

Analysis of the Canadian Geoscience Council 2001 Census of Geoscientists

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Volume 29, Number 3, September 2002

URI: https://id.erudit.org/iderudit/geocan29_3art01

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Publisher(s)

The Geological Association of Canada

ISSN

0315-0941 (print)

1911-4850 (digital)

[Explore this journal](#)

Cite this article

Coultish, T. L. (2002). Analysis of the Canadian Geoscience Council 2001 Census of Geoscientists. *Geoscience Canada*, 29(3), 101–109.

Article abstract

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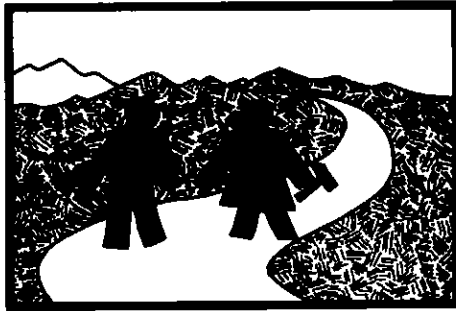
Based on the survey, it is apparent that geoscience in Canada is a male-dominated discipline. However, the demographic profiles of the two genders show that this will change slowly as retirements take place. The median salary range for male geoscientists is \$75-100K and for females, \$50-75K. A gender-based differential in compensation is not evident for males and females less than 40 years old, but is present for older respondents even after standardizing for educational level.

Canadian geoscientists who responded have high levels of education. Within federal and provincial governments and geotechnical environmental companies, most respondents have at least a master's degree. Elsewhere in the private sector, the majority of the mineral and energy sector respondents have a bachelor's degree. Surprisingly, higher degrees are not necessarily indicative of higher annual remuneration or higher levels of responsibility. In general, age and experience are more important than degree level in determining annual median remuneration and level of responsibility.

The census shows that, on the whole, Canadian geoscience will not experience above-average rates of retirement in the next 10 years. However, a high median age in the minerals sector may result in a significant loss of experienced personnel due to retirements over the next decade.

Almost two-thirds of respondents belong to two or more CGC member societies. Approximately 10% of the respondents belong to four or more societies, which suggests both the breadth of the discipline and its fragmentation. Slightly more than half of the respondents are provincially registered geoscientists.

ARTICLE



Analysis of the Canadian Geoscience Council 2001 Census of Geoscientists

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SUMMARY

The Canadian Geoscience Council (CGC) carried out a census of Canadian geoscientists in 2001. More than 3000 responses were received to a series of questions concerning age, gender, salary, education, level of responsibility, employment sub-sector, and membership in provincial and national societies.

Based on the survey, it is apparent that geoscience in Canada is a male-dominated discipline. However, the demographic profiles of the two genders show that this will change slowly as retirements take place. The median salary range for male geoscientists is \$75-100K and for females, \$50-75K. A gender-based differential in compensation is not evident for males and females less than 40 years old, but is present for older respondents even after standardizing for educational level.

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The census shows that, on the whole, Canadian geoscience will not experience above-average rates of retirement in the next 10 years. However, a high median age in the minerals sector may result in a significant loss of experienced personnel due to retirements over the next decade.

Almost two-thirds of respondents belong to two or more CGC member societies. Approximately 10% of the respondents belong to four or more societies, which suggests both the breadth of the discipline and its fragmentation. Slightly more than half of the respondents are provincially registered geoscientists.

RÉSUMÉ

Le Conseil géoscientifique du Canada (CGC) a réalisé un recensement de la population des géoscientifiques au Canada en 2001. Les questions posées portaient sur l'âge des répondants, le sexe, le salaire, le niveau de formation, le niveau des responsabilités au travail, le sous-secteur d'emploi ainsi que leur appartenance professionnelle à des associations provinciales ou canadiennes; plus de 3 000 réponses ont été traitées. L'enquête démontre qu'au Canada, les géosciences sont principalement des disciplines d'hommes. Cependant, les profils démographiques des deux sexes montrent que cette situation changera lentement au gré des départs à la retraite. La fourchette médiane des salaires des hommes est de 75 à 100 k\$, alors que

celle des femmes est de 50 à 75 k\$.

L'analyse comparative entre les sexes montre qu'il n'y a pas de différence détectable dans le profil d'indemnisation pour la tranche d'âge de 40 ans et moins, mais qu'il y a une différence pour la tranche d'âge de plus de 40 ans, même lorsqu'on tient compte du niveau de formation.

Les géoscientifiques qui ont répondu avaient des niveaux de formation élevés. Dans les milieux gouvernementaux fédéraux et provinciaux ainsi que dans les sociétés de services géotechniques, la majorité des répondants détenaient une maîtrise. Dans les autres domaines du secteur privé, la majorité des répondants des sous-secteurs de l'énergie et des minéraux détenaient un baccalauréat. Étonnamment, les plus hauts niveaux de diplomation ne correspondent pas nécessairement à des salaires annuels plus élevés, non plus qu'à des niveaux de responsabilité plus importants. En général, l'âge et l'expérience sont plus importants que le niveau de diplomation comme facteurs déterminant le niveau salarial médian ainsi que le niveau des responsabilités.

Ce recensement montre qu'en gros, au cours des 10 prochaines années, les taux de départ à la retraite dans le secteur canadien des géosciences n'excèdera pas celui de la moyenne canadienne. Cependant, l'âge médian élevé des géoscientifiques du secteur des minéraux pourrait signifier des pertes importantes de personnel d'expérience au cours de la prochaine décennie. Près des deux tiers des répondants sont membres de deux sociétés professionnelles ou plus du CGC. À peu près 10 % des répondants sont membres de 4 sociétés professionnelles ou plus, ce qui est un indice de l'étalement des spécialités et de la fragmentation du domaine professionnel. Un peu plus de la moitié des répondants sont des géoscientifiques de sociétés professionnelles provinciales.

INTRODUCTION

The Canadian Geoscience Council (CGC) undertook a census of Canadian geoscientists in spring 2001. Approximately 15,000 census forms were distributed by CGC to its member societies. The member societies subsequently sent the forms to their members at the same time as their dues notices.

A total of 3098 completed census forms were tabulated by Dr. A.V. Morgan, University of Waterloo, and the data were arranged in a spreadsheet for analysis. A preliminary report was produced that essentially graphed the raw data (Morgan *et al.*, 2002).

