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Canadian Geoscience: Charting New Territory in the 21st Century

The Geological Association of Canada Presidential Address, GeoCanada 2010, May 10, 2010

Daniel Lebel

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Article abstract

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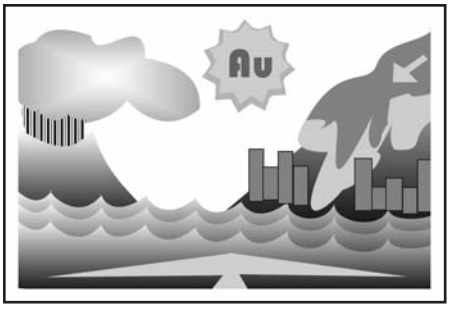
- To outline the status and trend information and observations on what economic and natural drivers influenced geoscience societies and geoscience careers in Canada over the last 10 years;
- To anticipate what the future might hold for individual geoscientists and the organizations for whom they work;
- To encourage more support for geoscience societies from geoscientists and their employers; and
- To call for a renewal of cooperation between geoscience associations in Canada and abroad.

ARTICLE



Canadian Geoscience: Charting New Territory in the 21st Century

The Geological Association of Canada Presidential Address, GeoCanada 2010, May 10, 2010

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SUMMARY
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SOMMAIRE
Conformément à la tradition le président sortant de l'Association géologique du Canada a profité de la tenue de GeoCanada 2010, à Calgary, Alberta pour livrer le message du président 2010. Les objectifs de son message – et du présent article sont les suivants :

- Décrire l'état et la tendance de l'information et des observations sur les facteurs économiques et naturels qui ont influés sur les sociétés et les carrières géoscientifiques au Canada au cours des 10 dernières années;
- Projeter les changements à venir tant pour les personnes que pour les organismes où elles travaillent;
- Attiser l'aide aux sociétés géoscientifiques de la part des géoscientifiques et de leurs employeurs; et
- Promouvoir la répétition de la coopération entre les associations géoscientifiques canadiennes et étrangères.

INTRODUCTION
I am honoured to deliver this address to the GeoCanada 2010 conference. I want to congratulate the organising committee of GeoCanada 2010. They offered an outstanding program that attracted more than 900 oral presentations and posters covering a broad range of geoscience topics. It is a great privilege for the Geological Association of Canada to have co-hosted this event with the Canadian Society of Petroleum Geologists (CSPG), the Canadian Society of Exploration Geophysicists (CSEG), the Canadian Well Logging Society (CWLS), the Canadian chapter of the International Association of Hydrogeologists (IAH), and with our long-time partner, the Mineralogical Association of Canada (MAC). The GeoCanada 2010 organising committee has worked very hard and successfully, with outstanding professional conference staff support and numerous volunteers.

Is geoscience still at the frontier of science? Charting new territory through Canadian geoscience may sound like old news to earth scientists. After all, Canadian geoscientists have been at it for close to 168 years now, and through this time, have joined forces with atmospheric and ocean scientists to explore and understand ever further our physical world and its ramifications in the life sciences. We all know how important geoscience has been for the development of Canada, so we would be remiss not to reflect on events and trends of the last decade and their impact on geoscience on the eve of this second decade of the new millennium.

What an amazing adventure it has been! The Canadian geoscience community of the 21st century is a large community that is rich and diverse, one that touches many if not most key aspects of the Canadian economy and society, and that continues to play a premier role in asserting national sovereignty over northern Canadian frontier lands.

GAC: SOME BASICS
Founded in 1947 in Toronto, the Geological Association of Canada has effectively become Canada's national geological academy over the past 63 years. The association counts over

1500 members, who represent in roughly equal proportions the four main categories of geoscience: industry, academia, government, and self-employed. The GAC Mission, as stated on our web site [http://www.gac.ca] is

> *"to facilitate the scientific well-being and professional development of its members, the learned discussion of geoscience in Canada, and the advancement, dissemination and wise use of geoscience in public, professional and academic life".*

The GAC has four core areas of activities or programs. These consists of a science program, an outreach/student career-retention program, a support program for a federation of 13 geoscience sections (discipline-based) and 6 divisions (region-based), and a career recognition program for outstanding geoscientists – a means of providing awards to Canadian geoscientists in honour of worthy scientific and volunteer/service achievements.

THE VIEW AHEAD

Over the past 30 years, GAC memberships and revenue from publications and meetings, the key areas of our business, have declined. It has been a gradual decline that has been slowed at times through special efforts, but has remained a disturbing trend for many past GAC executives to confront. This slow decline is not unique and is encountered in other Canadian geoscience societies (Canadian Federation of Earth Science round table, May 2010). The trend is also found in other scientific societies in Canada. The Canadian Mathematics Society (2009), which has many similar types of programs and activities as GAC, recently reported financial difficulties linked to loss of publication and investment revenues. The Canadian Association of Physicists, presumably facing membership challenges, has established 5-year memberships and a 30 percent reduction in their membership fees when they are also members of the Chemical Institute of Canada or the Canadian Organisation of Medical Physicists.

All of these natural science societies share a relatively healthy level of dynamism and member enthusiasm, and offer annual conferences, newsletters, publications and awards – the key member services of all such societies. Are these membership difficulties the symptom of changing conditions, and an indication that geoscience and other science societies need to adapt in order to practice in a changing world?

Our science societies, as volunteer-based organisations, face problems similar to those of other organisations that are struggling to keep up with changing times and that we all have come to take for granted. Other volunteer-based societies (e.g. Scouts Canada 2009) have noted culture gaps with youth who tend not to volunteer as much as their elders, and must deal with the impact of the worldwide web, demographic trends, turnover in volunteers and a resulting difficulty in transferring knowledge, competition with other organisations, and an apparent lack of organisational capacity for change. Although these observations appear to apply to many science societies, we can also ask whether there is some other profound reason for a decline in memberships, and lack of interest in geoscience society activities – perhaps a decline in the relevance of science in this country, or an overall related decline in the pool of interested scientists, be they younger or older practitioners? As the following section will demonstrate, there is little evidence of a decline in the relevance of our science or in the number of professional geoscientists in this country.

