6.2% of respondents, respectively.



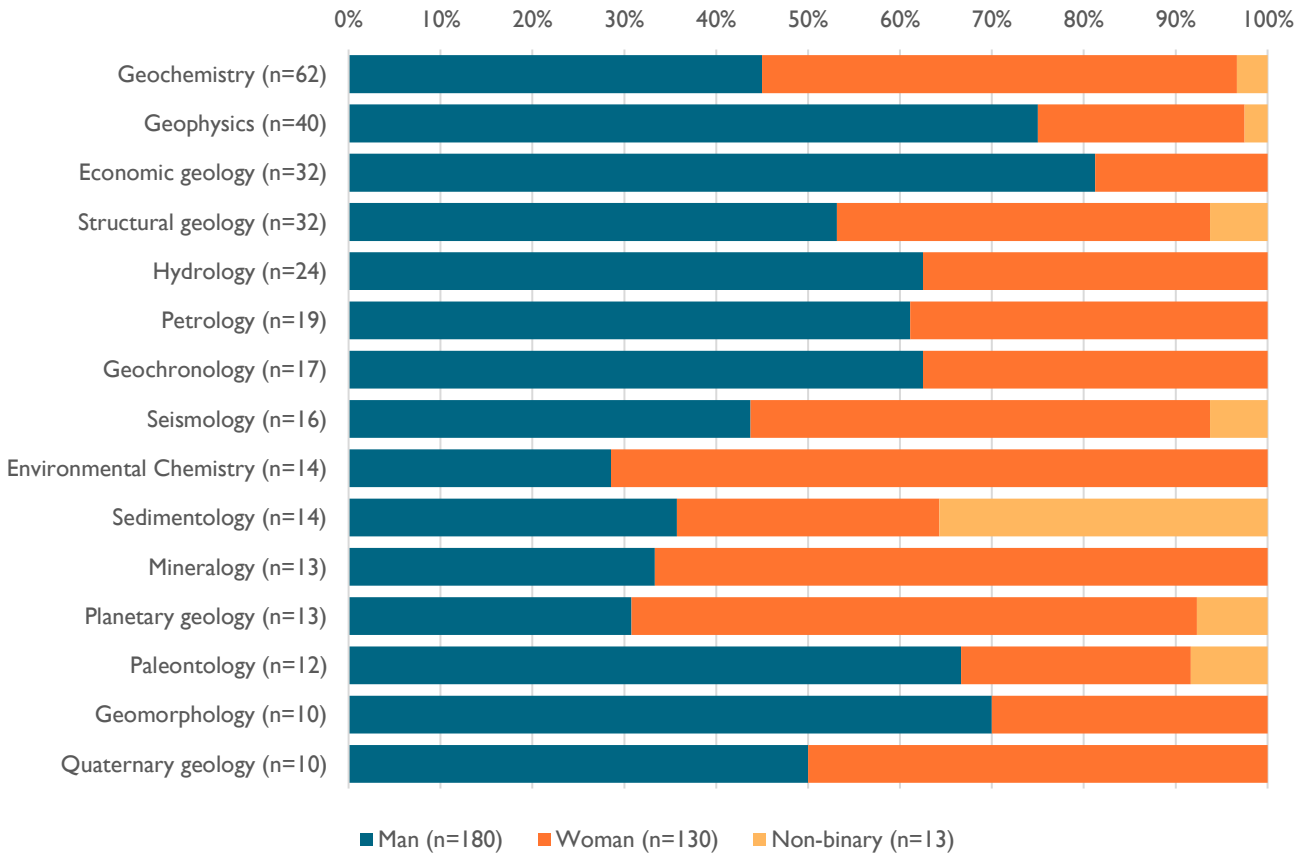
The majority of respondents that held tenure identified as men (65.7%), followed by women (32.0%). Of those on a tenure track, 60% were men, while 37.8% were women and 2.2% were non-binary. Men and women were near evenly split (46.9% and 49.4%, respectively) for non-tenured staff and faculty with the remainder identifying as non-binary (3.8%). Associate professors had the greatest proportion of women (54.2%) compared to assistant professors (21.4%) and full professors (23.2%), though the sample of assistant professors was small (n=14).



We asked participants who held tenure the year in which this status was achieved. These data show men have held the majority of tenure appointments since 1985. Notably, between 2003 and 2009, men achieved 39 tenure appointments compared to 10 women and 0 non-binary individuals.



Gender representation by specific geoscience field was assessed for fields with >10 respondents. Economic Geology has the greatest proportion of men (81.3%), followed by Geophysics (75%), and Geomorphology (70%). The highest proportions of women are in Environmental Chemistry (71.4%), followed by Mineralogy (66.7%), and Planetary Geology (61.5%). Sedimentology has the highest representation of non-binary persons (35.7%), followed by Paleontology (8.3%), and Planetary Geology (7.7%).

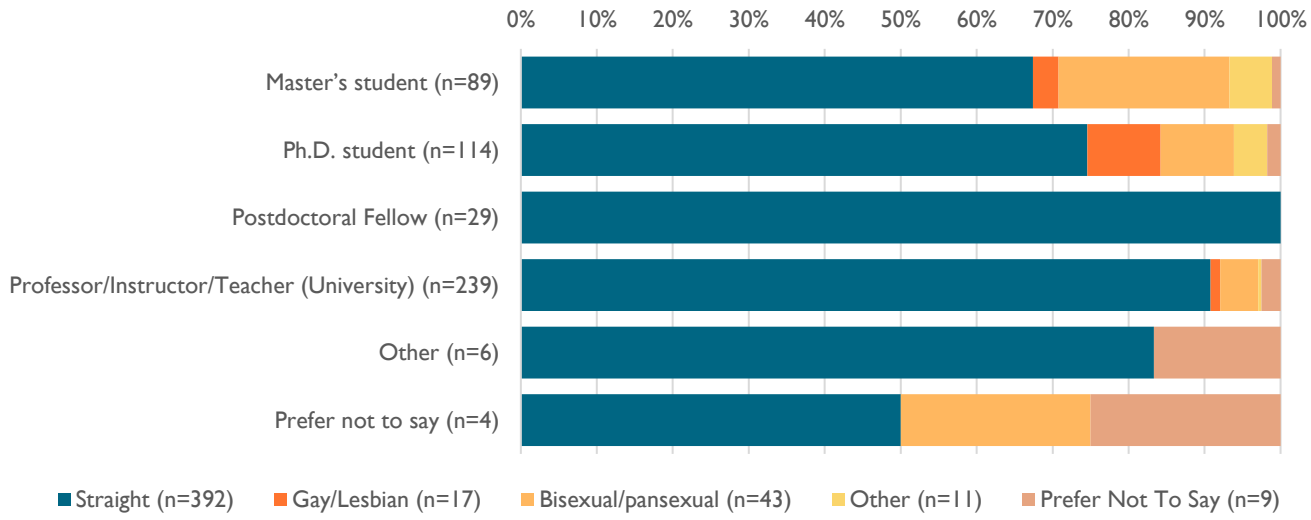


2.0 SEXUAL ORIENTATION

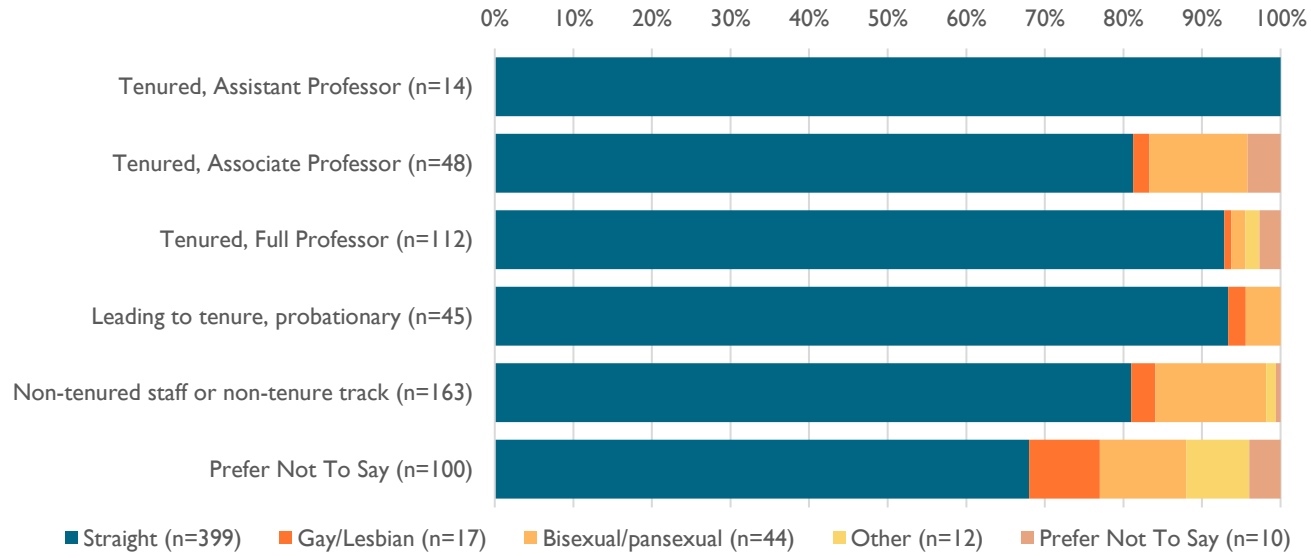
For this survey, we asked respondents to self-identify their sexual orientation. Respondents could identify as one of: straight, gay/lesbian, or bisexual/pansexual. Additionally, participants could choose not to answer the question or write in another option if their sexual orientation was not represented by one of the options.

The majority of respondents identified as straight (81.3%), followed by bisexual/pansexual (8.9%), and gay/lesbian (3.5%), while 2.5% wrote in a different sexual orientation. A small proportion of respondents did not provide a sexual orientation (1.8%).

Among master's students, 31.4% identified as LGBTQ+, which was the highest proportion among all positions. 23.7% of PhD students identified as LGBTQ+, and 6.7% of university staff/faculty. All postdoctoral respondents identified as straight.



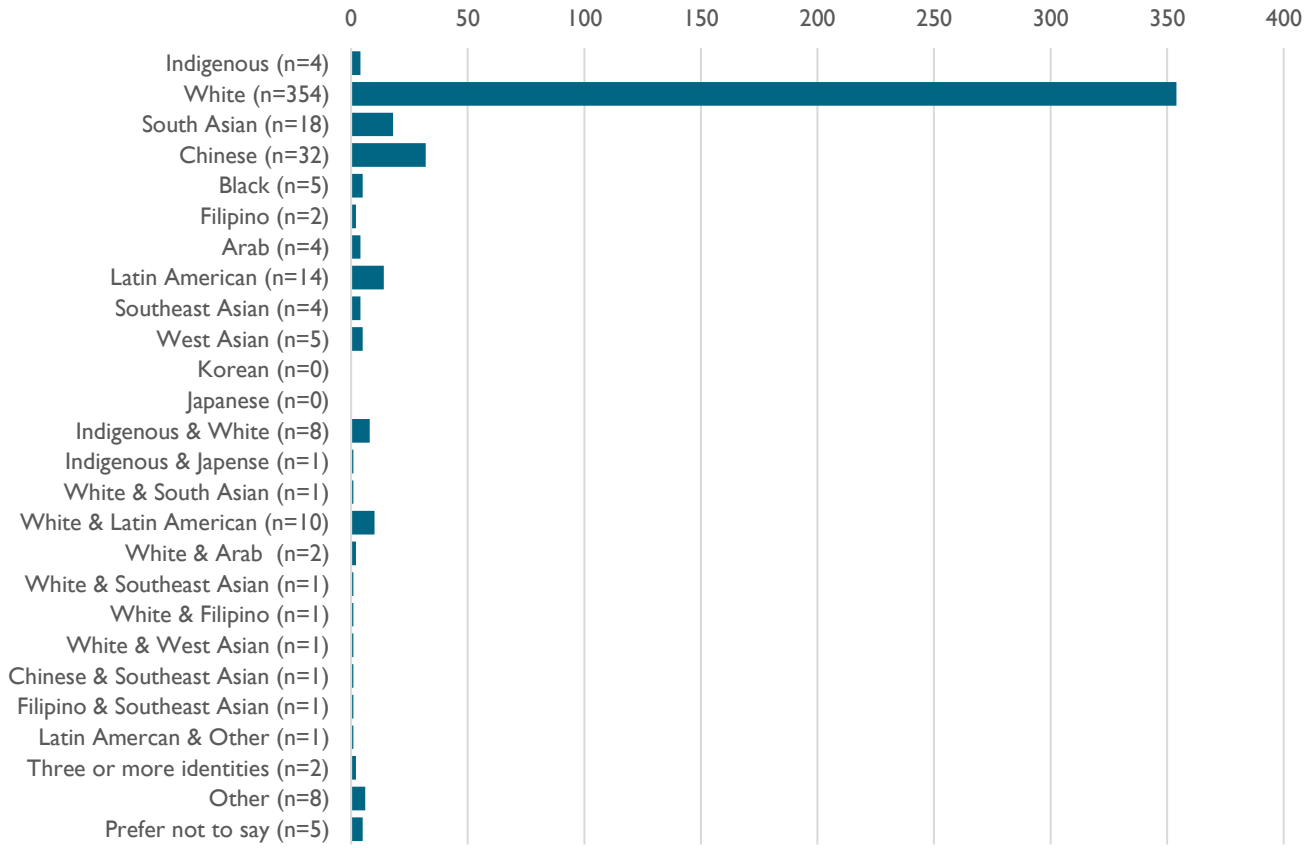
Among participants with tenure status, 93% identified as straight. All tenured assistant professors were straight, along with 95.4% of full professors, 93.3% of those on a tenure path and 84.8% of associate professors.