The present article examines key interrelationships among the data. In order to make sense of these interrelationships, it also incorporates some of the results of the earlier study by Morgan. The new analyses are selective, focussing on the questions that are thought to be of greatest importance to the Canadian geoscience community, including: demographic issues, particularly potential human resource "gaps," remuneration, gender issues, education and responsibility levels, professional registration, and society memberships.

DEMOGRAPHICS

Male respondents (2633, 85%) far outnumber the female respondents (352, 11%). Respondents that were "undeclared" (4%) were discarded in the following gender-based analyses.

The male respondents are generally older than the female respondents. The median age group (half respondents older and half younger) of the males is 45-49 years old, as is the modal (largest single) age group. The median age group of the females is 35-39 years old, and the modal age group is 25-29 years old.

There are 18% of male respondents within 10 years of the standard retirement age (*i.e.*, 65) and 12% of the males are over 65 years old. In contrast, only 6% of female respondents are within 10 years of the standard retirement age with 1% over 65 years old. Overall, the numbers in the 55+ group do not suggest a strong human capacity loss in the next decade. Given a career path of 30-40 years, one should expect 2-3% of geoscientists to reach retirement age in any given year. However, the demographic profile

varies among sectors as well as between the genders, and some sectors will experience much greater loss of expertise due to retirements in the next decade.

RESPONDENT PROVINCIAL RESIDENCE

Completed censuses were received from all parts of Canada (Fig. 1). One-third of respondents are from Alberta, 28% from Ontario, and 16% from British Columbia. The relatively small number of responses from Quebec (9%) suggests that, despite the bilingual census, geoscientists from this province may be under-represented in the sample.

Most respondents who hold federal government jobs reside in Ontario (~52%). The distribution of respondents employed by provincial government is more even across the country, while municipal government respondents were mostly in Ontario and Alberta (50% and 33%, respectively).

There are significant differences in non-government employees across the country. In minerals, there is representation in all the provincial and territorial groupings, but most respondents are in Ontario (33%), British Columbia (29%), and Quebec (16%). The energy sector is completely dominated by Alberta (95%). The geotechnical/environmental sector is also spread across Canada, but the highest percentage of respondents resides in Ontario (31%), Alberta (23%), and British Columbia (21%). Not unexpectedly, Ontario also leads in university employment, with 32% of the respondents.

The location where the respondents work the majority of the time was also asked in the census survey. The vast majority of both male and female respondents (>90%) work in Canada for most of their professional time, with the United States and South/Central America as the next most important locations. Given this dominance, location of work is not analysed further in this paper.

EDUCATION

Despite the differences in the age of the male and female respondents, there is little difference in the highest degree obtained by both genders. Only 2% have a technical diploma, about 40% have a bachelor's degree, about 30% have a master's degree, and 22% of females and

30% of males have a Ph.D. The very high percentage of graduate degrees in the respondents suggests a possible bias in the sample. The distribution of the census *via* professional and learned societies is probably responsible for this, since only 58 geoscientists who do not belong to these societies completed a census form. More than half of geoscientists under age 30 have a bachelor's degree as their highest degree. This percentage declines in the higher age groups, and more advanced degrees become more common. More than half of respondents aged 60-65 have doctorates.

The largest group of respondents working in the federal government, either at the Geological Survey of Canada (GSC) or elsewhere, has doctorates (73% and 40%, respectively). Approximately half of the respondents from all other levels of government have master's degrees. Municipal government has the highest proportion of respondents with bachelor's degrees (33%). Very few responses were received from those with a technical diploma (<5%).

Outside of government, the greatest number of respondents in the mineral and energy sectors has a bachelor's degree (50% and 62%, respectively). The largest group of respondents in geotechnical/environmental companies (54%) has a master's, while most respondents working in universities have a doctorate (81%).

With regard to level of responsibilities and education, faculty members mainly have doctorates (95%), and those occupying junior technical positions mainly have bachelor's degrees (65%)

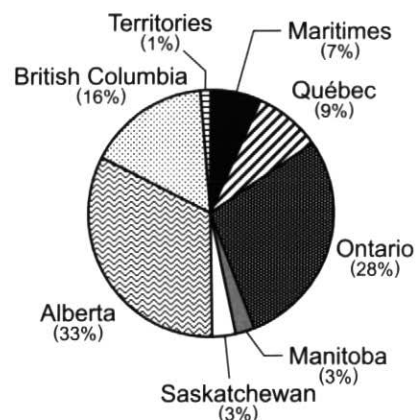


Figure 1 Provincial distribution of respondents.

(Fig. 2). Interestingly, the correlations between the intermediate technical to executive groups are relatively weak: formal education levels have similar distributions in all four categories. This suggests that age and experience are more important than level of formal education in determining level of responsibility.

The number of respondents that identified themselves as teachers is very low, making the results somewhat uncertain. However, it is still surprising to see that respondents who identify themselves as teachers have master's and doctoral degrees. This again is likely biased by the channels of distribution of the census through learned societies and technical associations.

EMPLOYMENT

There are 76% (2362) of the respondents currently employed as geoscientists or geotechnical engineers, whereas 22% (682) are not, and 2% (54) did not respond. The greatest number of respondents (26%) identifies as practicing within the mineral sector, and the next largest number of respondents is in the energy sector (22%). The majority of the respondents that identify with the university sector (11%) also identify with the research sector (12%). However, since the questionnaire allowed the respondents to identify with more than one sector, interpretation of the data with regard to sector proved to be difficult. Therefore, the question about place of employment was analyzed more thoroughly instead.

The distribution of males and females among various places of employment is fairly equal. The major employers for males and females (M/F) are energy

(21/27%), geotechnical/environmental companies (13/12%), universities (12/19%), and self-employment (17/11%). Collectively, all government levels employ 11% of males and 13% of females, with provincial governments employing the majority. The mineral sector employs only 12% of males and 6% of females, but responses to which sector one belongs show a much higher percent of respondents in the mineral sector. Many of the respondents who identified themselves as in the mineral sector, but are not employed at a mineral company, are actually in government or self-employed (Fig. 3). In fact, almost half of those respondents who are self-employed are working in minerals. Within all levels of government, 37% of respondents are doing research, and 26% are in minerals.