CHARTING NEW TERRITORY IN THE 21st CENTURY

Three lines of reasoning may help GAC and other Canadian geoscience societies 'Chart New Territory in the 21st Century', and, therefore, better serve the world.

1. First, some key statistics, trends, and observations will be reviewed regarding the state of our geoscience community through the last decade, 2000–2010.
2. Second, some reflections are presented on key trends that have been shaping the practice of geoscience in this country over the last 10 years; and
3. Finally, suggestions are offered on where we need to go as a geoscience community and what the continued role of the Geological Association of Canada might be.

Perhaps for a number of readers, few of these findings will be new. However, taken together, these elements could provide something of a general stimulus for geoscientists to band together and lead geoscience societies in new directions, thereby advancing geoscience for our society and the challenged world of the 21st century.

SOME KEY STATISTICS, TRENDS AND OBSERVATIONS

In Canada, the largest employment sector for geoscientists is industry (petroleum, mining or environment), as staff to private societies, or as self-employed individuals in many communities and cities across the country. Alberta has the largest group of geoscientists, as testified by CSPG, CSEG and CWLS memberships and by its large number of geoscience professional registrants. Other Canadian geoscientists practice at universities, government surveys and, to a smaller extent, in other areas of business.

As of 2008, according to the Canadian Federation of Earth Scientists (CFES), our Earth Science community numbers approximately 20 000 people (CFES 2010).

A Canadian Council of Academies (2006) study, which included an opinion survey of senior people considered to be well informed on the state of science and technology in Canada, found that earth science research was among the very few fields where respondents believed that Canada has its greatest scientific advantage. It also found that this is considered to be an economic advantage for natural resource development.

Canadian Geoscience Societies and Associations by Membership

Geoscience societies form a fairly important group of natural science societies, which cumulatively count over 10 000 members. The GAC is the third largest geoscience society in Canada, following the Canadian Society of Petroleum Geologists and the Canadian Society of Exploration Geophysicists (Fig. 1).

There are seven Canadian geoscience societies that count at least 500 members each (Fig. 1), but there are many others of smaller size that share various levels of affiliation. Each geoscience society, whatever its specific

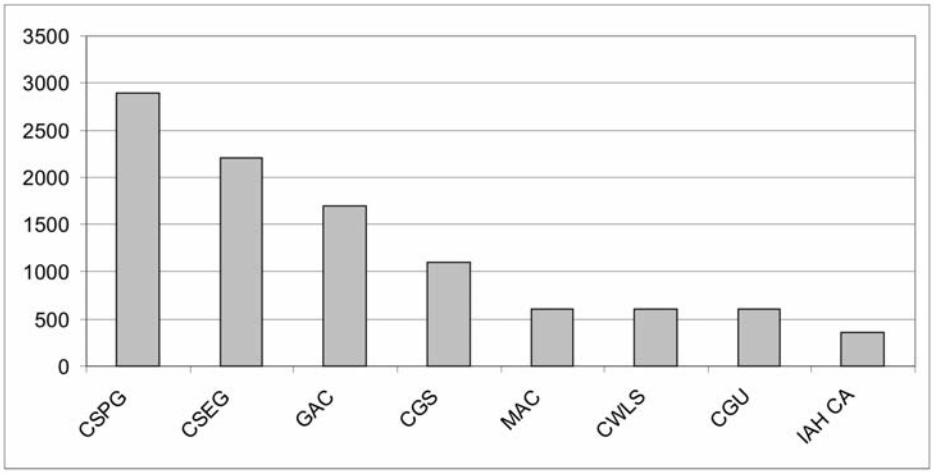

Figure 1. Geoscience society membership in Canada, 2008 reporting year (source: geoscience society websites). CSPG: Canadian Society of Petroleum Geologists; CSEG: Canadian Society of Exploration Geophysicists; CGS: Canadian Geotechnical Society; MAC: Mineralogical Association of Canada; CWLS: Canadian Well Logging Society; CGU: Canadian Geophysical Union; IAH CA: International Association of Hydrogeologists – Canadian Chapter

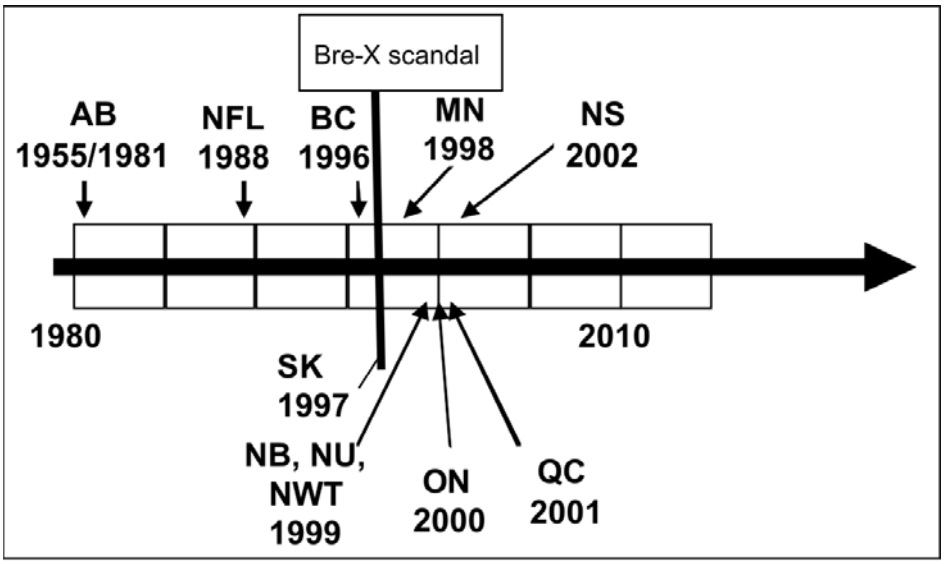

Figure 2. Timeline of establishment of Acts governing the practice of professional geoscience in Canadian provinces and territories.

area of interest, has as its primary mission the advancement of geoscience technical knowledge; however, regionalisms play a strong role in the strength of membership. Hence, CSPG and CSEG have historically drawn the majority of their members from the strong Calgary-based petroleum-related geoscience community.