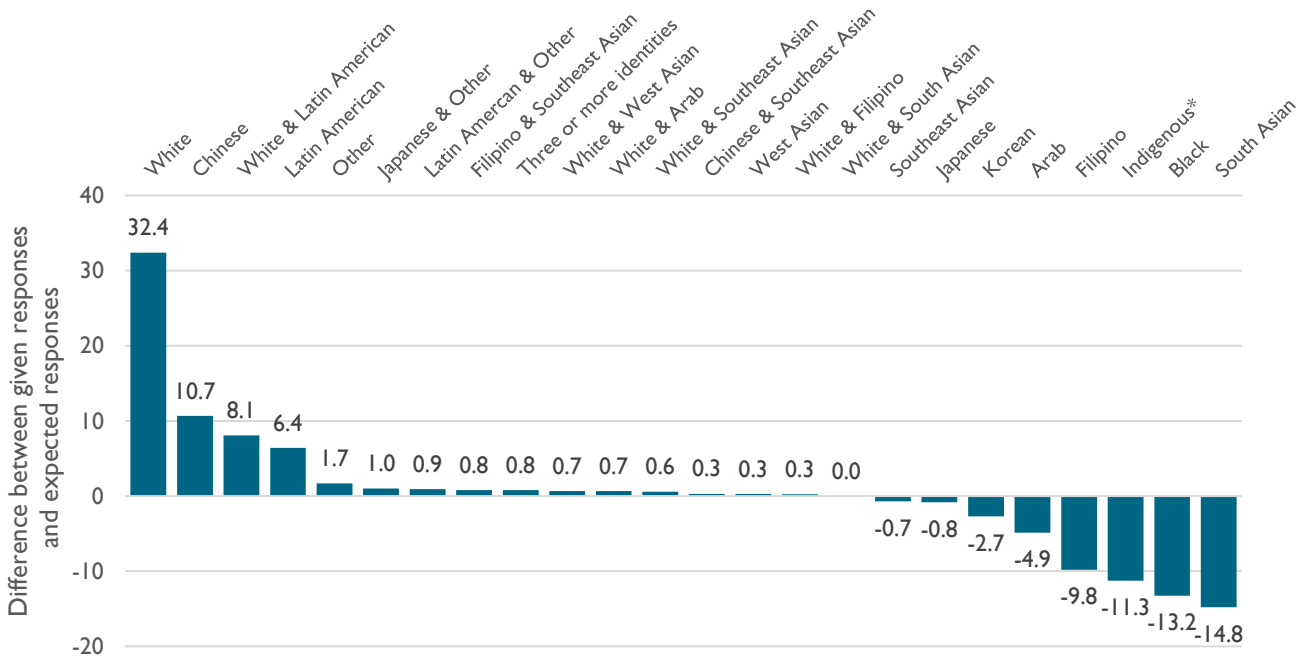
3.0 RACIAL IDENTITY

For the question on racial identity, we asked individuals to choose a racial category that best describes them, or they could specify a different racial identity. Participants could choose more than one identity from the list provided: White, South Asian (e.g., East Indian, Pakistani, Sri Lankan), Chinese, Black, Filipino, Arab, Latin American, Southeast Asian (e.g., Vietnamese, Cambodian, Laotian, Thai), West Asian (e.g., Iranian, Afghan), Korean, Japanese, and Other. Of the 482 eligible participants, 447 provided a single racial identity, 28 provided two racial identities, 2 provided three or more racial identities and 5 did not provide a response.

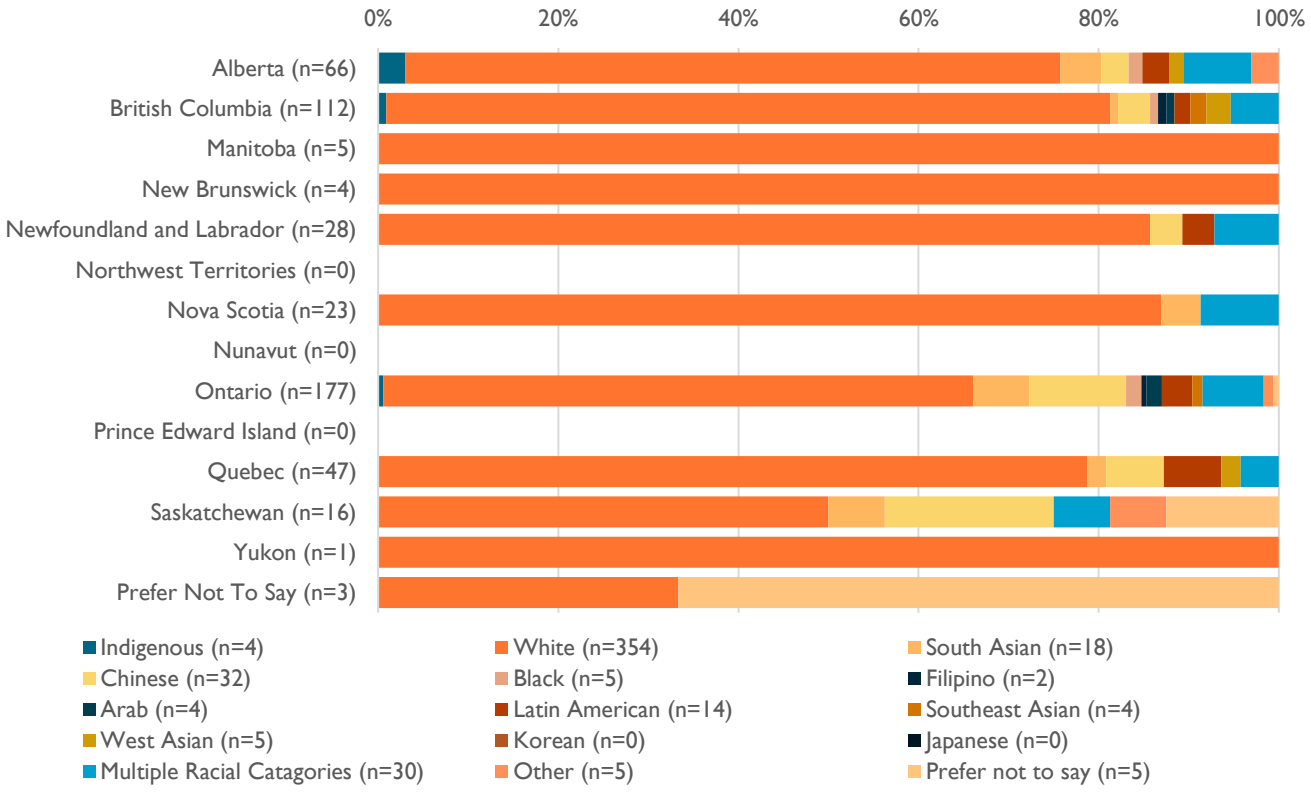
The vast majority of participants identified solely as white (73.4%), higher than the national average from the 2021 Canadian census (67.4%). The most underrepresented racial identities among our participants were South Asian, Black and Indigenous identities. Indigenous, and Indigenous and White participants made up 2.5% of our sample, compared to 4.9% from census data. Compared to 7% of the Canadian population, 3.7% of our participants identified as South Asian. Black individuals made up 1.0% of our sample compared to approximately 4% of Canadians. Chinese and Latin American identities are well represented in our population compared to 2021 Canadian Census data (Statistics Canada, 2022a), making up 6.6% and 2.9% of the sample, respectively.



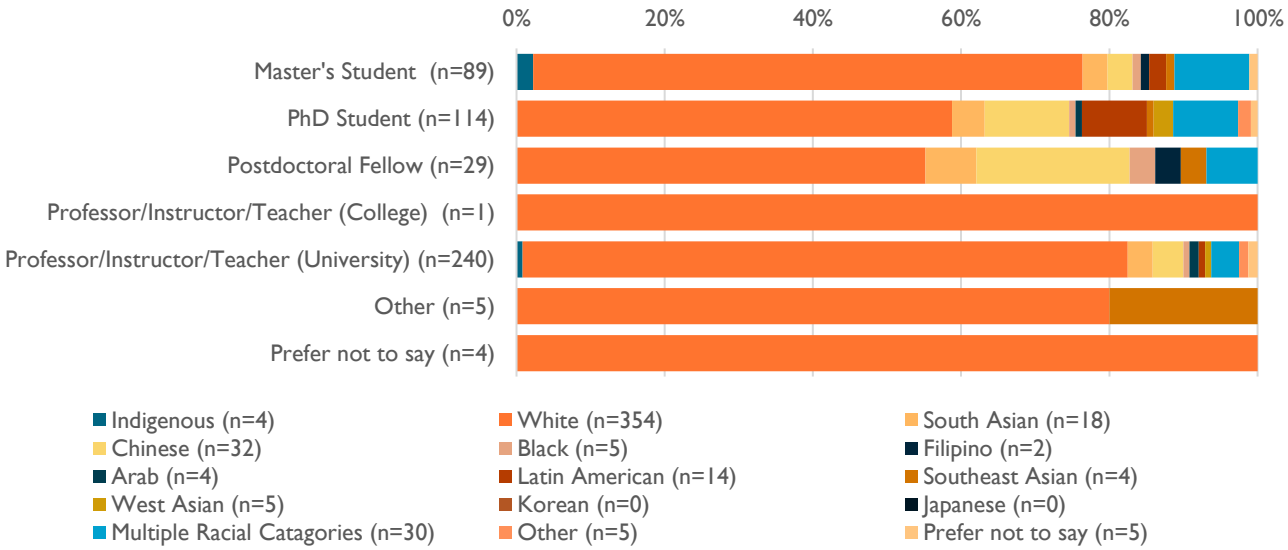
To characterize the representation of racial identities more effectively we compared the number of respondents for each category with the number expected given 2021 Canadian census data (Statistics Canada, 2022a). To allow for comparison of FNIM respondents, those participants who provided multiple racial identities but also identified as FNIM were combined with those who solely identified as 'Indigenous' to create a new category we call Indigenous*. This shows that white persons are the most overrepresented racial identity, with 32.4 more respondents than expected. South Asian persons were the most underrepresented, with 14.8 fewer responses then expected, followed by Black and Indigenous* persons, with 13.2 and 11.3 fewer persons respectively.



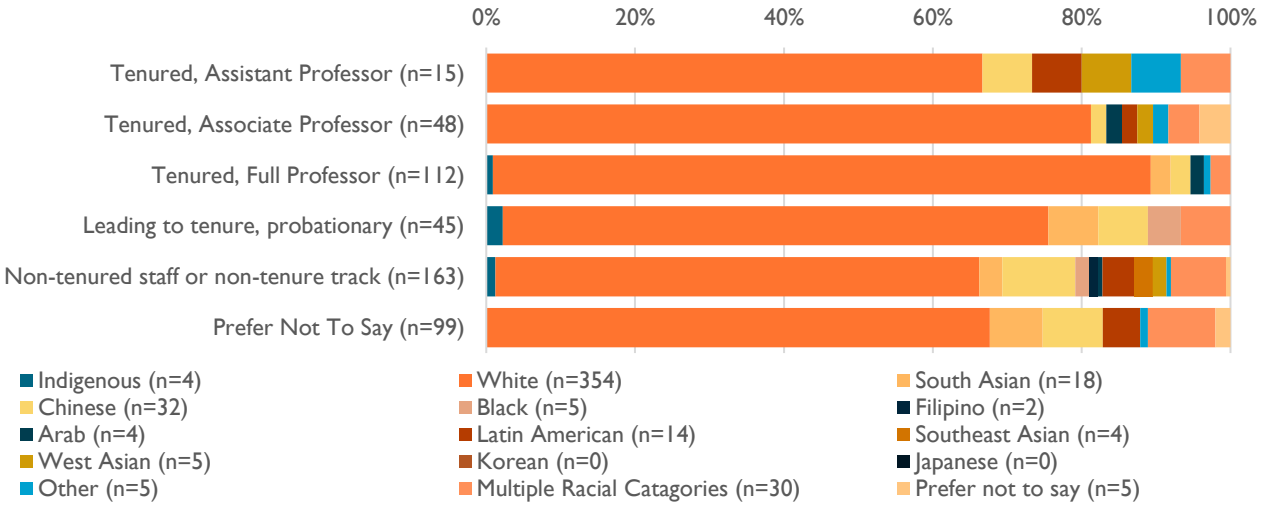
Out of provinces with >20 respondents, Ontario had the greatest degree of racial diversity with 33.8% of respondents identifying as racialized, followed by Alberta with 27.3% of respondents identifying as racialized. Quebec and British Columbia had similar proportions of racialized respondents (21.2% and 19.6%, respectively). Nova Scotia and Newfoundland had the smallest proportions of racialized respondents (13.0% and 14.3%, respectively), but also had a low number of overall respondents (23 and 28, respectively).



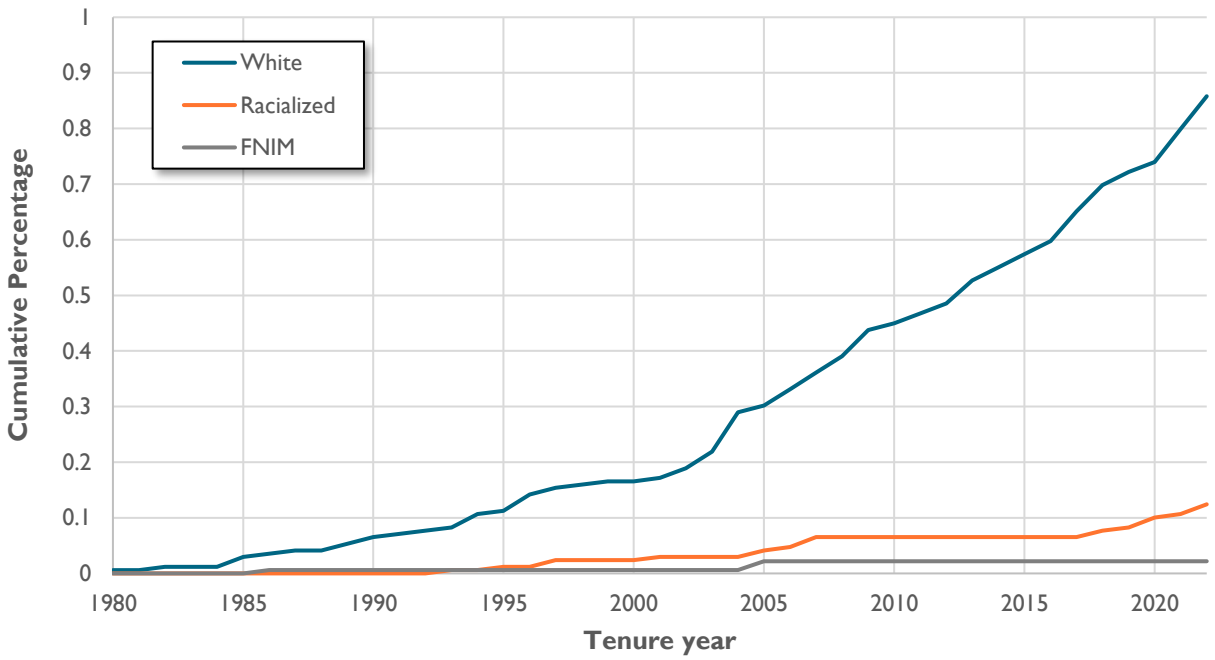
The proportion of racialized participants was lowest among university staff/faculty/instructors (16.7%) and was highest among post-doctoral fellows (44.8%). Among master's level respondents, the proportion of racialized individuals (24.7%) was lower than both post-doctoral participants and PhD participants (40.4%), and only slightly higher than among university professors.