LEVEL OF RESPONSIBILITY

Senior technical is the largest group for both genders, consisting of 50% males and 34% females (Fig. 4). Junior and intermediate technical constituted only 11% of males, but 36% of females. Twenty percent of males are executives, but only 6% of females have a similar level of responsibility. At least part of the differences between the males and females can be explained by the demographics of the two groups, with the median age of females 10 years below that of males.

Figure 2 shows a weak link between highest degree achieved and the level of responsibility of the respondents. It appears that age is a more important factor than degree level when considering the level of responsibility (Fig. 5). The overwhelming majority (77%) of respondents who are less than 25 years old

are in junior technical positions. The largest percent (~48%) of respondents who are 25-34 years old are in intermediate technical positions. The majority of respondents over age 35 are in senior technical positions (~40-60%). However, there is a progressive diminution in the dominance of senior technical older than 35 years of age, and a concurrent increase in the executive category.

Examining level of responsibility by place of employment revealed several differences. Distributions of responsibility levels are very similar for the respondents in federal and provincial governments, with the majority of these respondents identifying themselves as senior technical (~50-60%). Junior technical, intermediate technical, administration, and executive positions have less than 20% of the respondents for each position. Within the territorial government, 63% identify themselves as senior technical, however no respondents assessed themselves in the junior technical or executive categories.

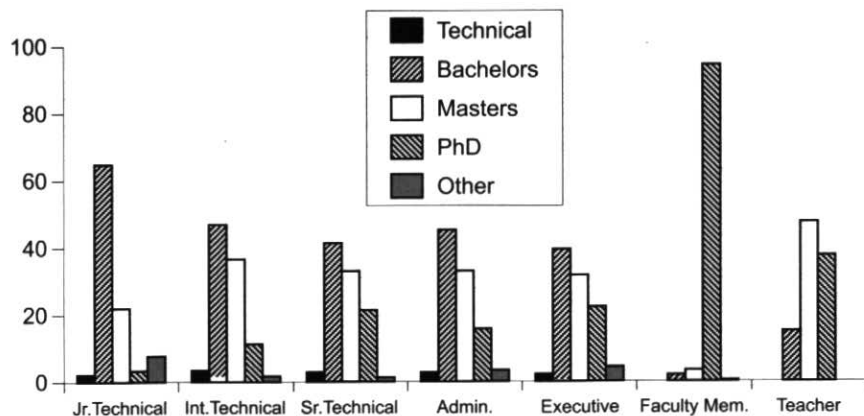


Figure 2 Percent highest degree achieved for each level of responsibility.

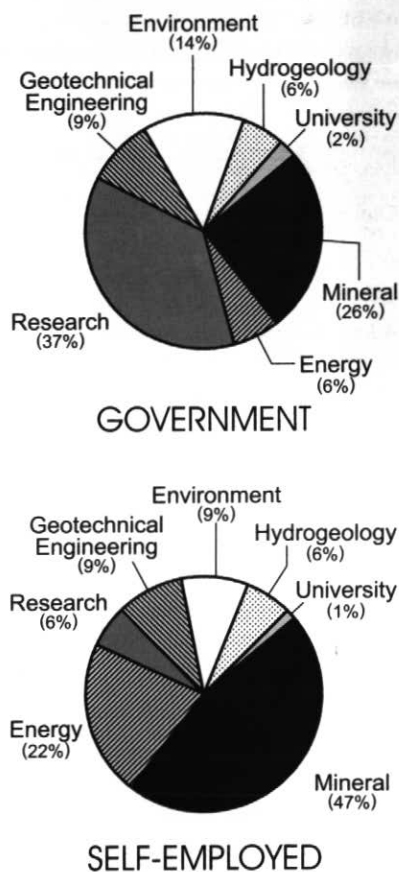


Figure 3 The sectors that government and self-employed respondents identify with.

Within the municipal government, 42% of the respondents are in senior technical positions, 33% in administrative positions, 25% in executive positions, and none in junior or intermediate technical positions.

The distributions of level of responsibilities in the non-government places of employment were very similar to those in the government. A majority of the respondents who are self-employed or work in the mineral, energy, and geotechnical/environmental sectors stated they are in senior technical positions (~45-65%). A majority of respondents in executive positions are in the "other" (not specified) category (36%), the mineral sector (33%), and retired (27%). Most of the retired geoscientists stated that they have high levels of responsibilities; however, it is uncertain if they are reporting on the position they held before retirement.

EMPLOYMENT IN GEOSCIENCE

There are 86% (2678) of the respondents who obtained their highest degree in a geoscience or geotechnical field, whereas

only 12% (363) did not, and 2% (56) who did not respond. However, the census questionnaire was not designed to allow one to determine if a respondent had a lower degree in geoscience.

Out of the 2678 respondents who did achieve their highest degree in geoscience, 81% are currently working in a geoscience field, whereas 19% are not. Out of the 363 respondents who do not have their highest degree in geoscience, 52% are now working in a geoscience field, whereas 48% are not. Examining where the respondents are presently employed with regard to their background in geoscience revealed some interesting results (Fig. 6).

Those respondents who have their highest degree in geoscience and are currently working in a geoscience field ("yes/yes") are distributed fairly evenly in five main domains: mineral, energy, geotechnical/environment, university, and self-employed. This group of respondents reflects the general distribution of census respondents in the given places of employment (see "Employment" above). Those respondents who have their highest degree in geoscience but are not currently working in a geoscience field ("yes/no") are mainly retired, not employed, or "other" (not specified).

Those respondents who do not have their highest degree in geoscience but are currently working in a geoscience field ("no/yes") are found mainly in energy and secondarily in geotechnical/environmental companies or self-employed. It was determined that those respondents in the "no/yes" group mainly

have senior technical positions (63%) or are executives (16%). It is possible that these respondents are experts in different fields that have been brought into a geoscience workplace for a very specialized task, or they hold an MBA as their highest degree.

Finally, those respondents who do not have their highest degree in geoscience and are not currently working in a geoscience field ("no/no") are fairly evenly distributed among the various places of employment. Out of these respondents, 34% hold executive positions and 28% hold senior technical positions. Also, 96% of these respondents have at least one membership to a geoscience society. It is possible that these respondents have lower degrees in a geoscience field, which could explain why they received the census survey for geoscientists.