Further, two other types of geoscience-related associations are present in Canada.

First, associations that represent the interests of industry, such as the Prospectors and Developers Association of Canada or the BC Chamber of Mines, count a large number of geoscientists as members. Although it is not their primary goal, over the years these associations have come to compete with Canadian geoscience societies in the organisation of conferences, workshops and other activities that mix geoscience, other technical presentations, and industry advocacy.

Second, provincial and territorial professional registration/membership, is now an obligation for anyone who offers professional geoscience services. The core mandate of professional associations is to protect the public interest and maintain a sound and regulated professional registration process, but they also present geoscience career awards, enforce rigorous technical standards, and advocate geoscientific careers. As a result of major growth over the last ten years, about 50% of all Canadian geoscientists, a minimum of 10 000 people, are registered geoscientists or members-in-training.

Professional Registration

The spread of professional registration in Canada to most jurisdictions by 2001 (Fig. 2) is one of the great events that shaped the practice of geoscience in Canada over the last decade. This growth in geoscience-related legislation followed the early model of Alberta, Newfoundland and Labrador, and British Columbia, and was spurred by the 1996 Bre-X mining scandal. Within a short period thereafter, most provinces and territories adopted professional geoscientist legislation and established or strengthened related professional associations to ensure appropriate licensing, review of qualifications against standards, and review mechanisms to protect the public against misconduct or misappropriation of the title of professional geoscientist.

Professional registration has steadily increased over the last decade (Fig. 3). According to our review of the annual reports of the ten provincial and territorial licensing bodies that regulate the practice of geoscience in Canada, in 2008 close to 9000 geoscientists were registered, plus roughly 1450 members-in-training. With few exceptions, the 2007 to 2008 growth of licensed professional geoscientists varied among jurisdictions from 2 to 6%; the growth rate was highest in Québec, at 11%.

Geoscience University Enrolment

Most geoscientists are familiar with the fact that student enrolment is highly dependent on career opportunities in the job market. The Council of Chairs of Canadian Earth Science Departments (CCCESD 2010), which now represents 31 universities, has been

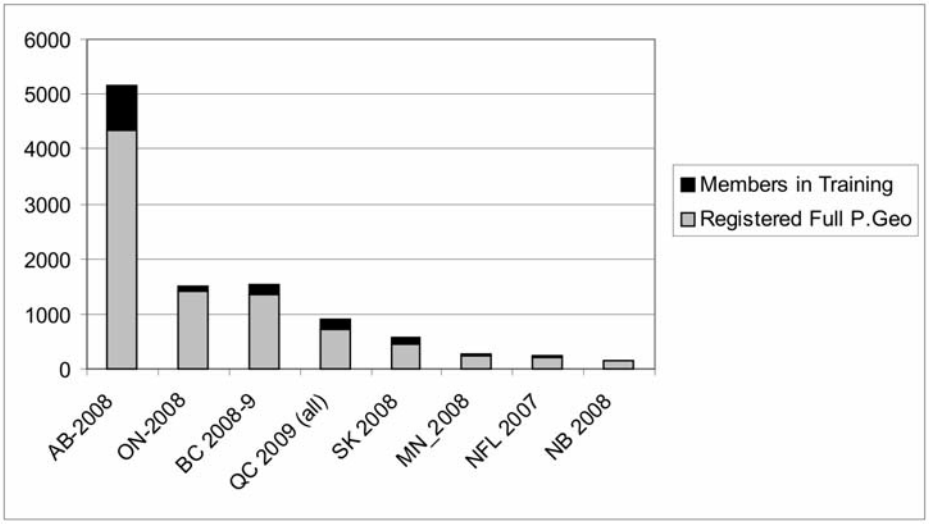

Figure 3. Survey of the number of registered geoscientists (P. Geo., P.Geol., and P. Geoph.), and 'members-in-training' in various Canadian jurisdictions as reported in recent annual reports (report years vary from 2007 to 2008). Excluded are Nova Scotia, Nunavut and Northwest Territories (no report). Prince Edward Island and Yukon do not have professional registration legislation. The total of fully registered geoscientists for 2008 was 8888 for this survey, plus more than 1453 members-in-training.