Faculty with a tenured position (assistant professor, associate professor, or full professor) were 84.6% white. The proportion of racialized respondents increased as professor status decreased with rank: 33.3% of tenured assistant professors identified as racialized compared to 14.5% of associate professors and 11.6% of full professors. Non-tenure track respondents had the highest proportion of racialized respondents among those who indicated their tenure status, with 34.4% identifying as a racialized individual.



We assessed diversity in tenured positions from 1980 to present based on the year participants received tenure. These data highlight that tenured positions in Canadian geoscience have been dominated by white individuals since at least 1980, with the percentage of white tenured researchers never dropping below 80%. Notably, a dramatic plateau in the cumulative percentage of racialized tenured researchers is present between 2007 – 2017, where no racialized participants were granted tenure. In contrast, 54 white participants achieved tenure during this time at a rate of ~5 individuals a year (4.9). Moreover, FNIM make up only 2.2% of all tenured and were only granted tenure in two years (1986 & 2005)

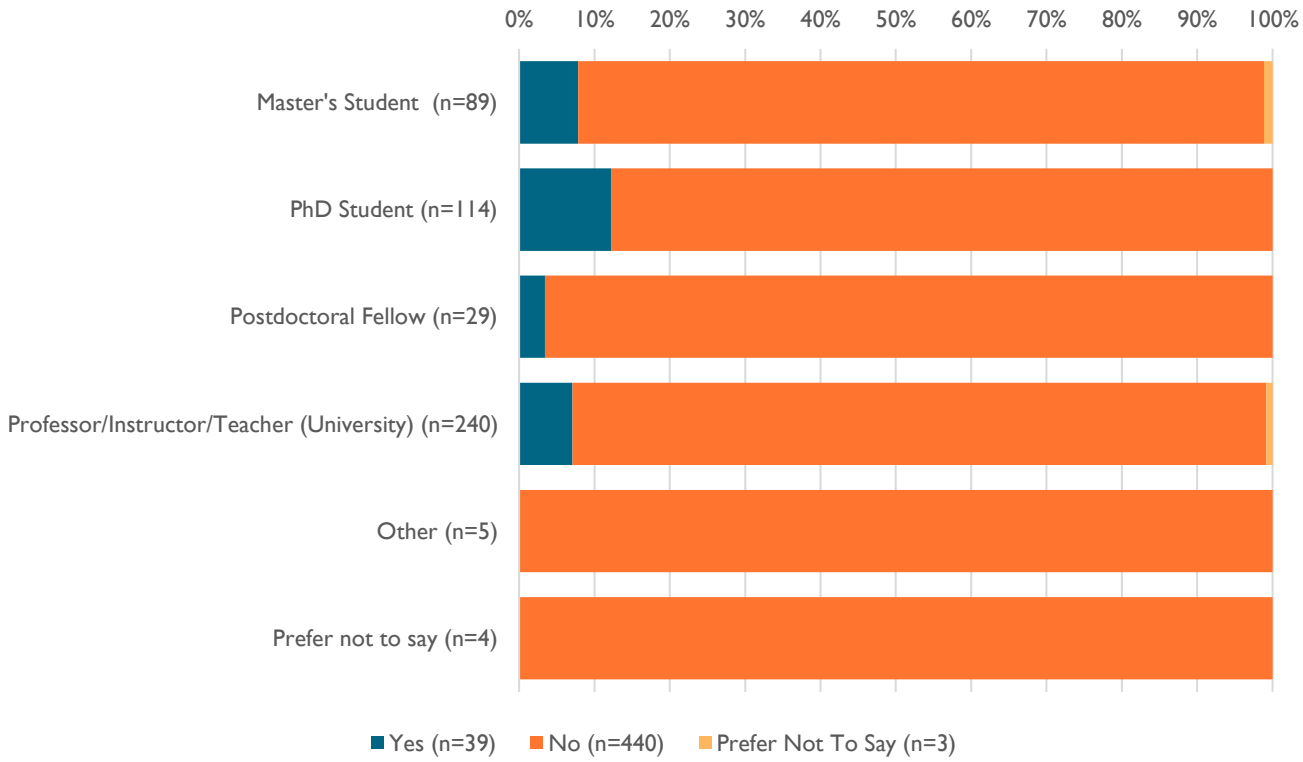

White
Racialized
FNIM
Cumulative Percentage
Tenure year
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1980
1985
1990
1995
2000
2005
2010
2015
2020

4.0 DISABILITY

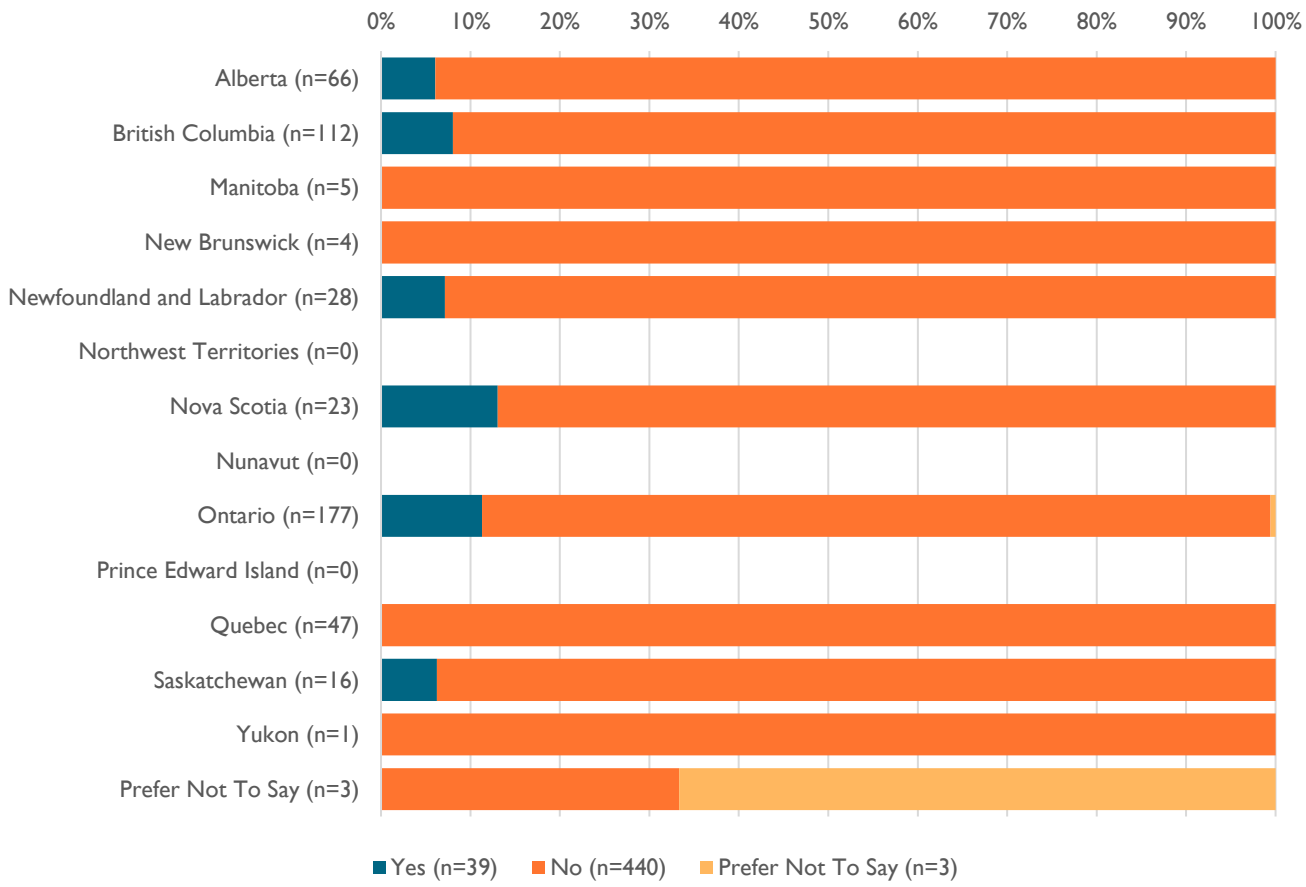
We asked participants to identify whether they have a disability, which we defined as, "long-term or recurring impairment that could be categorized into one of 10 types (vision, hearing, mobility, flexibility, dexterity, pain, learning, developmental, memory and mental health-related) and considers themselves to be disadvantaged in employment by reason of that impairment, or believes that an employer or potential employer is likely to consider them to be disadvantaged in employment by reason of that impairment. Persons with disabilities are also those whose functional limitations owing to their impairment have been accommodated in their current job or workplace." We did not ask participants to specify whether their disability is visible or invisible, whether they have a clinical diagnosis for their disability, or whether they require accommodations for their disability. Individual institutions may benefit from determining the specific adaptive needs of students, faculty, or staff with disabilities.

In total, 39 participants indicated that they have a disability, and a very small proportion of participants did not provide an answer to this question (<1%). 9.4% of women indicated that they have a disability, 4.7% of men, and 50% of non-binary participants.

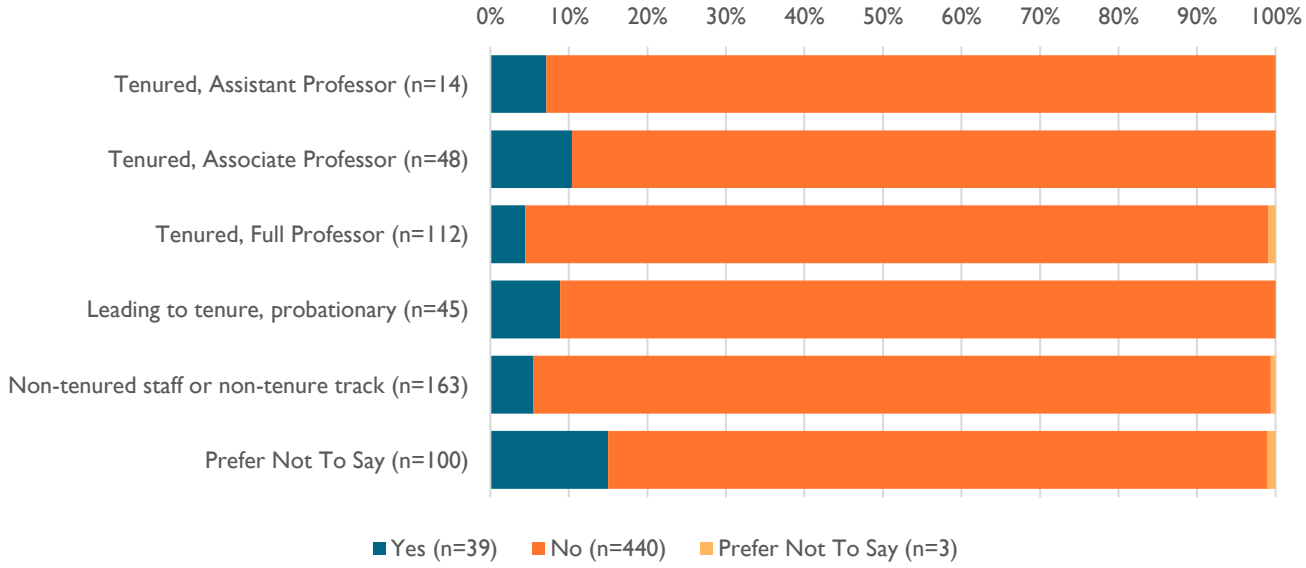
PhD students had the highest proportion of disabled respondents out of all positions (12.3%), followed by master's students (7.9%), and university professors (7.5%). A higher proportion of disabled respondents were employed part-time than full-time (11% vs. 9%, respectively), but the number of part-time employees in our study was relatively small (n=27).



Out of provinces with >20 respondents, Nova Scotia had the greatest number of disabled respondents with 13.0%, followed by Ontario with 11.4%. British Columbia, Newfoundland and Alberta all have similar proportions of disabled respondents (8%, 6.3% and 6%, respectively), while Quebec had no disabled respondents (0%).

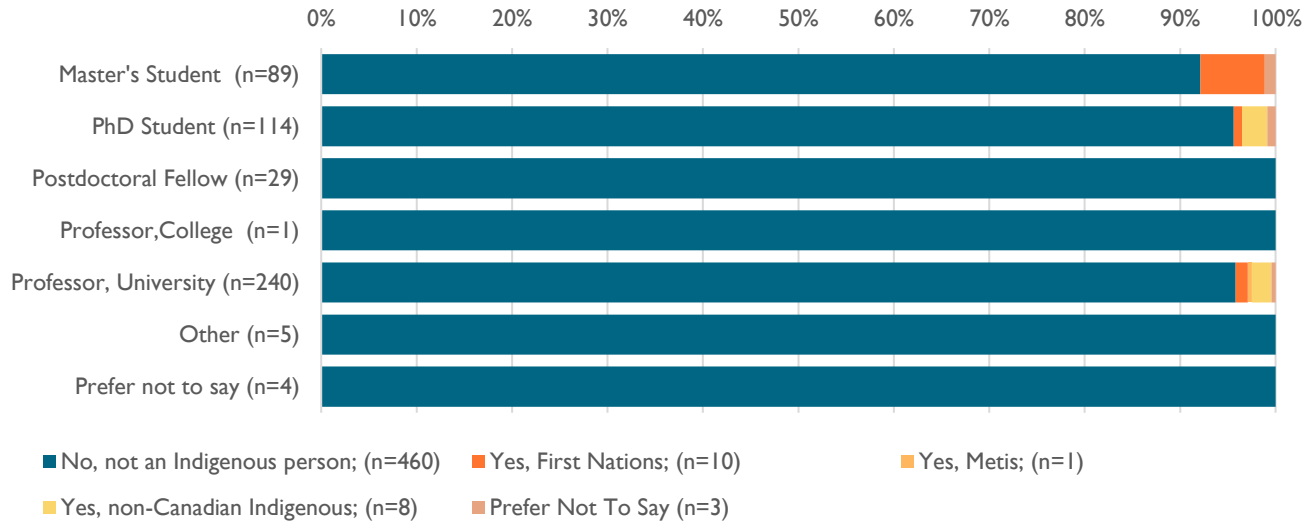


Among those respondents with a disability for whom tenure status was disclosed, 6.3% indicated they had achieved tenure, 8.9% were leading to tenure, and 5.5% were non-tenured. Of tenured faculty, 11.6% of associate professors reported a disability, followed by 7.7% of assistant professors and 4.7% of full professors.