Respondents who received their highest degree in geoscience and who are working in this field have a median salary of \$75-100K, with a modal value of \$50-75K. Respondents working in geoscience who do not have their highest degree in the field have the same median salary range but the modal value is \$100-150K. Individuals who have a geoscience degree but are not currently employed in geoscience generally have lower salaries than the rest. Median salaries for this group are \$50-75K and the distribution is bimodal with one peak at <\$25K and the other at \$50-75K.

REMUNERATION, AGE, GENDER, AND EDUCATION

The modal salary for both males and

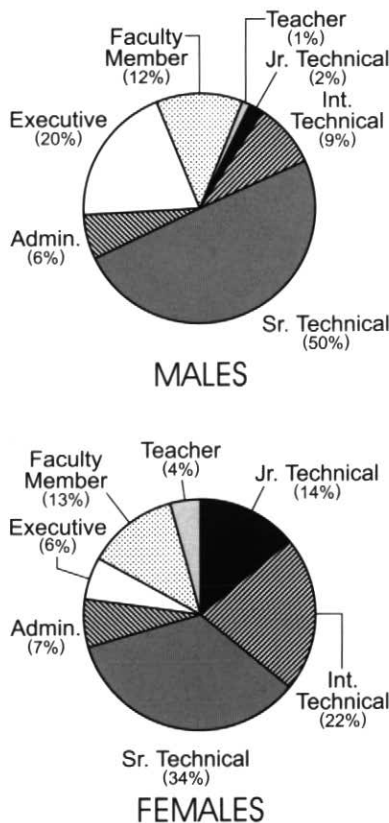


Figure 4 Percent of male and female respondents at each level of responsibility.

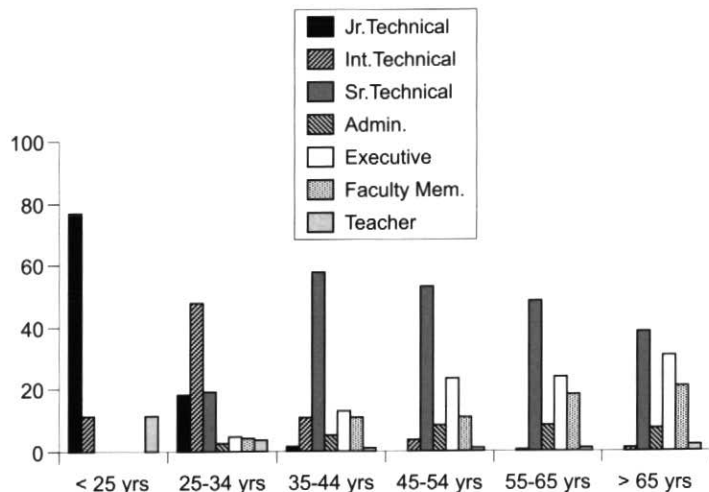


Figure 5 Percent level of responsibility by age group.

females is \$50-75K; however, the median salary for males is \$75-100K, and \$50-75K for females. The difference in compensation is still more obvious at the highest and lowest levels: 27% of males and only 5% of females receive more than \$100K as salary, while 7% of males and 17% of females receive less than \$25K. Some of these differences are attributable to the different demographic profiles of the two groups. No respondent under 30 years of age received a salary exceeding \$150K, while 2% of those aged 30-39, 6% of those aged 40-49, and 7% of those aged 50-59 did so.

There does not appear to be a

strong link between level of education and remuneration (Fig. 8). One might expect distributions with modal values for lower degrees/diplomas at lesser salary levels, and the converse for higher degrees achieved. These trends are only weakly expressed. For example, there is very little difference in the percentages of geoscientists with master's degrees and those with doctorates earning in the \$100-150K range. Surprisingly, a still higher percentage of those with undergraduate degrees are in this salary bracket. It is also interesting to note that more than 10% of those with "other" degrees earn >\$150K. As suggested above (e.g., Fig 2), this

analysis indicates that age and experience count more in terms of remuneration than education level.

The median remuneration for each gender, based on age and highest degree achieved, was examined to determine if a gender-based bias in remuneration existed within the geoscience community. From Table 1, it is evident that age and experience are more important than degree level in securing a higher salary. There is little difference between the median salaries earned with a technical diploma or a bachelor's degree and that of a doctorate for any given age group. This table also reveals differences between the salaries earned by males and females. Within the under 30 and 30-39 age groups, males and females have equal median salaries for all degree levels (except the "other degree" category).

In the 40-49 and 50-59 age groups, however, differences emerge. For each degree, female median income is almost always in the salary range immediately below that of the male median income. Exceptions are females between the ages of 40-49 with a technical diploma and those aged 50-59 with a bachelor's degree who have a median salary of \$25-50K, whereas males of the same status have a median salary of \$75-100K. Beyond the age of 40, the only group that does not show evidence of a gender-based salary gap is that aged 50-59 with a doctorate. In the group over 65 years of age, a bimodal distribution in salary developed, presumably as a consequence of retirement.

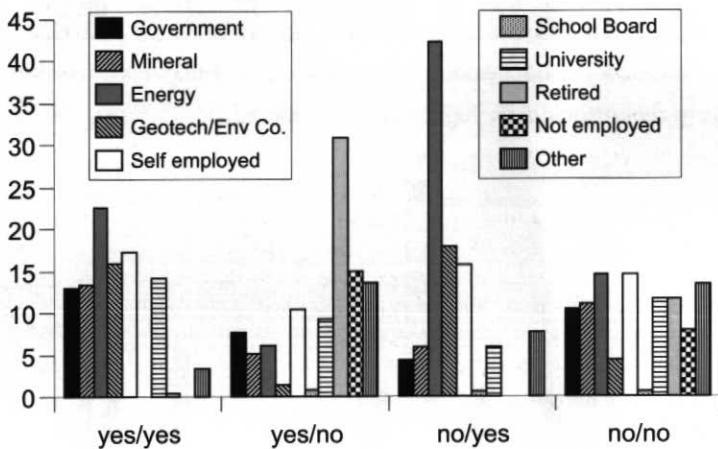


Figure 6 Percent of respondents with and without highest degree in geoscience, employment status in a geoscience field, and where they are currently employed.