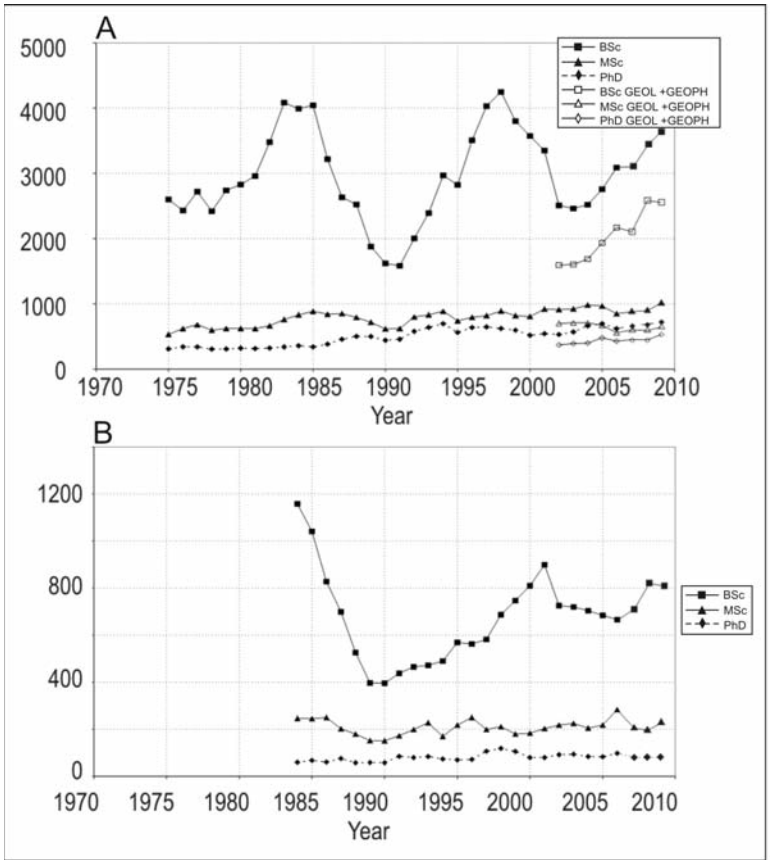

Figure 4. A. Number of geoscience program registrants at the B.Sc. (>year 1), M.Sc. and Ph.D. levels, 1975-2009; **B.** number of graduated students as compiled by the Council of Chairs of Canadian Earth Science Departments (CCCESD; [http://cccesd.acadiau.ca/rep2009.html]). Reproduced with permission from CCCESD.

acutely aware of this and has tracked enrolment and graduation for over 30 years (Fig. 4).

Over the last three decades there have been two enrolment peaks, in 1983 and 1997, and two enrolment troughs, centred on 1990 and 2003. From 2003 onward, student enrolment and graduation increased steadily until 2009. In each of these cycles there was a strong relationship between general economic conditions and student interest in pursuing careers in earth science.

Strong economic conditions, shortages of geoscientists, and consequent good starting salaries for geoscientists in the mid-2000s may have generated the latest up-cycle, at least until recently. An additional factor contributing to positive growth in enrolment is that over the last two decades, many geoscience departments have broadened their scope of teaching and research to include environmental science (or else merged with environmental-related departments) in response to the interests of young people and the public. It is too early to tell if the latest economic downturn of 2008–2009 will have any lasting impact on enrolment and job prospects in the mineral and petroleum industries, but one thing is apparent: when a downward cycle of enrolment is started, it seems very difficult to reverse.

Geoscience Faculty Trends

The CCCESD also compiles very interesting data on faculty and other earth science department employment. After a high point of nearly 600 faculty positions in 1993, these numbers declined until the year 2000, at which time they began to grow again to reclaim a total of nearly 600 faculty members, a remarkable 20% growth over ten years. Post-doctoral fellows (PDF) in geoscience have also grown steadily in number, an indication of an equally remarkable transition, namely that there is now one PDF for every two faculty members and every two Ph.D. students enrolled in Canada.

Geoscience is a varied scientific discipline. The Natural Sciences and Engineering Research Council of Canada (NSERC) received more than 200 applications for grants in 2009 for the 2010 funding year, as part of the normal five-year renewal cycle that

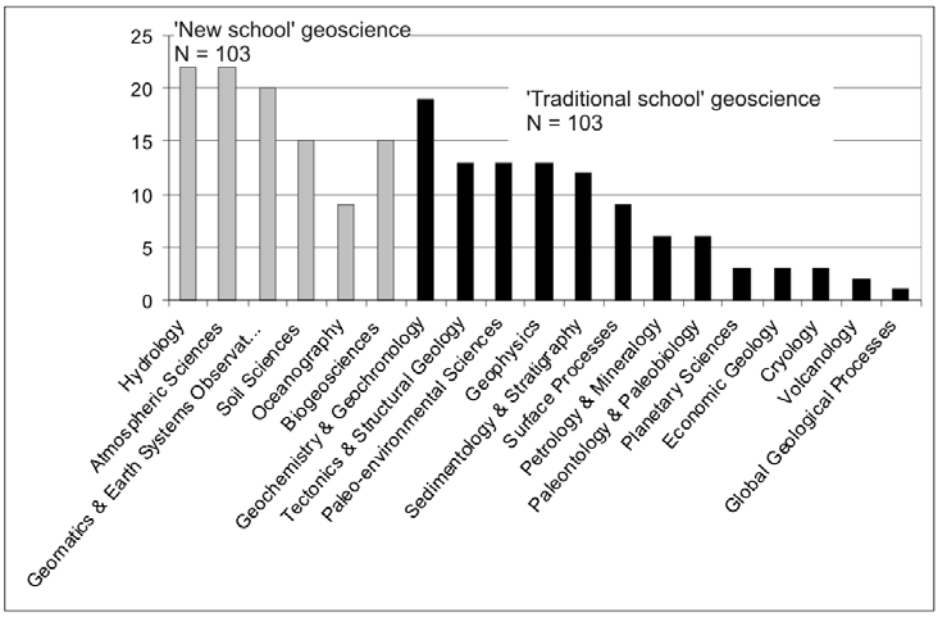

Figure 5. Grant applications by geoscience discipline for the 2010 NSERC round. The fields represented and the number of grants per field are only a sample of the overall scope of NSERC geoscience grants, which are usually renewed for individuals on a five-year basis. The division between 'new' and 'traditional' schools of geoscience is by the author. Source: NSERC 2009.

Canadian university researchers usually go through (Fig. 5). Although half of these Discovery Grant research applications relate to the more traditional aspects of earth science, namely geology, geochemistry, geochronology and geophysics, the other half relates to the environmental geosciences, including soil, water, surveying, space, ocean, weather and climate sciences. Although classified under the NSERC 'geoscience' grouping, the grant applicants do not necessarily only come from geoscience departments; many academic or disciplinary solitudes remain within the broad field of earth science but are not attached to 'traditional' schools or disciplines.

Are Canadian Geoscience Societies 'Species at Risk'?

What should we read from all of the above statistics and facts as it relates to the future of Canadian geoscience societies?