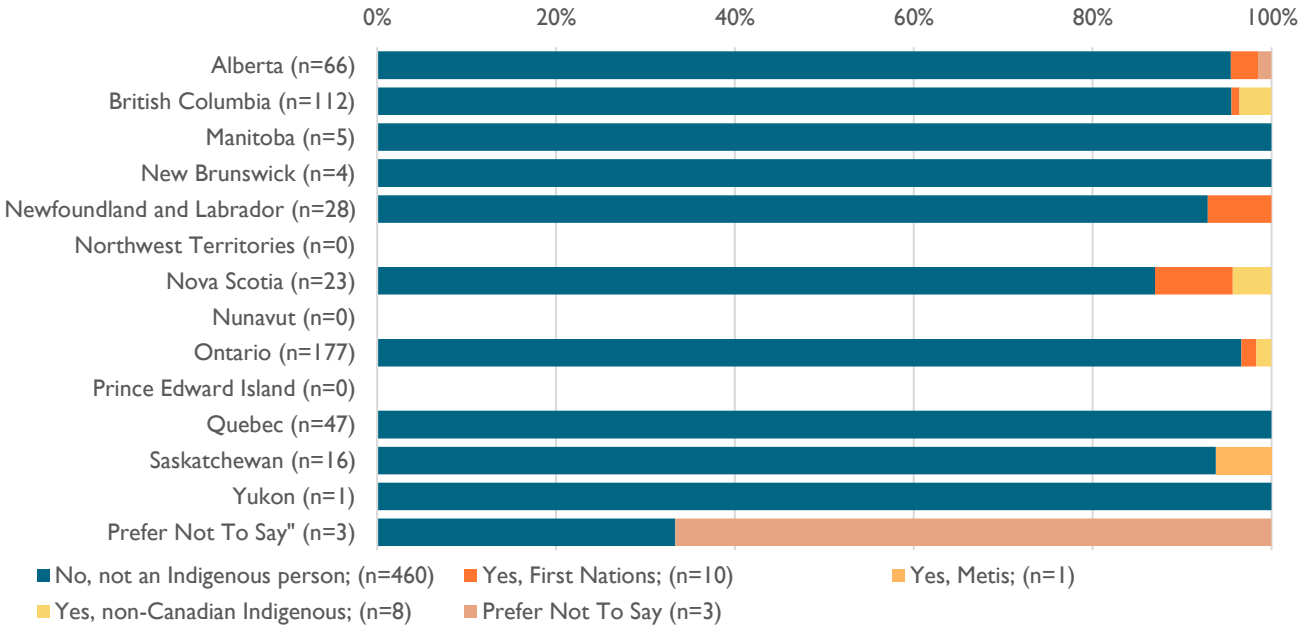


5.0 INDIGENEITY

We asked participants to indicate whether they identify as an Indigenous person. Respondents could identify as one of the three distinct Indigenous identities in Canada (First Nations, Inuit, or Métis), or another Indigenous identity. In total, 19 respondents self-identified as Indigenous, with 10 identifying as First Nations, 1 as Métis, and 8 as another Indigenous identity. No respondents identified as Inuit. Master's students had the highest proportion of Indigenous respondents (6.7%), followed by university or college professors (4.6%), and PhD students (3.5%).



Nova Scotia had the highest proportion of Indigenous respondents (13%), followed by Newfoundland (7%), and British Columbia (4.5%).



We are unable to provide data on tenure status by Indigenous identity due to the low numbers of Indigenous persons in tenured or tenure-track positions.

CONCLUSIONS AND FUTURE ENGAGEMENT

The results presented in this report show that Canadian academic geoscience lacks diversity at many levels. Within the main categories explored in this report (gender identity, sexual orientation, racial identity, disability, and Indigeneity) we see significant trends that suggest a lack of gender and racial diversity in higher-level research positions (research staff and faculty), while FNIM representation is low across the board. In this section we will highlight some of these trends, compare them to available public datasets (e.g., 2019 Survey of Postsecondary Faculty and Researchers, and the 2021 Canadian census), and outline actions that could help create a more inclusive and diverse discipline.

The great divide: research students and salaried researchers

These data highlight a clear divide between research students (MSc & PhD students) and 'salaried researchers' (postdocs, research staff and faculty). Women make up >50% of research students that participated in this survey, while non-binary persons are present in proportions much higher than the Canadian average. However, participants from salaried research positions are >60% men, with less than half the proportions of non-binary persons compared to student researchers. This divide is also present in racial data, where 30.3% of research students are racialized, compared to only 18.4% in salaried positions. This suggests that the pathway for students to transition to salaried positions is not supportive for women, non-binary persons, and racialized persons.

The loss of underrepresented groups from academia has been described as a "leaky pipeline" (Wickware, 1997), which implies a passive and unidentified mechanism through which individuals selectively leave academia before reaching salaried positions. An alternative analogy that acknowledges active barriers to a successful research career envisions the pathway for individuals from underrepresented groups as a "hostile obstacle course" (Berhe et al., 2022). This analogy is more fitting as academia appears to be actively presenting women, non-binary, and racialized persons with a number of barriers to a successful research career. Numerous studies have found university environments to be hostile spaces for women, non-binary, racialized and FNIM persons (e.g., racism, sexism, homophobia, transphobia) (e.g., Settles et al., 2006; Vaccaro, 2010; Johnson-Ahorlu, 2012; National Academies of Sciences, Engineering, and Medicine, 2018; Robinson, 2018; Harris, 2020; McKay, 2021; Sharanjit & Hango, 2022). Many universities in Canada have instituted improved harassment reporting systems and taken steps to improve supports for at-risk groups. But until university, discipline, and departmental cultures improve there will always remain grounds for individuals from these groups to leave academia, perpetrating a continued cycle of hostile environments.

It is clear from the data collected in this survey that a significant disconnect exists between student researchers and salaried researchers. Future efforts should be focused on tackling the mechanisms creating this disparity, ensuring women, non-binary and racialized researchers achieve salaried positions and are retained in their respective departments. Possible solutions include:

- Improve departmental cultures to be more inclusive (Marín-Spiotta et al., 2020; Moss-Racusin et al., 2014).
- Provide focused support and mentorship for students from underrepresented groups (Packard, 2015).
- Regulate the hiring of postdoctoral fellows (Patt, Eppig, & Richards, 2021).
- Increase postdoctoral fellow salaries (Mason, 2004; Powell, 2015).
- Review and improve faculty hiring policies (Smith, Handley, Zale, Rushing, & Potvin, 2015).

The final hurdle: Tenure

Trends in this dataset show that gender and racial disparities exist between those with and those without tenure. For those on the tenure-track or who have obtained tenure, only 33.2% are women. Only tenured associate professors are predominantly women (56.5%), while all remaining categories are <40% women (leading to tenure = 37.8%, tenured assistant professor = 21.4%, and tenured full professor = 23.2%). These data suggest women are

obtaining tenure, but at a much lower rate than men, as evidenced by the above plot of tenure over time, and even fewer are progressing to full professorships. In Canada, 41% of all tenured faculty in 2019 were women, indicating that the proportion of women obtaining tenure in geoscience is potentially much lower than in other fields (Statistics Canada, 2022b). Lower rates of tenure are partially attributable to whether a woman has children, which can make meeting the demands of a successful tenure application difficult (Careless, 2012). However, barriers to tenure are not limited to parental decisions and can include biases in student evaluations, obtaining grant funding, and a disproportionate burden of committee service, barriers which are even more significant for racialized women (Krebsbach, 2022).

Only 14.3% of tenure/tenure-track positions are currently occupied by racialized persons in our survey. A greater breakdown of these data show that only tenured assistant professors are above the national average, while the remaining categories are below the national average (leading to tenure = 22.2%, tenured associate professor = 15.2%, and tenured full professors 8.9%). The proportion from our survey is also lower than the proportion across Canada, where 19.4% of university faculty identify as racialized (Statistics Canada, 2020). This suggests that racialized persons rarely obtain tenure and even fewer are progressing to full professorships. This is made clear in our results by the gap in racialized persons receiving tenure between 2007 – 2017 and data from Canada confirming a marked decrease in the proportion of racialized researchers between postdoctoral fellows and faculty (Statistics Canada, 2020).

The data from this survey clearly show that the tenure process is limiting to women and racialized persons. Future efforts should focus on tackling the mechanisms creating this disparity, ensuring women and racialized researchers can achieve tenure and progress to full professorship within their respective departments. Possible solutions include:

- Design tenure systems that account for family planning (Careless, 2012).
- Conduct internal reviews of tenure evaluation processes (Abdul-Raheem, 2016).
- Require anti-oppression training for all faculty involved in the tenure process (Garran et al., 2015).
- Include an EDI component to the tenure application.
- Provide tailored mentorship for tenure-track faculty from underrepresented groups (Davis et al., 2022; Zambrana et al., 2015).

A lack of FNIM researchers

FNIM persons make up 5% of the Canadian population, though are poorly represented in this dataset (2.2%). Only master's students were over this national average (6.8%) while all other remaining categories fell well short. Of those tenure-track/tenured participants, only 1.8% are FNIM. Comparing these data with federal statistics of researchers across Canadian academia shows that FNIM representation is consistently low, though this does not excuse poor representation (Statistics Canada, 2019). Decolonization of geoscience in Canada and greater engagement with Indigenous communities are necessary steps to ensure Indigenous students and researchers can see a clear path to a successful degree or career without harassment or bias.

Post-secondary institutes across Canada have a responsibility to respond to the calls to action in the report from the 2015 Truth and Reconciliation Commission, specifically regarding the elimination of "educational and employment gaps between Indigenous and non-Indigenous Canadians" (Truth and Reconciliation Commission of Canada, 2015). Many Canadian universities have developed strategy documents with the aim of improving Indigenous representation and awareness on campus. These documents can be important as mechanisms for accountability, but the plans vary broadly in scope and practice (Tamtik & Guenter, 2019). For example, while some institutions aim for systemic change within research and campus activities, others opt to create pockets of Indigenous representation (e.g., committees) that may have limited capacity and resources. One common theme among these strategies is to increase the proportion of Indigenous students, scholars, and faculty recruited to the university. While this is an important and necessary objective, greater recruitment will not change an underlying

institutional environment that is hostile toward Indigenous individuals. In 2015, two instances of anti-Indigenous vandalism occurred at the University of Alberta, including attempted arson on an iconic Métis Red River Cart (Stirling, 2015; "University of Alberta staff condemn campus teepee vandalism," 2015). These accounts are not unique to that university and are blatant examples of the overt racism present in Canadian institutions.

Canadian universities historically played a role in the systematic erasure of Indigenous culture through the residential school system. To date, only three universities have apologized for the harm they caused by training the policy makers and administrators who operated these schools and for remaining silent throughout their operation (U of M president apologizes for residential schools, 2011; Ono, 2018; Lumpkin, 2021). These apologies are not meant to absolve the institutions of guilt or shame, but to accept responsibility and work toward the goal of rebuilding trust with Indigenous communities. Universities can continue to build trust by taking dedicated action toward the strategic directions in their reconciliation plans and continuing to adapt these plans with input from Indigenous voices.

Future action should additionally focus on incorporating Indigenous teachings into university curricula – a goal in direct opposition to the destructive efforts of residential schools. This framework of incorporating Indigenous and Western knowledge is known as "Two-Eyed Seeing" and is particularly relevant to geoscience research in Canada (Iwama et al., 2009). As a discipline with a large focus on field-based research, studies in geoscience take place on Indigenous land, whether unceded or traditional territory, and care must be taken to respect the land and its stewards. Going forward, research that engages with Indigenous communities or their lands should dedicate time and energy to relationship-building, collaboration regarding data collection, and ensuring that any tangible outcomes are mutually beneficial for all parties (Lin, Loyola-Sanchez, Boyling, & Barnabe, 2020).

The results from our survey show that FNIM representation is low across all levels of research, and existing literature shows that universities have not yet created environments to improve FNIM inclusion in academia. Possible solutions include:

- Support Indigenous students through mentorship and funding opportunities (Murry et al., 2022; Pidgeon, Archibald, & Hawkey, 2014).
- Conduct active and authentic efforts to work with local Indigenous communities in research (Klymiuk, 2021).
- Integrate Indigenous land use into research while ensuring data sovereignty is maintained (Kukutai & Taylor, 2016; Liboiron, 2021)
- Integrate Indigenous science into geoscience education (Todd et al., 2022).
- Integrate Indigenous science into research (Johnson et al., 2014; Zamparo, 1996).
- Use Indigenous terms and language in naming of geological features (Maloney et al., 2023).

Poor disability representation in geoscience faculty

In our sample, the proportion of participants who indicated they had a disability was lower than the proportions identified by both the Survey of Postsecondary Faculty and Researchers and Canadian census data (Statistics Canda; 2020; Statistics Canada, 2022). However, students (both master's and PhD) had a higher proportion of individuals with a disability than faculty, which suggests that those with a disability may struggle to continue their geoscience career due to institutional or other barriers.

The accessibility needs within geoscience are distinct to those in other scientific disciplines. Geoscience programs usually include a mandatory field-based component, which creates a perceived requirement for those in the profession to have certain physical, sensory, and cognitive abilities. This perception is such an established component of geoscience that professional geoscientists indicated in a survey that they felt that individuals with physical or visual disabilities would not be successful in a geoscience career (Atchison & Libarkin, 2016). In recent years, greater effort has been made to improve fieldwork accessibility for those with physical and sensory

disabilities (Chiarella & Vurro, 2020). These accommodations have included using colour accessible and tactile maps for those with visual disabilities (Crameri et al., 2020; Rutkofske et al., 2022), providing interpreters or assistants for those who need them (Kingsbury et al., 2020), and using technology to promote inclusion (Carabajal et al., 2017).

While accessibility requirements for students with disabilities have improved on university campuses in recent years, these accommodations are often inadequate or difficult to access for those who need them most. For many universities, accessibility accommodations are decided on a case-by-case basis, and individuals may need to disclose information such as an official diagnosis, medications, or symptoms of their disability to be considered for accommodation (University of British Columbia Board of Governors, 2019; University of Calgary, 2015; University of Guelph, 2023). This process can be onerous and uncomfortable for those requiring accommodations, and the documentation can take months to acquire. Geoscience students will often also downplay their need for accommodation because they do not want to be perceived as incapable in the discipline. In these cases, students may opt to not get the help they need in order to avoid social bias (Bruce & Aylward, 2021).