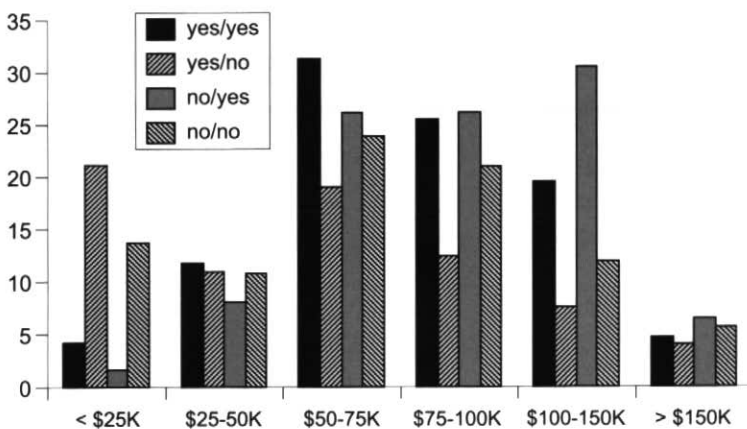


Figure 7 Percent remuneration of respondents with and without highest degree in geoscience and current employment status in geoscience. See Figure 6 for explanation of categories.

Explanation of categories in Figures 6 and 7:

- yes/yes = a degree in geoscience and current employment in geoscience
- yes/no = a degree in geoscience but current employment *not* in geoscience
- no/yes = a degree *not* in geoscience, but currently working in geoscience
- no/no = a degree *not* in geoscience and *not* working in geoscience

REMUNERATION, RESPONSIBILITY, AND EMPLOYER

Level of responsibility is an important determinant of income (Fig. 9). Median salaries increase from \$25-50K for junior technical to \$75-100K for senior technical responsibilities. Administrative and executive responsibility levels also have a median income of \$75-100K, but the modal value for executive geoscientists is \$100-150K. Faculty members have a salary distribution similar to administrators, but a lower percentage earns \$100-150K, and virtually none earns more than \$150K. Geoscientists who are teachers have a median remuneration of \$25-50K, the same as junior technical employees, but the distribution of salaries is bimodal,

with peaks in <\$25 and \$50-75K.

It was also of interest to determine which employers had higher median and modal salary ranges (Table 2). Median and modal salaries are in the range of \$50-75K for all government employees, except those employed by the GSC, where both are \$75-100K. Fewer than 5% of all government geoscientists have salaries that exceed \$100K. Remuneration for respondents employed outside government varies considerably from sector to sector. Geoscientists in the mineral sector have median and modal salary ranges of \$75-100K, the median for the energy sector is the same, but for the geotechnical/environmental sector the modal value is \$100-150K, while median and modal values are \$50-75K. Similarly, the percentage of respondents with salaries exceeding \$100K is ~30% for minerals, ~48% for energy and ~20% for geotechnical/environmental.

Median and modal values for school boards and universities are also in the \$50-75K range. About 15% of university respondents, but no school board employees, have salaries exceeding \$100K. About 80% of those responding from the university sector are faculty members, with technical staff forming most of the remainder.

Median and modal salaries for self-employed geoscientists are \$50-75K, similar to those of non-GSC government employees and respondents in the geotechnical/environmental sector. However, these self-employed geoscientists have a larger range of salaries than those in the government: ~20% have salaries exceeding \$100K, whereas 15% earn <\$25K. The self-employed category probably includes some respondents who are partially retired and undertake limited contract work, resulting in relatively low annual remuneration. Many of the retired geoscientists who responded continue to receive salaries similar to actively employed geoscientists (median and modal range of \$50-75K), but it is not possible to determine from the survey how much income is derived from pensions and how much from continued part-time employment.

DEMOGRAPHICS AND EMPLOYMENT

Important differences in demographic profiles among places of employment are

examined in Figure 10. The median age group for federal and provincial government employees is 45-54 years, as is the modal for the GSC and provincial government. In the federal government

other than GSC, however, the modal value is lower, at 35-44 years, but this area also has the largest percent of respondents over the age of 55 (~25%) out of any government sector. Territorial

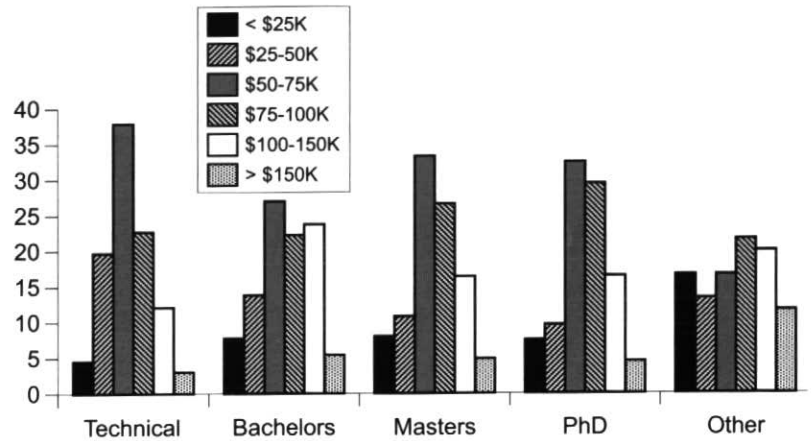


Figure 8 Percent remuneration for highest degree achieved.

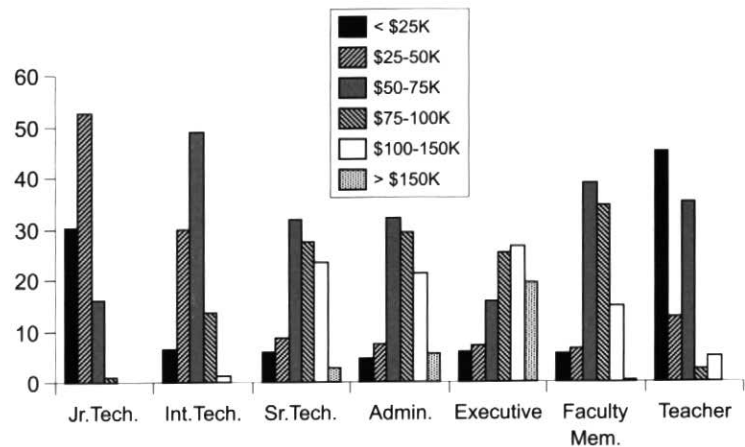


Figure 9 Percent remuneration for each level of responsibility.