Although fundamentally different, the three types of associations listed above (geoscientific societies, industry associations and professional associations) are effectively competing with one another for geoscientist membership (or licensing fees) and attention. In such a competition, geoscientific societies could become 'species at risk', if individuals, governments and corporate sponsors do not favour beneficial 'habitat' conditions. Because these societies are volunteer-based, non-regulatory, non-obligatory associations, we can easily lose track of them in the business environment that exists today for individual professionals and in light of busy lifestyles. Therefore, the willingness of employers to provide sufficient time, encouragement and recognition to employees who participate in scientific societies is critical. Employers need to recognize that support to geoscience societies will increasingly be a critical success factor for their business, will help attract and retain talent, and will support professional networking, training and career development. If this is secured, the future of geoscientific societies will be secured and they will continue to provide their traditional benefits and services to all of the community.

There are a number of advantages and a certain level of resiliency built into the present system of geoscience associations in Canada; i.e. associations that serve different interests. Because all these groups certainly share a common interest in advancing geoscience, the current diversity of associations and meeting venues presents some challenges, and increases the risk of overlap and duplication of efforts. To address these challenges and reduce these risks, the Canadian Federation of Earth Science (CFES) was created in 2006 as a successor to the former Canadian Geoscience Council (CGC), with the goal of uniting our various societies, professional and industry associations around common issues, to provide a unified voice for earth science in Canada, and raise awareness of the importance of earth science in Canadians' daily lives. The GAC is one of the founding members of CFES.

For CFES and its constituent members, the key challenge lying ahead will be to focus their efforts on areas of common interest, such as ensuring that a steady and sufficient group of professional geoscientists come out of universities or immigrate to Canada, that appropriately high-standard training is available, and that society benefits from the advancement and sound use of geoscience. In this context, CFES, GAC and all geoscience associations will have to continuously scan the evolving economic and societal landscape that surrounds them, find the appropriate 'niches' in the crowded habitat, and maintain a balanced, healthy 'ecosystem' relationship where commensalism (two-way, where one benefits without hurting the other) or mutualism (both benefit) are the rule. Business people would call this 'market segmentation', 'synergies', 'partnerships' and 'cooperation'. Scanning the landscape for more fundamental and difficult-to-perceive trends and changes will be just as important. Let us examine some of the more important trends of the last ten years.

KEY TRENDS IN SHAPING GEOSCIENCE IN CANADA OVER THE PAST TEN YEARS

It would be a difficult list to draw, and a very contentious one I am sure, to compile the top ten Canadian geoscience achievements of the last decade. So I will venture instead to pick a 'top 10' list of drivers and trends that impacted Canadian geoscience over the last decade. In the context of these drivers and trends, I will briefly explore key events and

forces, which are still at play in many cases, that are impacting Canada, its territory, its economy, its environment and society, through the advancement of geoscience research and knowledge and the efforts of our geoscience community. I see these as the 'top ten' drivers that shaped Canadian geoscience through the first decade of the 21st century, and in all likelihood, for most of the coming decade.

1. Renewed Race for Minerals and Energy on the Canadian Frontier

We live in a resource-hungry world, where the dominant global model of development requires economic growth, fed every year by more minerals and more energy resources. We all know that these resources are not boundless, although opinions diverge, for example, on when we will hit peak world oil production. To date in Canada, we have not reached any peak in the general production of energy resources and there are, so far, few immediate signs that we may be hitting a production wall. However, the GDP value of metal mining production has declined from $4.6B in 2000 to $3.8B in 2008, and several alarm bells have sounded about the decline of Canadian mineral reserves and the need for geoscience mapping and exploration (Mining Association of Canada 2009; Lydon 2005). This decline in metal production has been compensated by an increase in the value of metal manufacturing from 2000 to 2008, and by other non-metal production increases such as diamonds.

Readily available government and industry statistics show that Canada has benefitted from demand for our natural resources from clients in the USA and abroad. In 2008, Alberta exported 1.51 million barrels per day (bbl/d) of crude oil to the USA, supplying 15% of US crude oil imports, or 8% of US oil demand. Altogether, Canadian oil production increased from 2000 to 2008 by 25%, to 2.7 m bbl/day, largely because of increased output of crude bitumen from the oil sands projects. This amounts to more than $75B per year, or 6% of Canada's GDP, in oil production alone. CAPP, the Canadian Association of Petroleum Producers (2010), recently forecast that overall oil production could reach 4.3 m bbl/day by 2025, with close to 3 m bbl/day coming from oil sands alone by 2020.

We presently account for more than 3% of global oil production, and we are using a good deal of it domestically. But oil is not our only natural resource of high economic value. Natural gas production is changing rapidly with the development of shale gas in this country and in the USA. What many thought was a rapidly depleting resource is now seen by some as crucial to the reduction of greenhouse gas emissions in North America over the next 100 years, as natural gas continues to replace coal in electricity generation.

In terms of minerals for this resource-hungry world, Canada continues to be the world's leader in the production (by volume) of potash and uranium, and it ranks in the top five in production of cobalt, gypsum, molybdenum, nickel, platinum group metals, salt, titanium concentrates, tungsten and zinc, according to Natural Resources Canada's latest statistics.

For most of the last decade, Canada has been the top world destination for mineral exploration dollars, with 19% of the world's exploration budgets. Some $2.8B was spent on exploration in Canada in 2007 alone. This demonstrates that a lot of geoscience activity has taken place, activity that has grown in demand throughout the last decade. And many of the demands for geoscience activity and knowledge have been varied and new.

From a standing start in the 1990s, Canada's diamond exploration and production has ramped up to account currently for approximately 17.7% of world diamond production, worth over $2B in 2008. We now have five active mines and four deposits that are likely to be mined soon.

It has taken a lot of geoscience to get to this point. Till sampling campaigns, advances in diamond indicator mineralogy, and understanding of glacial dispersion patterns are all factors that have led to the high level of success that Canada now enjoys in the gem diamond market.

But diamonds are only part of the story in the renewed race for minerals and energy that is playing out in the Canadian frontier. Nearly a billion dollars was spent on gold exploration alone in 2009!