Instructor perception of disability accommodations can make the experience more difficult for students. While instructors are often aware of the burden placed on students with disabilities to receive accommodation, they may believe that this is an unfortunate necessity for the student. Similarly, instructors and administrators may feel either that the accommodations provide an unfair advantage to individuals with disabilities (Pardy, 2017), or that accommodations are "altruistically" provided by the university, suggesting that students should be grateful (Bruce & Aylward, 2021). These attitudes normalize the burdensome process of obtaining accommodations and may deter students from seeking accommodations at all (Carabajal et al., 2017).

Instructors who are supportive and encouraging of accommodations acknowledge that disabled and neurodivergent students can add important insight to activities and allow instructors to improve their teaching (Bruce & Aylward, 2021). This insight suggests that it is necessary to adjust the perception of disability accommodations in universities from a burdensome favour to a universal benefit for all involved. Without taking the steps to challenge the current stereotypes and instructional methods of geoscience, "faculty are merely replacing themselves with future scientists who act, think, and perform as they do" (Atchison, 2021). Possible solutions include:

- Embracing principles of Universal Design for Learning (UDL) (Benton et al., 2022).
- Providing adequate funding and resources for accommodations and reduce the burden on students to disclose and self-advocate (Bruce & Aylward, 2021; Carabajal et al., 2017).
- Inviting students to participate in planning for lab and fieldwork (Carabajal et al., 2017; Kingsbury et al., 2020).
- Pursuing alternative approaches to fieldwork (e.g., Virtual fieldwork or remote access to live fieldwork) (Adams et al., 2010; Stokes et al., 2011; Stokes & Atchison, 2015).

LIMITATIONS

The results of this study are limited by the inherent challenges involved with survey design and dissemination. First, while we made several attempts to recruit participants for the survey, the response rate (~20%) is still lower than we would prefer to achieve a truly representative sample. Accurate numbers for each position were difficult to ascertain due to university websites lacking specific information and requests to departments being unanswered. Our best estimates of these numbers suggest the response rate from Faculty/Staff/Instructors was 36%, postdoctoral fellows was 15% and graduate students was 15.4%, though student numbers were especially difficult to obtain suggesting this response rate is likely lower. We hope that, with future dissemination of this survey, participation will increase. Second, selection bias is a concern for any survey that could result in bias in either direction. Individuals from underrepresented groups may not participate in the survey because of fear of identification or a lack of trust in the institution to use their data appropriately. Conversely, individuals in privileged groups may not participate because they may feel that they do not benefit from diversity work, or that their responses are not relevant. In our results, gender and sexual minorities are overrepresented compared to the Canadian population, which may suggest bias in favour of underrepresented groups; however, no other categories showed significant over- or under-representation. Third, while we used established surveys from the literature to develop the demographic questions here, we recognize that some identities may have been overlooked. In each subsequent year, we plan to consult the literature and adjust the survey as required. We intend to take these limitations into account for future iterations of the survey to improve our sample.

Despite these limitations, we believe the strength of the survey outweighs any concerns. With this sample size, we have identified new and important information about representation in Canadian geoscience that can be used to develop strategies for inclusion and diversity moving forward.

APPENDIX A: SURVEY QUESTIONS

Survey of Postsecondary Faculty and Researchers in Canadian Geoscience

Section 1: Introduction and Consent

Thank you for your interest in this survey. Your participation is entirely voluntary. You can withdraw your consent to participate at any time and for any reason. You have a right to have all your questions answered before deciding whether to take part.

The purpose of this study is to establish the demographics of those working or pursuing a graduate degree within Canadian academic geoscience.

The survey includes 22 questions and will take 5-10 minutes. There is only one mandatory question, which is used to establish your eligibility. All other questions are optional.

The survey is anonymous, and you will not be asked any through the online system. You must provide consent for responses to be collected by clicking the box below. Should you wish to remove your consent while completing the survey, simply shut the browser tab or window and your responses will not be recorded. Should you wish your responses to be discarded following completion, we ask you to save your responses as a .pdf at the end and email this document to scott.jess@utoronto.ca where your inputs will be removed. There will be no penalty to you if you choose to withdraw your responses.

The information collected as part of this survey is designed to be non-intrusive. The most important risk involved in a study like this is the unintended disclosure of your data. The study will follow all privacy and confidentiality laws to minimize this risk. All information obtained during the course of this study is anonymous. Your identity will be protected at all times.

The results of the study may be published in a professional journal and may be presented at scientific meetings or to government regulatory authorities. Moreover, data will be made available from the compiler to those who request it. Your identity will not be disclosed in any of these settings.

All data will be stored in an external password protected hard drive once the survey has is closed (1st Jan 2023). You have the right to check your study records and request changes if the information is not correct.

You may contact me at scott.jess@utoronto.ca with any questions or concerns about the research or your participation in this study.

□ I agree to take part in this survey

Section 2: Eligibility question

Are you currently a graduate student (PhD or MSc), Postdoctoral Fellow or Faculty Member based at a Canadian institution in the field of Geoscience?

- Yes
- No

Section 3: Personal Information

What is your age?

- [text box]

What was your sex at birth?

Sex refers to sex assigned at birth.

- Male
- Female

What is your gender?

Gender refers to current gender which may be different from sex assigned at birth and may be different from what is indicated on legal documents.

- Man
- Woman
- Non-binary
- Two-spirit
- Other, please specify:

What is your sexual orientation?

- Straight
- Gay/Lesbian
- Bisexual/pansexual
- Other, please specify:

Are you a person with a disability?

A person with a disability is a person who has a long-term or recurring impairment that could be categorized into one of 10 types (vision, hearing, mobility, flexibility, dexterity, pain, learning, developmental, memory and mental health-related) and considers themselves to be disadvantaged in employment by reason of that impairment, or believes that an employer or potential employer is likely to consider them to be disadvantaged in employment by reason of that impairment. Persons with disabilities are also those whose functional limitations owing to their impairment have been accommodated in their current job or workplace.

- Yes
- No

What is your country of birth?

- [List of countries]

What is your legal status in Canada?

- Citizen
- Permanent resident
- Work/study permit
- Other, please specify:

Are you an Indigenous person?

- No, not an Indigenous person

OR

- Yes, First Nations
- Yes, Métis

- Yes, Inuk (Inuit)
- Yes, non-Canadian Indigenous, please specify:

Which race category best describes you?

Are you:

Select all that apply:

- White
- South Asian (e.g., East Indian, Pakistani, Sri Lankan)
- Chinese
- Black
- Filipino
- Arab
- Latin American
- Southeast Asian (e.g., Vietnamese, Cambodian, Laotian, Thai)
- West Asian (e.g., Iranian, Afghan)
- Korean
- Japanese
- Other, please specify:

What is your ethnic or cultural origin(s)?

Ethnic origin refers to a person's ethnic or cultural origins. Ethnic groups have a common identity, heritage, ancestry, or historical past, often with identifiable cultural, linguistic, and/or religious characteristics. Examples include Canadian, Québécois, Chinese, East Indian, English, Italian, Filipino, Scottish, American, Irish, Portuguese, German, Polish, Dutch, French, Jamaican, Pakistani, Iranian, Sri Lankan, Korean, Ukrainian, Lebanese, Guyanese, Somali and Jewish.

Specify as many as applicable:

- [Write in box]

Section 4: Education information

What is the highest certificate, diploma or degree that you have completed?

- Earned doctorate (e.g., Ph.D., Ed.D.)
- Master's degree (e.g., M.A., M.Sc., M.Ed., M.B.A.)
- Degree in medicine, dentistry, veterinary medicine or optometry (e.g., M.D., D.D.S., D.M.D., D.V.M., O.D.)
- University certificate, diploma or degree above the bachelor's level
- Bachelor's degree (e.g., B.A., B.A. (Hons), B. Sc., B.Ed., LL.B.)
- University certificate or diploma below the bachelor's level
- College, CEGEP or other non-university certificate or diploma (other than trades certificates or diplomas)
- Trades certificate or diploma
- High school diploma or a high school equivalency certificate
- Less than high school diploma or its equivalent

In what year did you receive this certificate, diploma or degree?

- *yyyy*

In which country did you obtain this certificate?

- [List of countries]

Section 5: Professional information

Within the last 3 months, were you considered a part of any of the following groups?

- Master's student
- Ph.D. student
- Postdoctoral fellow at a postsecondary institution
- Professor, instructor or teacher at a college (Including sessionals and part-time lecturers.)
- Professor, instructor or teacher at a university (Including sessionals and part-time lecturers.)
- Other, please specify:

Do you currently work/study part-time or full-time?

- Part-time
- Full-time

Did you arrive in Canada specifically to work in the position you are currently in?

- Yes
- No

In which province/territory is your institution?

- [List of Provinces and territories]

Which field within Geoscience most closely reflects your research/teaching?

- [drop down menu include list fromhttps://geosciencewomen.org/find-your-path/geosciences/geoscience-subdisciplines/]
- Other, please specify:

If applicable, what is your tenure status?

- Tenured
    - Are you a:
    - Assistant?
    - Associate?
    - Full Professor?
- Leading to tenure, probationary
- Non-tenured staff or non-tenure track (This Includes annual, sessional or other definite term contracts, visiting staff, and continuing staff.)

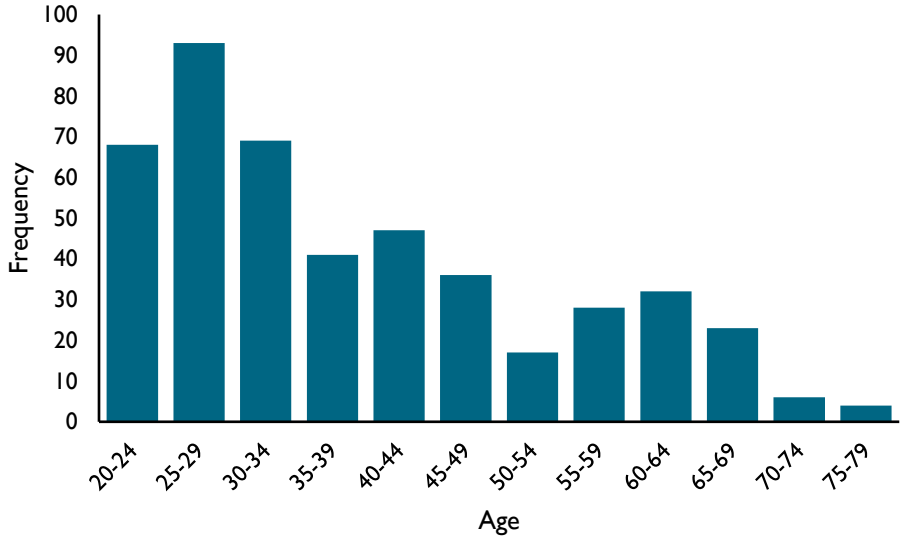
If Tenured, in which year did you achieve this status?

- yyyy

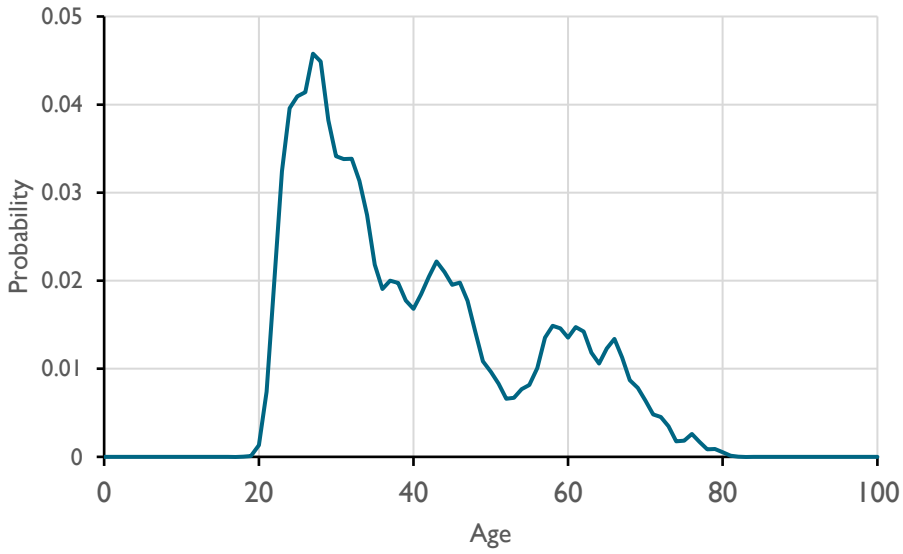
APPENDIX B: REPONSES TO EACH QUESTION

What is your age?