Table 1 Median remuneration for males and females depending on age and highest degree obtained

Degree	Gender	Age <30	30-39	40-49	50-59	60-65
Tech	male	< \$25K	\$50-75K	\$75-100K	\$75-100K	\$75-100K
	female	—	\$50-75K	\$25-50K	—	—
Bachelor's	male	\$25-50K	\$50-75K	\$75-100K	\$75-100K	\$75-100K
	female	\$25-50K	\$50-75K	\$50-75K	\$25-50K	—
Master's	male	\$25-50K	\$50-75K	\$75-100K	\$75-100K	~\$75K
	female	\$25-50K	\$50-75K	\$50-75K	\$50-75K	—
PhD	male	\$25-50K	\$50-75K	\$75-100K	\$75-100K	\$75-100K
	female	\$25-50K	\$50-75K	\$50-75K	\$75-100K	\$50-75K
Other	male	\$25-50K	\$50-75K	\$75-100K	\$75-100K	—
	female	~\$25K	<\$25K	\$50-75K	—	—

Note: Cells that are blank are due to insufficient number of respondents to calculate median for the category

governments have equal numbers of respondents from the 45-54 and 35-44 age groups and the highest percentage of respondents younger than 35 (~18%) in the government sector. Municipal governments have the highest percentage of respondents who are 35-44 years old.

For non-government places of employment, the mineral sector has an older age structure than the energy or geotechnical/environmental sectors. The median and modal value for the mineral sector is 45-54 years, and 18% are older than 55 years. The median and modal

values for the energy and geotechnical/environmental sectors are 34-45 years, and each has a much higher percentage of respondents younger than 35 years old, (~18% and ~23%, respectively, compared to the mineral sector with ~7%). The median and modal age group in universities is 45-54 years, and nearly 24% are within 10 years of retirement.

One of the goals of the CGC census survey was to examine potential human resource gaps. The 55-65 age group was selected on the basis that it consists of those respondents who will potentially retire within the next 10 years. The greatest number of respondents in this age group is self employed (Fig. 11). Universities are the employers with the greatest number of retirements to be expected: around 25% of their staff. The mineral sector should expect 15% of its geoscientists to retire within the next 10 years. The federal government, other than the GSC, should expect 25% of its geoscientists to retire within the next 10 years.

The greatest number of respondents younger than 30 years old work in geotechnical/environmental companies and the energy sector (Fig. 12). The demographic renewal currently underway in universities is weakly indicated in this age group. By comparing Figures 11 and 12, apart from self employment, it is evident that the greatest difference between those under 30 years old and those 55-65 years old occurs in the mineral sector.

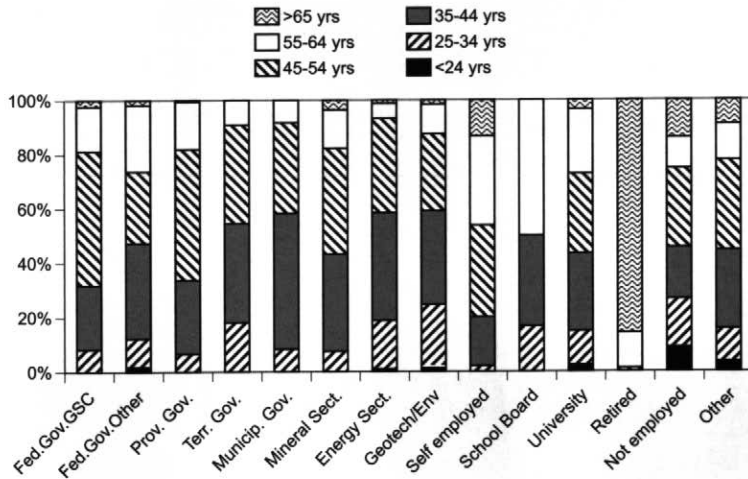


Figure 10 Age structure within places of employment.

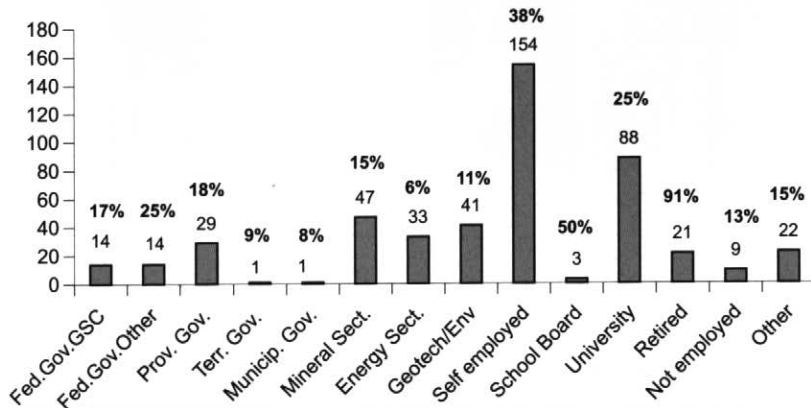


Figure 11 Number of 55-65 year old respondents at each place of employment and their percent representation of all respondents under 65 years.

Table 2 Median and modal salary ranges by employer (males and females combined)

Place of Employment	Median Salary	Modal Salary
Federal Government GSC	\$75-100K	\$75-100K
Federal Government Non-GSC	\$50-75K	\$50-75K
Provincial Government	\$50-75K	\$50-75K
Territorial Government	\$50-75K	\$50-75K
Municipal Government	\$50-75K	\$50-75K
Geotechnical/Environment Co.	\$50-75K	\$50-75K
Energy Sector	\$75-100K	\$100-150K
Mineral Sector	\$75-100K	\$75-100K
University	\$50-75K	\$50-75K
School Board	\$50-75K	\$50-75K
Self-Employed	\$50-75K	\$50-75K
Retired	\$50-75K	\$50-75K

MEMBERSHIP IN SOCIETIES

Respondents to the census were asked to indicate all of the societies in which they were members. The greatest number of respondents are members of the Geological Association of Canada (GAC, 1134), followed by the Canadian Institute of Mining and Metallurgy (CIMM, 856), the Prospectors and Developers Association of Canada (PDAC, 563), and the Canadian Geotechnical Society (CGS, 511) (Fig. 13). There were 911 respondents who were members of societies other than those specified in the census. The societies with the fewest number of respondents were Canadian Society of Coal and Organic Petrology (CSCOP, 10) and Canadian Meteorological and Oceanographic Society (CMOS, 10), and 38 respondents did not belong to any

societies. However, varying fractions of each society's members responded to the census survey, therefore a societal bias may exist within the survey. Most of the 2000-2001 membership numbers for each society were available to compare to the 2001 census respondents, and suggest that approximately 50% of the members from each society responded to the survey. The most noticeably under-represented societies are the Canadian Geophysical Union (CGU, 25%), Canadian Society of Exploration Geophysicists (CSEG, 22%), Mineralogical Association of Canada (MAC, 15%), and Canadian Society of Petroleum Geologists (CSPG, ~13%, based on an estimated membership number). This under-representation of certain societies does not overly influence within-group analyses.