What does this mean for geoscientists? Many of the exploration and development success stories can be attributed to the tenacity and dynamism of junior companies that often have a geologist at, or very close, to the helm. Overseeing every drilling rig looking for a mine or a gas discovery, ahead of and after every seismic survey, there is a geoscientist at work, shaping the next stage of the mineral industry. We still have a lot of buried treasures, but they will come at a higher price, with more effort, more geoscience technology, more clever people and ideas. This is truly frontier work: deeper, farther, and, by definition, where no-one has gone before.

2. Greed and Fear: Stock Market Swings and Economic Cycles

Finding new mines and new oil and gas deposits has been a roller coaster experience for exploration companies and geoscientists – even more so since 2000 than in the previous decade.

Toronto is the world's leading city for mining finance and the Toronto Stock Exchange (TSE) handles about 80% of mining equity transactions. Whatever affects commodity prices worldwide also impacts the mood of investors in Canada and the USA. And as we know, the mood has swung wildly from fear to greed and back over the last decade. After a low point through the early 2000s, oil prices rose steadily until the summer of 2008, when they collapsed to US$40 a barrel from a peak of US$140 only weeks before. Although gold prices have increased steadily through the last decade, it has been a wild roller coaster ride for base metals, as typified by copper prices (Fig. 6), which have gone through 3 dramatic downswings, the largest following the same stock market collapse that also impacted oil prices so dramatically in 2008–2009. Now, most commodity prices have rebounded, and oil is selling at US$70–$80 per barrel as of this writing. It seems that resource exploration companies will have to continue to adapt to schizophrenic markets, where greed and fear will coexist and will continue to complicate efforts to borrow from banks or raise capital from the stock market.

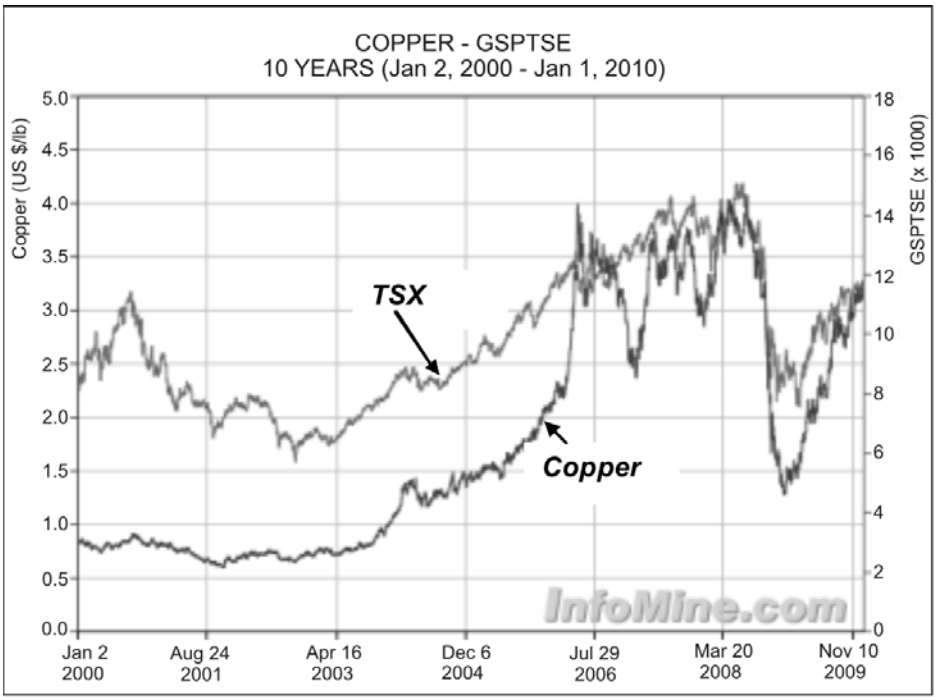

Figure 6. Base-metal commodity price swings through the 2000s, as represented by copper, in comparison to the Toronto stock exchange index (TSX source: infomine.com).

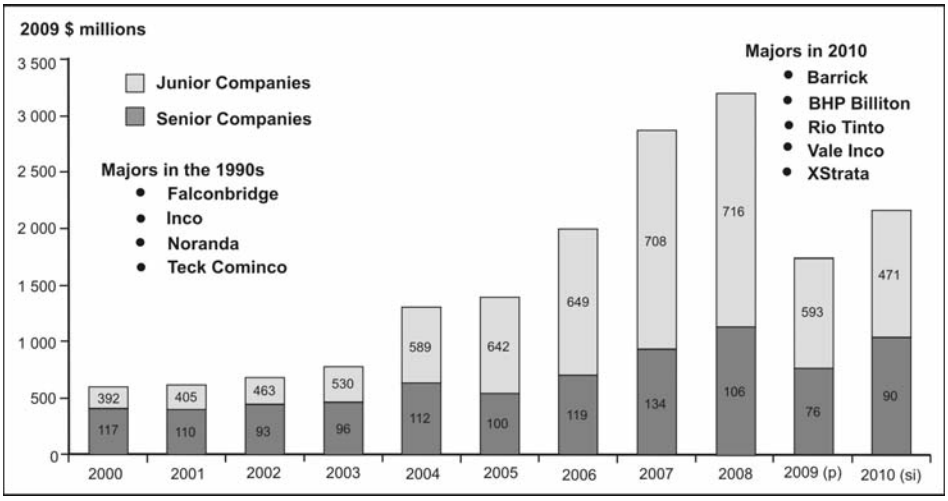

Figure 7. Changes in major and junior mining company exploration spending in Canada, 2000 to 2010. p: preliminary estimates; si: spending intentions. Spending includes field work, overhead, engineering, economic and pre- or production feasibility studies, environment, and land access costs for on-mine-site and off-mine-site activities. Source: Natural Resources Canada (2010), from the federal/provincial/territorial survey of Mineral Exploration, Deposit Appraisal and Mine Complex Development Expenditures.