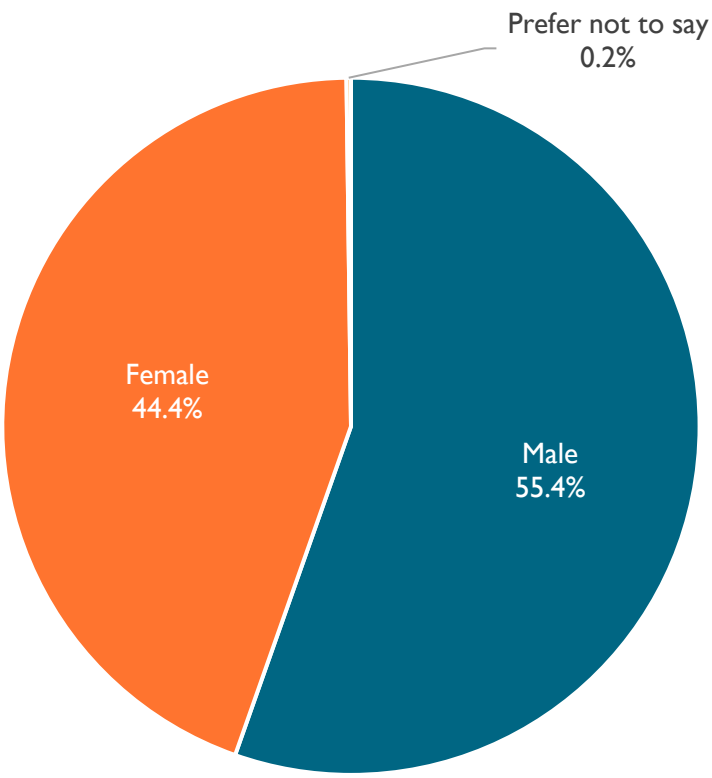
Histogram (5 YEAR BINS)



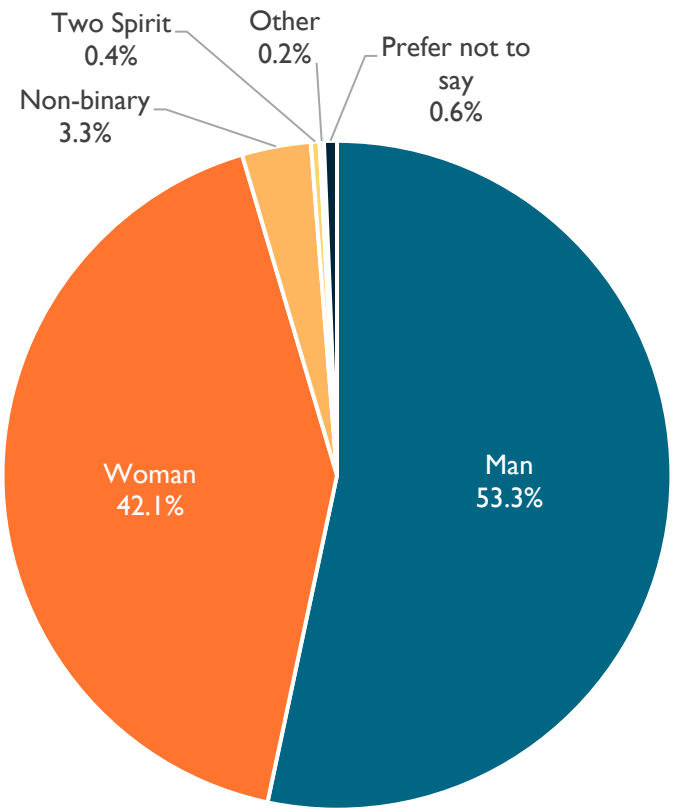
Kernel Density Estimate (Bandwidth = 1)



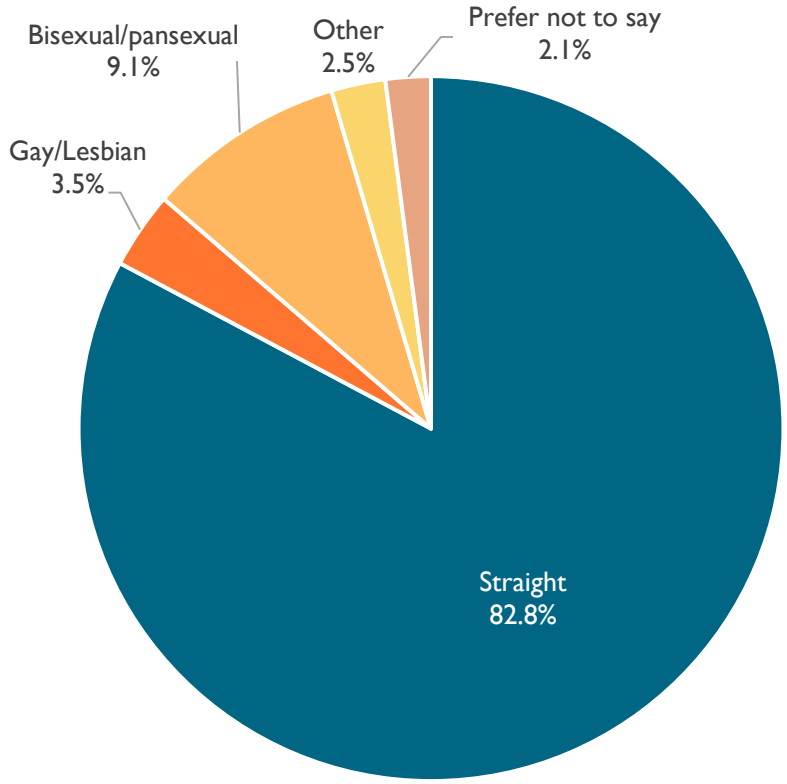
What was your sex at birth?



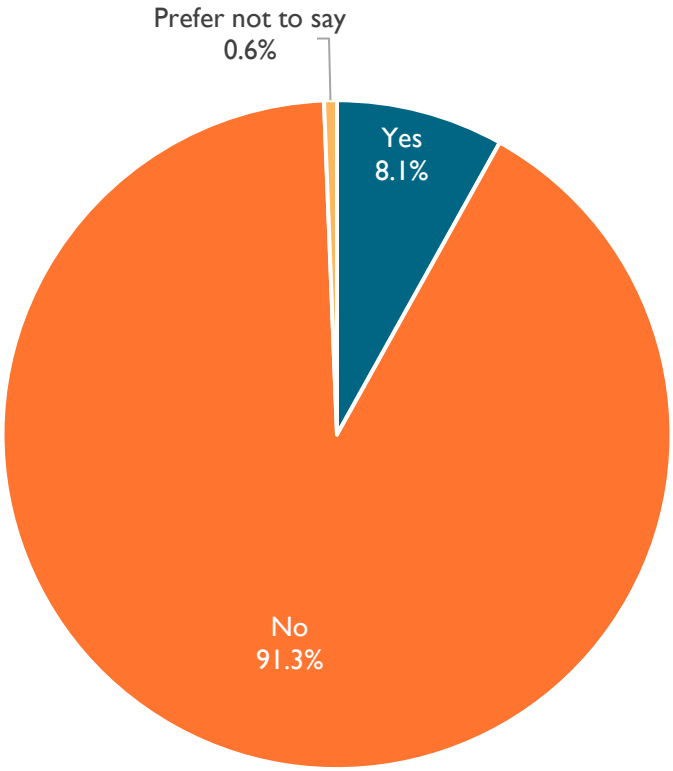
What is your gender?



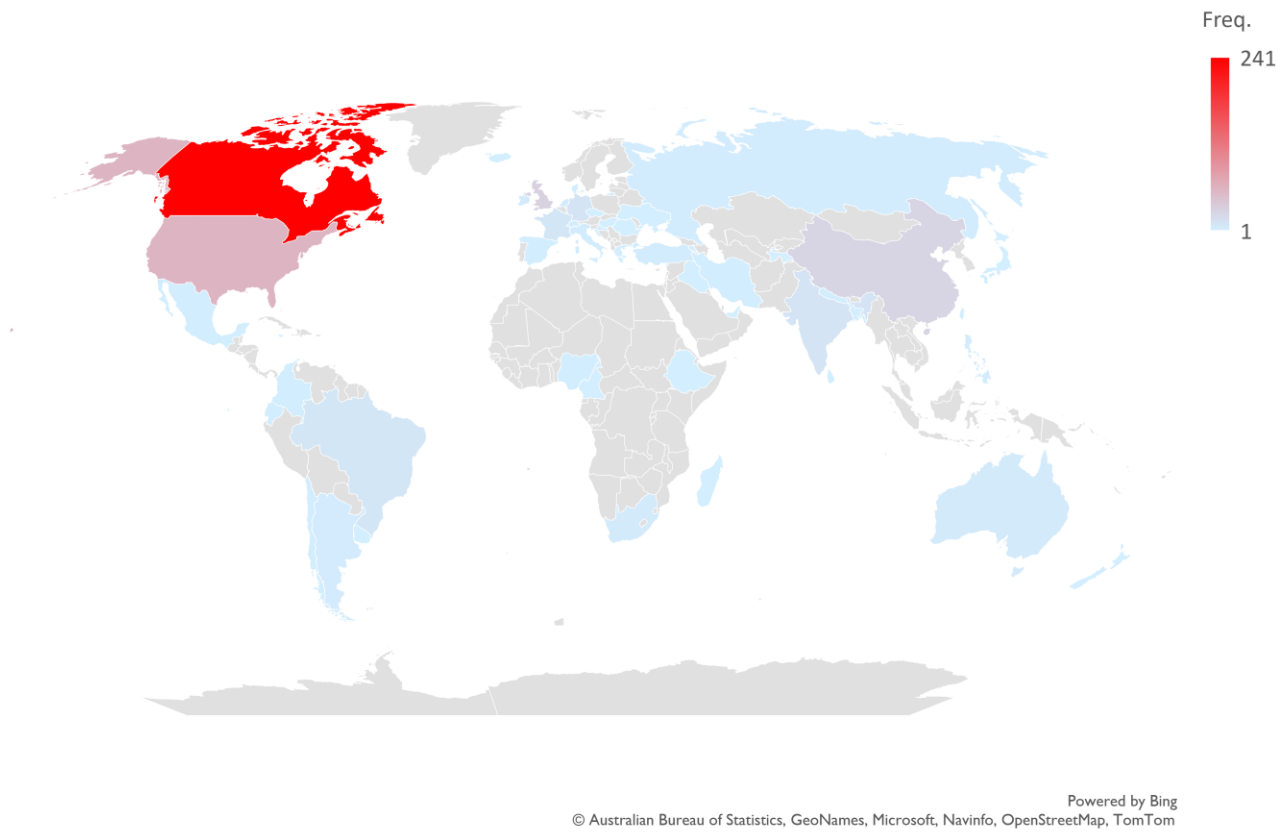
What is your sexual orientation?



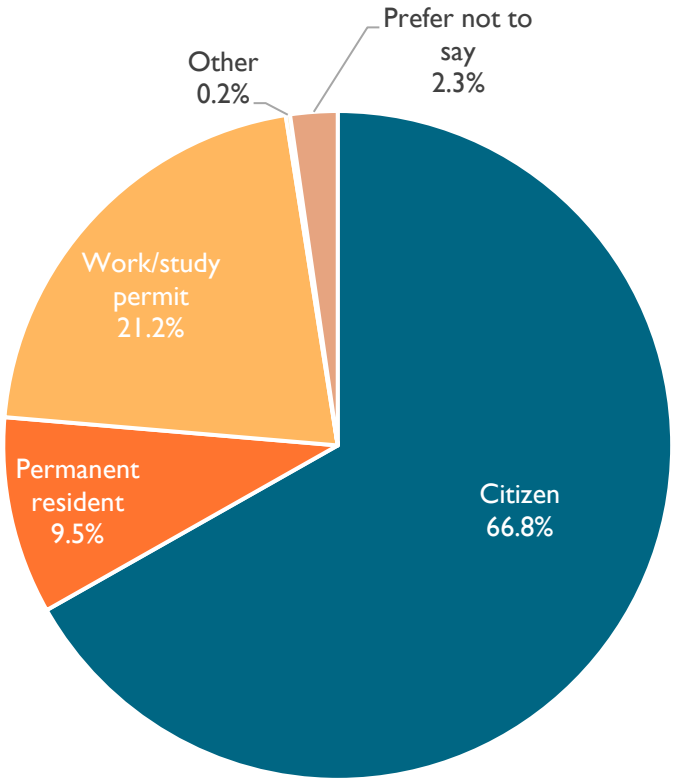
Are you a person with a disability?



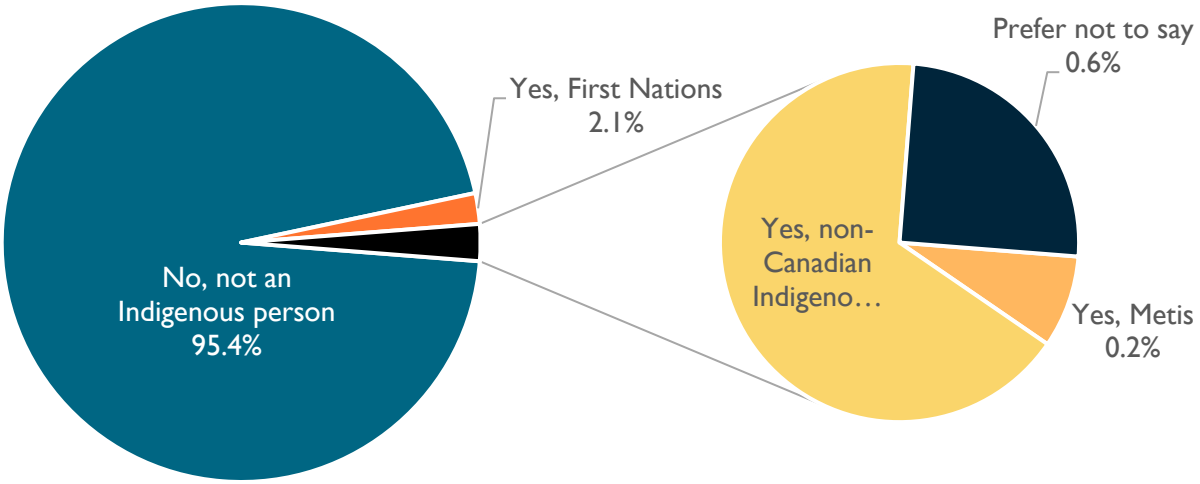
What is your country of birth?



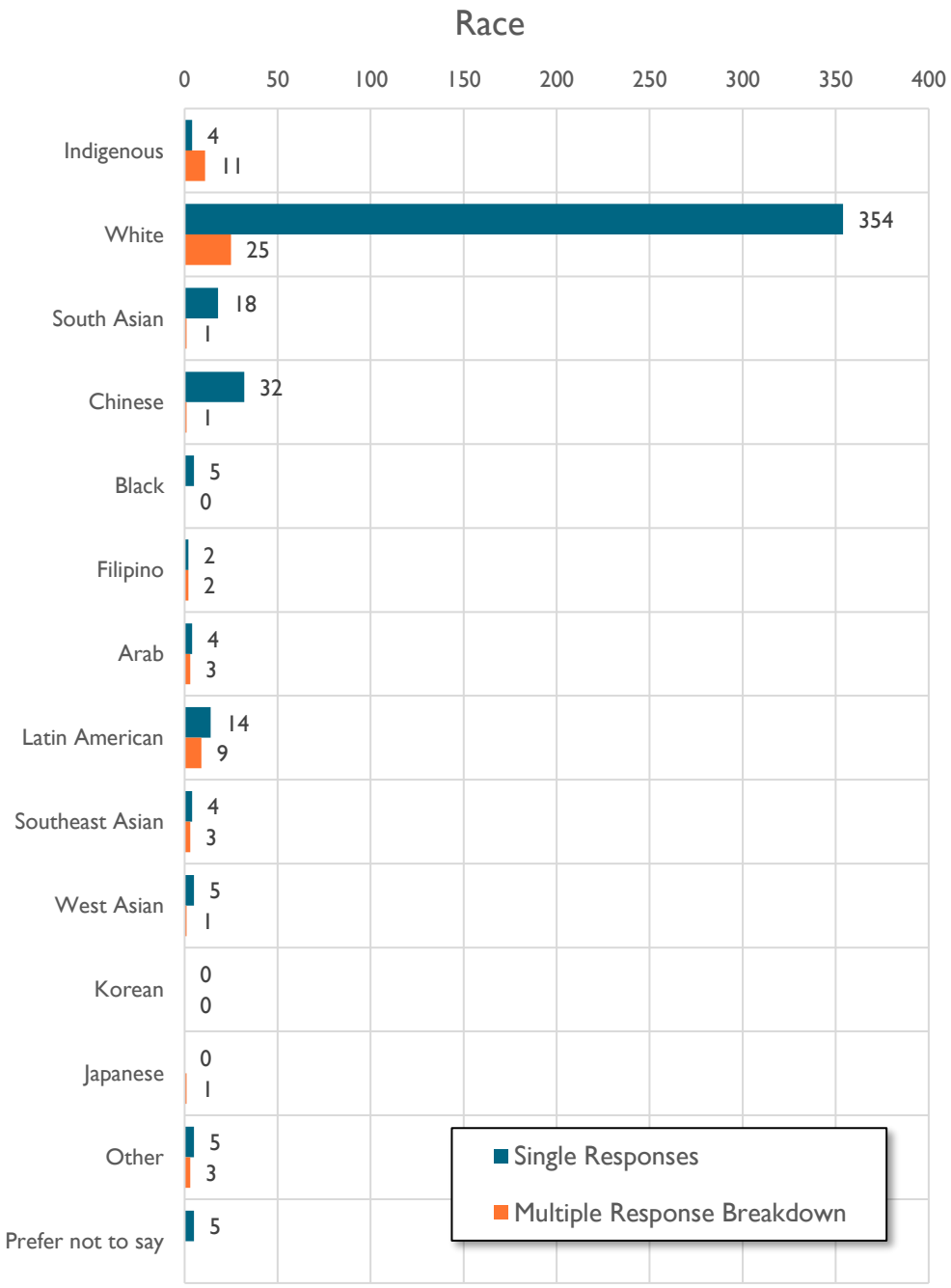
What is your legal status in Canada?