Figure 13 also reveals the broad patterns of societal affiliations, as 60% of the respondents belong to more than one society, and 10% of the respondents belong to four or more societies. For example, many members of the Association of Exploration Geochemists are also members of CIMM, GAC, PDAC, and the British Columbia and Yukon Chamber of Mines. The societies that have the highest number of respondents in common were CIMM and GAC (413), CIMM and PDAC (388), and GAC and PDAC (388). These data reflect the breadth of geoscience across Canada, but also suggest fragmentation of the discipline in terms of member societies.

As expected, analysis of the number of society memberships according to age of the respondents showed that older geoscientists tend to belong to more societies than younger geoscientists. Similarly, a single society membership is the modal value for those with technical, bachelor's, and master's degrees, while the largest group of respondents with doctorates or "other" (not specified) qualifications belong to two societies. It was found that those with higher degrees are more likely to become members of four or more societies.

In all cases, except Ontario, the modal value is one membership per respondent. The majority of respondents in Ontario are members of two societies (32%). Respondents from British Columbia and the territories have a higher percentage of four or more memberships

(14% and 13%, respectively).

The vast majority of government-employed geoscientists belong to at least one of the CGC's member organizations.

Median values are two memberships for all levels of government, except municipal government employees with a median value of one membership. The GSC and

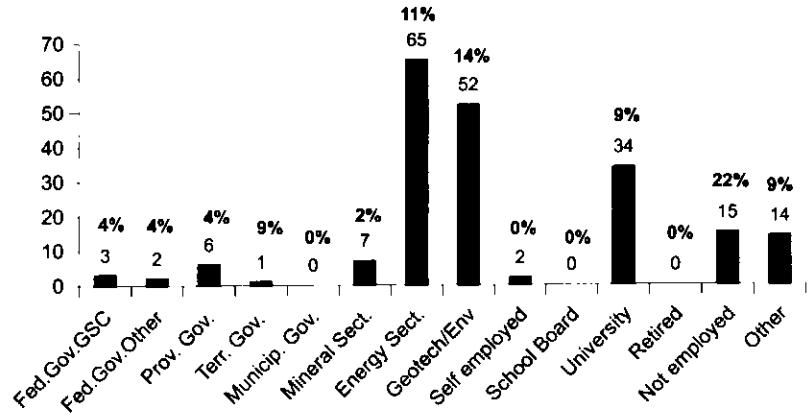


Figure 12 Number of respondents younger than 30 years of age at each place of employment and their percent representation of all respondents under 65 years of age.

AEG		CAG		KEGS		CGU		CGS		CIMM		IAH		CANQUA		CSCOP		CSEG		CWLS		GAC		CSPG		MAC		PDAC		BCYCM		RSC EOASD		CMOS		MINAC		Other	
AEG	123	0	1	1	1	2	7	13	13	183	86	10	0	0	0	0	0	0	0	0	0	13	134	9	40	146	40	563	126	254	41	0	0	0	0	41	911		
CAG	0	120	1	1	1	1	7	10	67	856	86	10	0	0	0	0	0	0	0	0	0	13	134	9	40	146	40	563	126	254	41	0	0	0	0	41	911		
KEGS	1	1	112	1	1	1	7	10	67	856	86	10	0	0	0	0	0	0	0	0	0	13	134	9	40	146	40	563	126	254	41	0	0	0	0	41	911		
CGU	1	13	14	130	1	1	7	10	67	856	86	10	0	0	0	0	0	0	0	0	0	13	134	9	40	146	40	563	126	254	41	0	0	0	0	41	911		
CGS	2	0	1	7	10	67	856	86	10	0	0	0	0	0	0	0	0	0	0	0	0	13	134	9	40	146	40	563	126	254	41	0	0	0	0	41	911		
CIMM	71	1	8	10	67	856	86	10	0	0	0	0	0	0	0	0	0	0	0	0	0	13	134	9	40	146	40	563	126	254	41	0	0	0	0	41	911		
IAH	1	0	2	7	73	13	183	86	10	0	0	0	0	0	0	0	0	0	0	0	0	13	134	9	40	146	40	563	126	254	41	0	0	0	0	41	911		
CANQUA	6	21	3	10	8	9	0	86	10	0	0	0	0	0	0	0	0	0	0	0	0	13	134	9	40	146	40	563	126	254	41	0	0	0	0	41	911		
CSCOP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	134	9	40	146	40	563	126	254	41	0	0	0	0	41	911	
CSEG	0	0	58	26	1	10	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	13	134	9	40	146	40	563	126	254	41	0	0	0	0	41	911		
CWLS	0	0	2	0	2	22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	134	9	40	146	40	563	126	254	41	0	0	0	0	41	911		
GAC	86	21	13	57	40	413	27	68	8	19	4	1134	146	40	563	126	254	41	0	0	0	13	134	9	40	146	40	563	126	254	41	0	0	0	0	41	911		
CSPG	1	1	12	5	7	46	6	3	3	103	82	108	418	146	40	563	126	254	41	0	0	13	134	9	40	146	40	563	126	254	41	0	0	0	0	41	911		
MAC	13	1	0	4	1	45	0	2	1	1	1	97	9	146	40	563	126	254	41	0	0	13	134	9	40	146	40	563	126	254	41	0	0	0	0	41	911		
PDAC	67	0	9	12	15	368	5	9	0	9	0	388	17	40	563	126	254	41	0	0	0	13	134	9	40	146	40	563	126	254	41	0	0	0	0	41	911		
BCYCM	38	2	0	4	7	151	2	4	1	1	0	196	12	20	126	254	41	0	0	0	0	13	134	9	40	146	40	563	126	254	41	0	0	0	0	41	911		
RSC EOASD	0	3	0	2	3	9	0	6	0	3	1	31	15	4	5	2	41	0	0	0	0	13	134	9	40	146	40	563	126	254	41	0	0	0	0	41	911		
CMOS	0	5	0	1	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	13	134	9	40	146	40	563	126	254	41	0	0	0	0	41	911		
MINAC	5	0	0	0	4	28	3	1	0	0	0	17	2	5	22	11	0	0	0	0	0	13	134	9	40	146	40	563	126	254	41	0	0	0	0	41	911		
Other	37	39	31	36	109	241	50	32	3	154	39	370	139	49	166	84	11	1	8	911																			