It is no small wonder that in such an atmosphere it is hard to maintain a steady workforce, or to attract young potential geoscientists to universities! It has also been increasingly difficult to find volunteers for our associations. Perhaps we should ask ourselves, "How can we obtain more corporate support to develop stronger geoscience societies?" Surely, this could prove to be a reliable asset through the ups and downs of the economy.

3. Resource Exploration Industry: Globalisation and the Surge of Junior Companies

A third major force shaping the career of geoscientists, and impacting GAC, is the major changes that have occurred in the structure and direction of the mining exploration industry.

Let us start by going back to the year 2000. Remember when major and long-standing industry fixtures of mining in Canada included Noranda, Falconbridge, Inco and Teck-Cominco? All but one of these, Teck-Cominco, have been bought by foreign interests since then (Fig. 7). The consolidation and globalisation of the Canadian mining and petroleum industry has been driven by relentless market forces: a commodity price rollercoaster since 2005, increasing development costs, tight credit markets, talent and equipment shortages, volatile regulatory or permitting regimes, staking rushes for the best land, benefits of scaling up, corporate sustainable responsibility and energy costs.

Junior mining companies have been surging in Canada from 2005 onward (Mining Association of Canada, 2009). For most of the late 2000s, they were outspending the major companies and also exploring internationally (Fig. 7). How can we develop a stronger partnership with these international companies to better support junior companies in Canada?

4. Climate Change and Other Global Environmental Concerns

There is an increasingly pressing need for an understanding of, and adaptation to, climatic changes that may affect the landscape and the way we live. Climate change mitigation and the concerns over oil reserves and security, have led most G20 countries to adopt new domestic climate change or energy policies that now encourage major reductions in their consumption of fossil fuel to reduce carbon emissions and build on policies enacted previously to reduce domestic dependence to foreign oil. These policies generally include an aggressive shift to renewable and low-carbon energy resources through tax and regulatory incentives, and government subsidies. In Canada, this has led to two new major trends; each have elements of resource explo-

ration and environmental risk reduction through geoscience:

1. An increased interest for uranium as fuel for the large number of nuclear reactors being built worldwide; and
2. Carbon capture and sequestration (chiefly in western Canada).

In addition, there is an emergent renewed interest in developing geothermal energy that might accelerate in the next decade, as it has elsewhere in the world, given Canada's notional resource potential (Lebel 2009).

Global population and environmental pressures also have direct and indirect impacts on the practice of geoscience. Mine tailings ponds, mining wastes and other visible consequences of mineral development, require risk assessment and the development of mitigation strategies. As a direct consequence of past environmental damage (e.g. industrial, military, etc.) and the resulting economic and environmental costs that have increased public scrutiny over time, more rigorous environmental assessments processes have been implemented.. Most such assessments for major projects now evaluate the impact of the development on air, water and land and require a thorough risk assessment through various measures of geoscience: aquifers and their vulnerability to anthropogenic contaminants, natural geochemical contaminant mobility (e.g. mercury), seismic vulnerability, permafrost stability, land subsidence, etc. The recent Gulf of Mexico deep offshore oil well blow-out has yet again demonstrated the inherent risks of oil and gas exploration and the importance of mitigating such risks through appropriate engineering and geoscience.

A 2008 survey by CFES has shown that major geoscience employers predict a five-year increase of some 30% in environmental geoscientist positions by 2013. This implies that expertise and interests in the geo-environmental area will continue to grow, supporting regulatory and other concerns, as well as contributing to sound decision-making and an increase in public understanding of environmental changes and hazards.

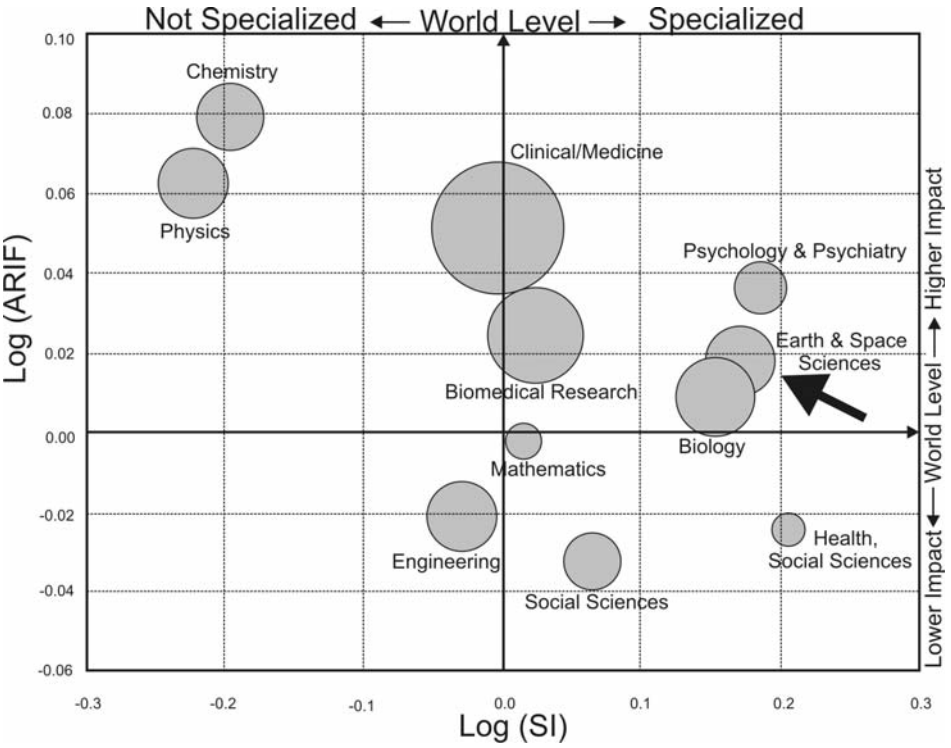

Figure 8. Position of Canadian earth and space sciences in terms of the impact of scientific research publications, 1997-2005. SI: Specialisation Index; ARIF: Average Radiative Impact Factor. Source: Canadian Council of Academies (2006).