Are you an Indigenous person?

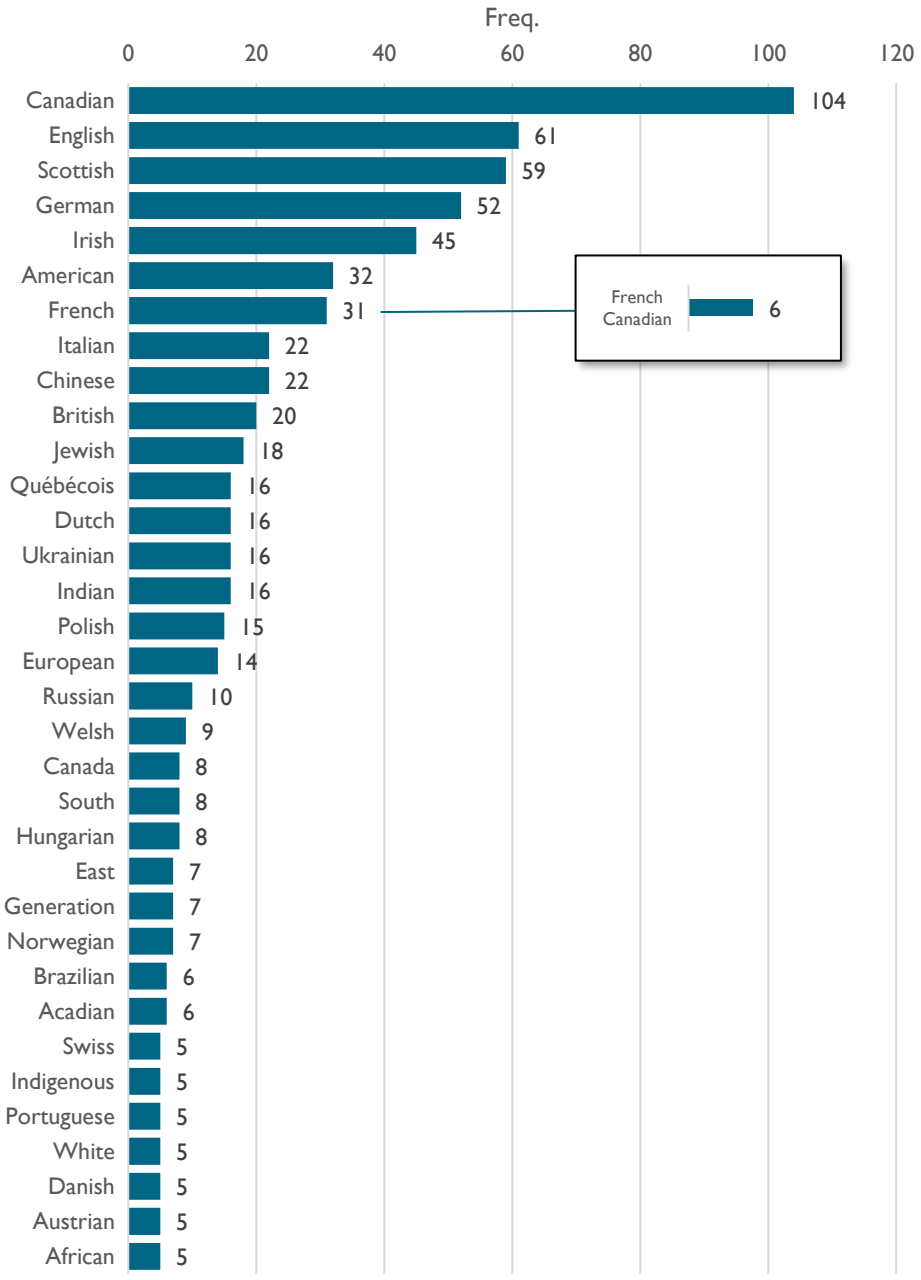


Which race category best describes you?

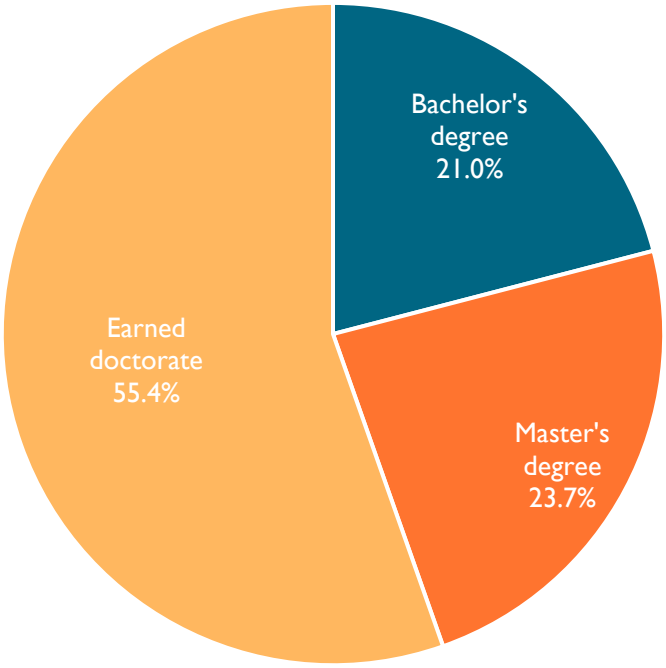


What is your ethnic or cultural origin(s)? (Please specify as many as applicable)

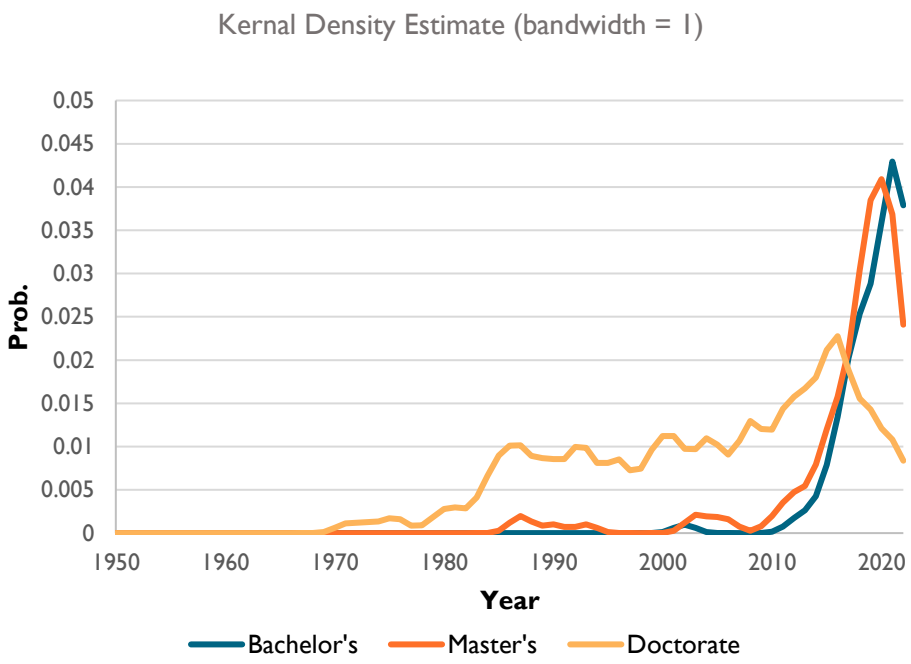
Respondents were provided a text box to write down their self-identified ethnic or cultural identify. Responses provided vary widely and the approach deemed best appropriate to present this result was a breakdown of word use in these responses. Below is the top 40 words used in these responses. From the original list of word use articles, conjunctions, pronouns and prepositions were removed (e.g., I, and, a, of etc.). Below are all words with a frequency of >5.



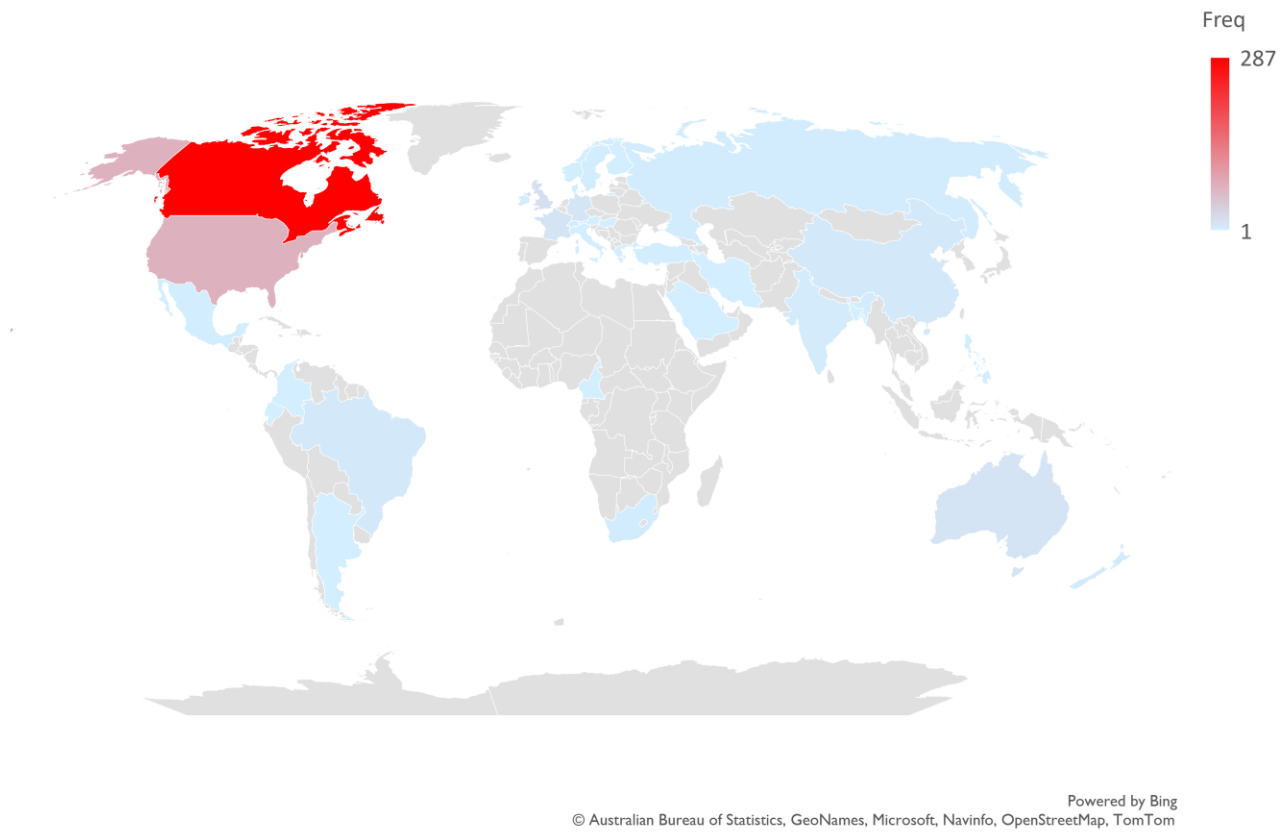
What is the highest certificate, diploma or degree that you have completed?



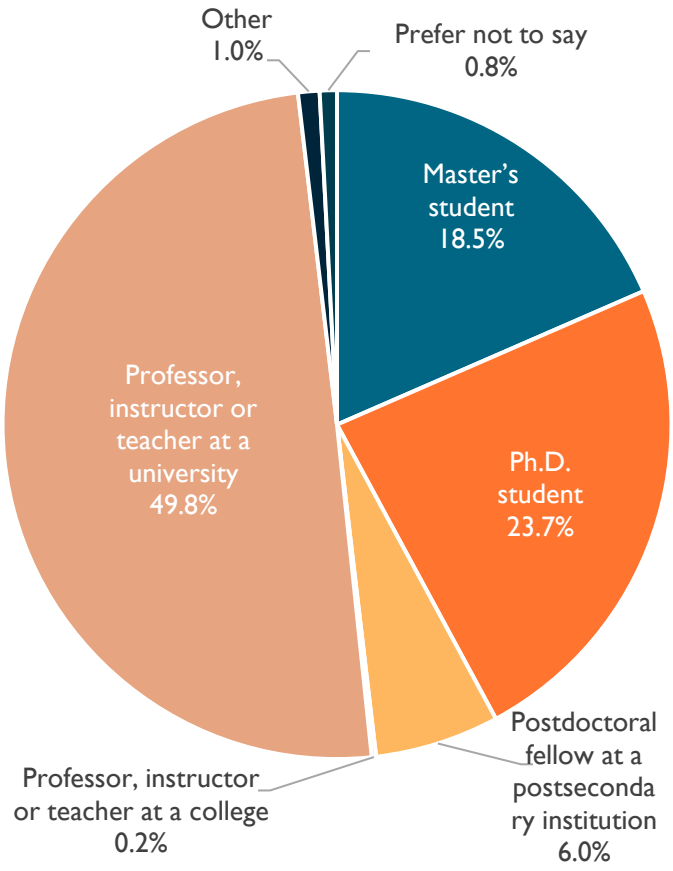
In what year did you receive this certificate, diploma or degree?