- AEG = Association of Exploration Geochemists
- BCYCM = BC and Yukon Chamber of Mines
- CAG = Canadian Association of Geographers
- CANQUA = Canadian Quaternary Association
- CEGS (KEGS) = Canadian Exploration Geophysical Society
- CGS = Canadian Geotechnical Society
- CGU = Canadian Geophysical Union
- CIMM = Canadian Institute of Mining, Metallurgy and Petroleum (Geology Division)
- CMOS = Canadian Meteorological and Oceanographic Society
- CSCOP = Canadian Society of Coal and Organic Petrology
- CSEG = Canadian Society of Exploration Geophysicists
- CSPG = Canadian Society of Petroleum Geologists
- CWLS = Canadian Well Logging Society
- GAC = Geological Association of Canada
- IAH = International Association of Hydrogeologists Canadian National Chapter
- MAC = Mineralogical Association of Canada
- MINAC = Mining Association of Canada
- PDAC = Prospectors and Developers Association of Canada
- RSC EOASD = Royal Society of Canada (Earth, Oceanographic and Atmospheric Sciences Division)

Figure 13 Matrix of multiple memberships in societies.

territorial government employees have modal values of two and three memberships, respectively. The statistics for the territories may not be statistically representative because of the small number of respondents.

Median values are three society memberships for geoscientists in the mineral sector and those who are self-employed, two society memberships for the energy sector, university, retired, and not-employed geoscientists, and one society membership for geotechnical/environmental company employees. Modal values are all one, except for the mineral sector (3), self-employed (2), and not-employed (2) geoscientists.

PROFESSIONAL REGISTRATION

Slightly more than half of the respondents (1694) to the census are provincially registered. There were 1356 respondents who are not registered for various reasons, and only 48 respondents did not answer this question. Those with bachelor's and master's degrees are most likely to be provincially registered (63% and 60%, respectively). Respondents with doctoral degrees and technical diplomas are less likely to be provincially registered (44% and 38%, respectively).

Of those not registered, 38% are not involved in work that required provincial registration (Fig. 14). The second largest group of those not registered work in jurisdictions where registration is not required (26%). Geoscientist practitioners employed in mineral, energy, geotechnical/environmental companies as well as self-employed geoscientists, are most likely to be members of provincially legislated registration organizations

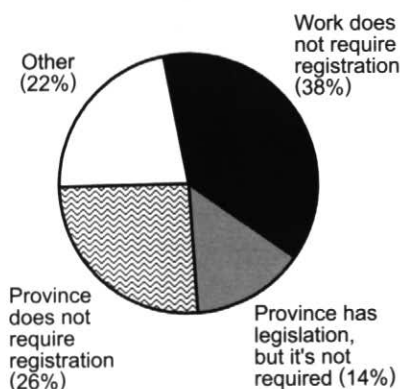


Figure 14 Reasons for not being professionally registered.

(~65%). Provincial government employees have higher registration rates (57%) than the other levels of government. Only 30% of federal government employees are registered, and approximately half of the municipal and territorial government employees are registered. As expected, respondents employed by universities and school boards are unlikely to be provincially registered (35% and 16%, respectively).

With regard to level of responsibility, the results found were expected. The respondents in senior technical positions have the greatest likelihood to be registered provincially (66%), whereas teachers and faculty members are least likely to be registered (17% and 35% respectively). Approximately half of respondents in intermediate technical, administrative, and executive positions are provincially registered, and surprisingly, only 35% of respondents in junior technical positions are provincially registered.

CONCLUSIONS

The number of responses received was large enough that, if the sample were random, great confidence could be placed in the results. However, since the sample was distributed through member societies of CGC, response rates are probably biased toward more senior geoscientists. Similarly, it appears that even though the census was bilingual, response rates from Quebec may have been lower than elsewhere in the country. Despite these caveats, within-group analyses should be valid (e.g., the percentage of junior technical geoscientists may be low compared to the senior technical group, but salaries and education within the groups are likely to be reflected accurately).

Based on the survey, geoscience in Canada is a male-dominated discipline. However, the demographic profiles of the two genders show that this will change slowly as retirements take place. Taken as a whole, geoscience will not experience above-average rates of retirement in the next 10 years. However, the minerals sector, in particular, has a very high median age and will be affected by significant loss of experienced personnel due to retirements.

Canadian geoscientists who responded have a high level of education: about 40% have bachelor's degrees, 30%

have master's, and 22% (females) and 30% (males) have doctorates as their highest degree. However, it has been demonstrated that age and experience are more important, in terms of annual median remuneration, than degree level. Level of responsibility is also an important determinant of income, and is only weakly related to degree level, with the exception of university faculty members where more than 95% have doctorates. A gender-based differential exists in terms of annual median remuneration for females over the age of 40, even after standardizing for educational level.

Almost two-thirds of the respondents belong to two or more of the societies that are members of CGC, with 10% belonging to four or more societies. This suggests fragmentation of the discipline in terms of member societies. Also, any societal bias within the survey has not affected the within-group analyses. There are no differences between the numbers of societal memberships held by government employees *versus* non-government employees; however, those respondents with doctorates generally were members of more societies than respondents with other degrees.

ACKNOWLEDGMENTS

This study was originally produced as a contract report to the CGC. The original data were tabulated under the supervision of Alan Morgan, University of Waterloo. I am grateful to Jeremy Hall (former president of CGC), Memorial University of Newfoundland, for his encouragement to publish this paper and for his suggestions on shortening the original report. I am also very grateful to Antoni Lewkowicz, University of Ottawa, for his great help in editing the original report and subsequent guidance in the preparation of this paper. The reviewers, Grant Mossop and John Gartner, and the editor, Godfrey Nowlan, provided helpful comments on an earlier version of this manuscript.

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Accepted as revised 26 July 2002