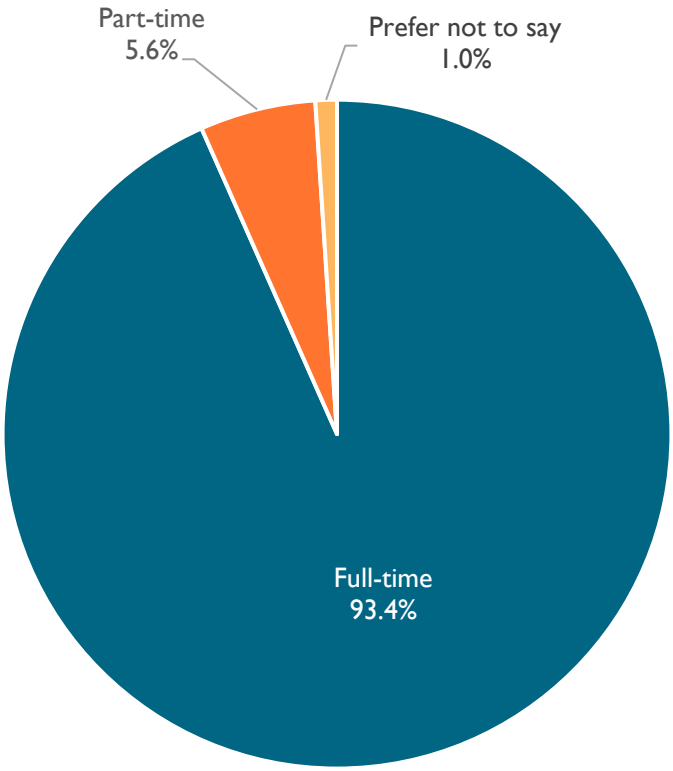
In which country did you obtain this certificate?



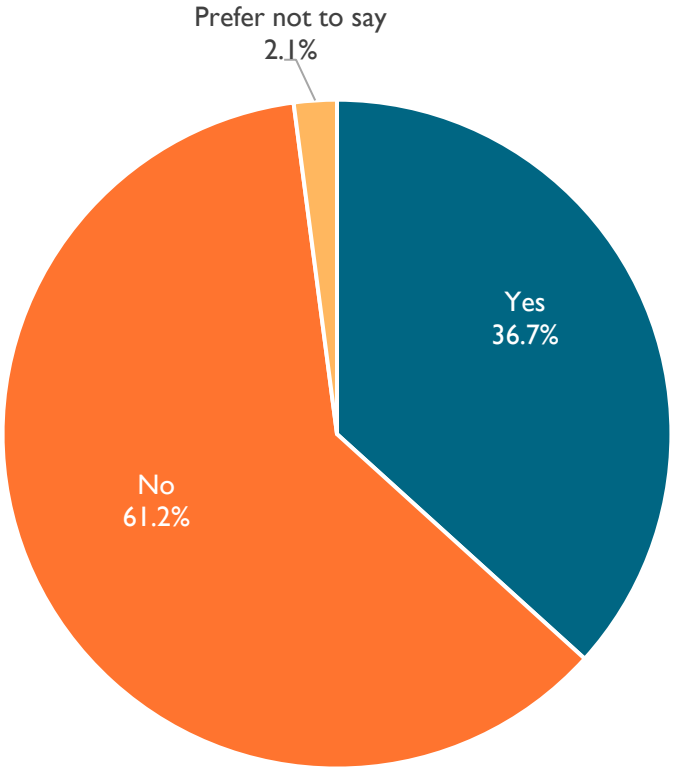
Within the last 3 months, were you considered a part of any of the following groups?



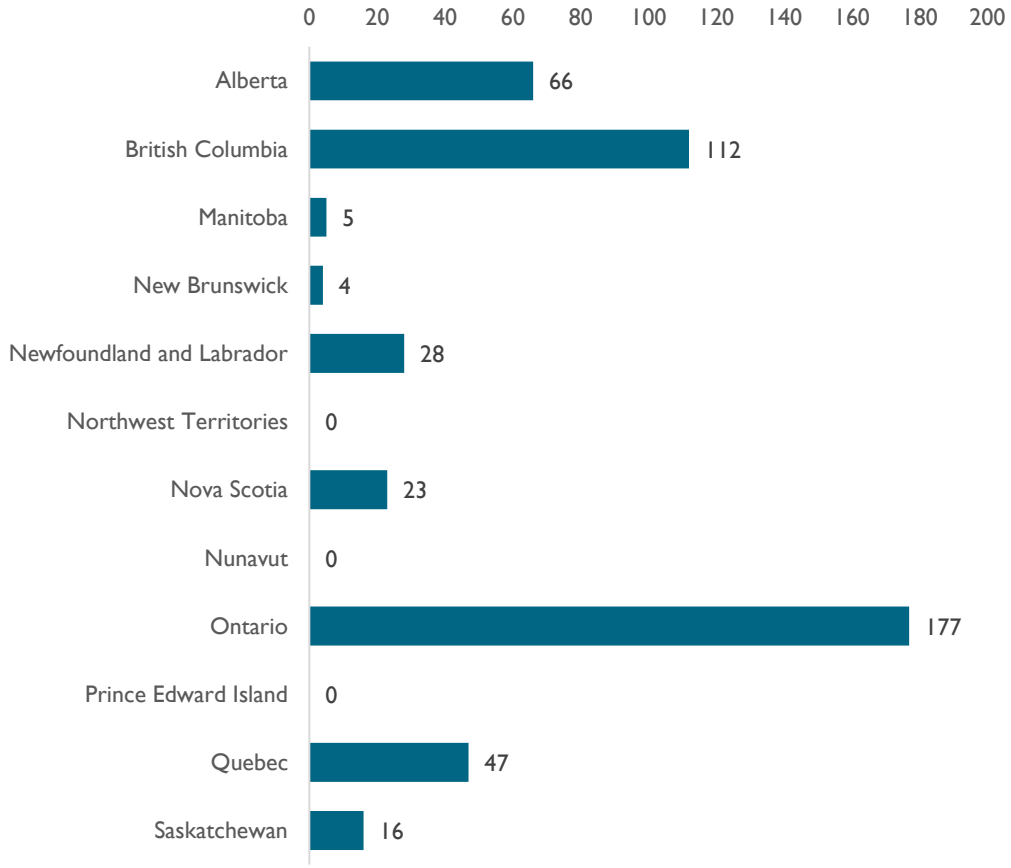
Do you currently work/study part-time or full-time?



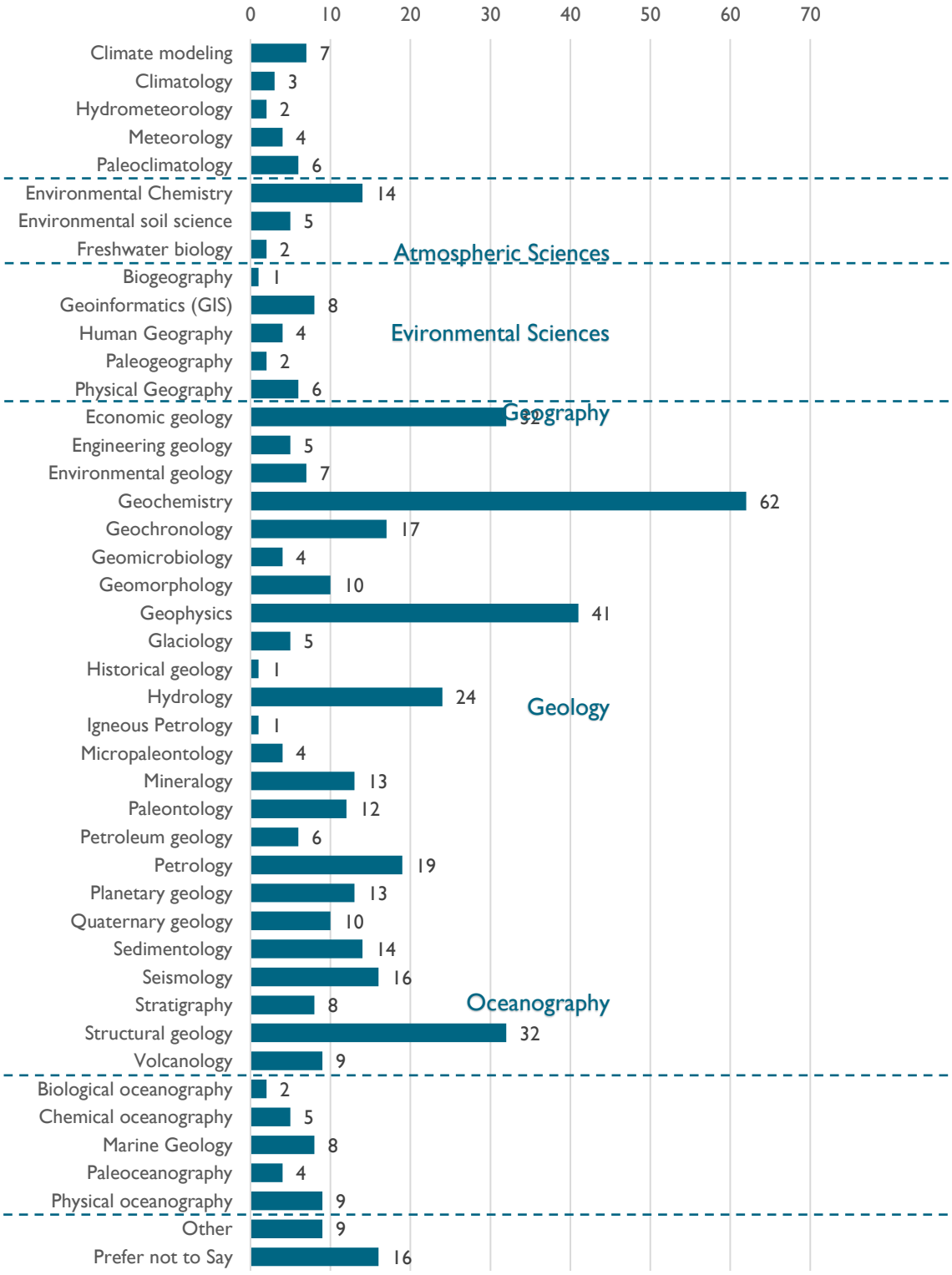
Did you arrive in Canada specifically to work in the position you are currently in?



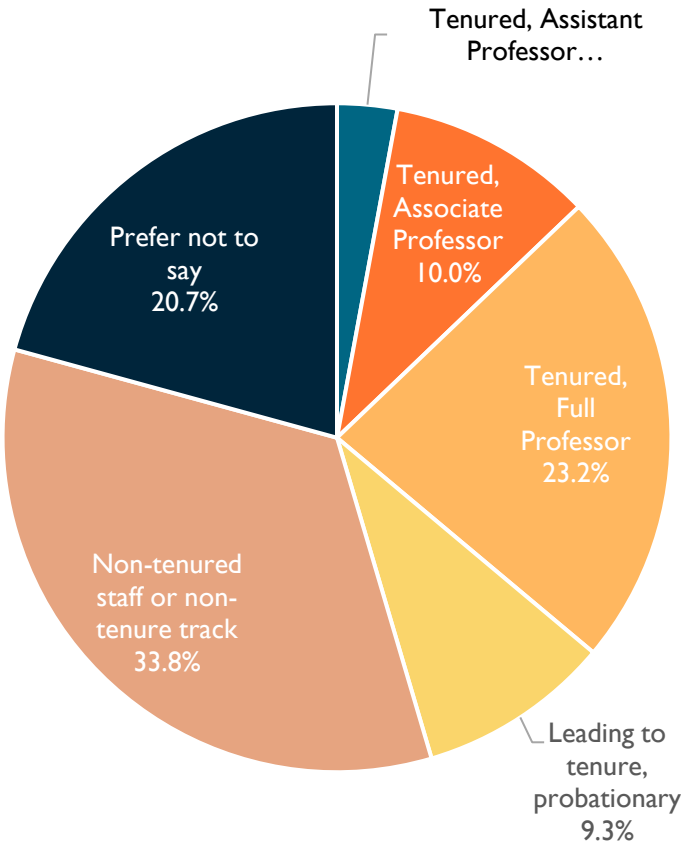
In which province/territory is your institution?



Which field within Geoscience most closely reflects your research/teaching?

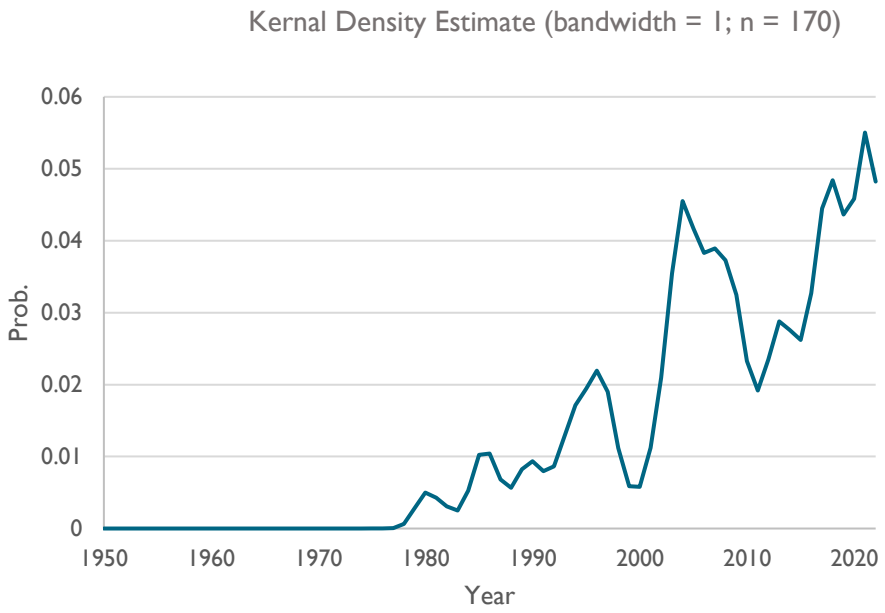


If applicable, what is your tenure status?



In which year did you achieve your tenure status?

Respondents that provide the year they received tenure make up 35% of all eligible respondents. The KDE of their responses is found below, highlighting three major peaks: 1996, 2004 and 2021. The middle peak (2004) is flanked by two significant troughs: 2000 and 2011.



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