5. Globalisation of Science

It is not just mining that has become a global enterprise. More than ever, science is conducted on the global scene, posing a challenge to national associations such as GAC. Canadian geoscientists have participated in several global earth science programs in the last decade, e.g. the International Year of Planet Earth (2009) and the International Polar Year (2008–2009). These Canadians have been important contributors in the preparation of reports for international bodies such as the Intergovernmental Panel on Climate Change.

The Organisation for Economic Cooperation and Development (OECD) has shown that Canada stands at number four on a list of nations active in international scientific cooperation, with nearly 45% of its science papers being internationally co-authored. In Canada and worldwide, single-authored papers are gradually decreasing in numbers, as opposed to the rapid global increase in internationally co-authored papers, particularly since 2005 (OECD 2009).

In 2006, in assessing science and technology in Canada, the Council of Canadian Academies emphasised that earth and space sciences are fields in which Canada excels in terms of both publication quality and intensity, and that these publications have a high impact coefficient (Fig. 8).

6. Government Program Reviews and Priority Setting

Since 2007, more than C$30M in federal funding has been directed toward geological and bathymetric mapping of the Arctic continental shelf. In addition, $100M more over five years (2008 – 2013) was announced for the new 'Geo-mapping for Energy and Minerals' (GEM) program, which can be considered an extension of the original mandate of the Geological Survey of Canada, as undertaken by Sir William Logan, more than 160 years ago. This five-year campaign is intended to complete broad-scale geological mapping of northern Canada, and renewed mapping will help establish the mineral and energy potential of this vast region to a level sufficient to orient future exploration and support northern economic development. The GEM program is an important event, marking a departure from past trends toward

decreased geological survey funding, that followed an intense period of downsizing in the 1990s, when federal and provincial geoscience surveys' operational funding decreased by more than 40% to about $100M by 1997 and did not stabilise until 2007. Other provincial and territorial geoscience initiatives have ramped up over the last 5 years, although it is still a far cry from the rich period of the late 1970s and 1980s when provincial and federal surveys expanded their activities across Canada to support regional development. It appears that national sovereignty interests and regional development of northern frontier areas have been the impetus for the latest renewed investments.

Geoscience mapping investments compete effectively when measured against other policy priorities in governmental agendas. In the challenging fiscal times of today and tomorrow, geoscience spending has remained up to now at the top of the federal priorities, as shown by the renewal of the Targeted Geoscience Initiative (TGI) program for two more years (2010 Federal Budget, Canada)

7. Onshore and Offshore Land Claims

It is clear that asserting national sovereignty through geoscience will remain a priority for some time to come in Canada. But asserting sovereignty is much more complicated when there are a number of competing domestic land claims involving First Nations. Land claims, including the desire of First Nations to obtain a larger share of development returns than in the past, and to see the development done in an environmentally sound manner, will continue to be factors impacting the conduct of geoscience for many years to come.

In addition, commitments by the Canadian and provincial governments to protect biodiversity will continue to increase the land excluded from mineral and energy resource development, and further complicate the identification of buried resources. Providing sound geoscience advice to government to balance political considerations will continue to be an issue in this country for the foreseeable future.

8. Competition for Students and Workers in Technical, Scientific, and Engineering Fields

Although the competition for people is increasing on the career and research front, Canada continues to be seen as an attractive place to live and work. From 1998 to 2006, the share of Ph.D. foreign students in Canada has increased from 14 to 38% of Ph.D. candidates. A factor in this desirable public perception is that the average salary for entry-level geoscientists has now reached $75 000 in Alberta (APEGGA 2009). Anecdotal evidence gleaned from newspaper articles in 2008 cited comparable salaries in the mining industry before the beginning of the 2008 economic downturn.

9. Public Concern and Liabilities Related to Public Safety

Although 2009 was a relatively quiet year for natural disasters, the 2010 Haitian and Chilean earthquakes as well as the Iceland volcanic eruption and the Pakistan floods are reminders that we cannot be complaisant with Nature – we have to prepare and be ready for these and other potential disasters. Luckily, Canada has escaped earthquake or volcano-induced catastrophes over the last decade, but geoscientists have continued to sound the alarm, and global catastrophes such as the Indonesian tsunami have helped to make these warnings heard. For example:

i. Canada now has a tsunami-warning system on our west and east coasts, comprising tide gauge and seismic monitoring;
ii. Storm surges in Eastern Canada are becoming increasingly frequent but are modelled and actively monitored;
iii. The West Coast readiness for a major earthquake has been enhanced; and,
iv. Natural hazard-risk assessment and monitoring is an intrinsic part of all environmental assessments of major projects (e.g. Mackenzie gas pipeline).

Yet, we can ask, can we be more prepared, reduce more risks to people and infrastructure? Hoping that such disastrous events will not happen is not enough, as world experience demonstrates. Closer to home, the tragic event that occurred immediately prior to GeoCanada 2010, the death of a family of four as a result of instantaneous liquefaction of Leda clay (glacial) deposits in Québec, is precipitating a re-assessment of the distribution of these deposits and their effect on suitability of some areas for development.

10. The Evolving Global Public Information System: What Does it Mean?

The tenth and final point speculates about the nature and influence of the global public information system. It has become ubiquitous since 2000 and has impacted the media and knowledge-industry workers more than we have yet realised. Questions such as these arise:

i. Will electronic social networking dominate or replace future geoscience conferences such as GeoCanada 2010?
ii. How can we, internationally seen as something of a drop in the sea or a wave on the ocean, be visible as a community among the thousands of communities in cyberspace?
iii. Will webcasting and/or YouTube make a conference such as this one more visible? and
iv. Will we be able to sustain geoscience publications as we know them?

Through these and a myriad of other new technologies, will the holistic approaches of earth science make their way to a broader group of thinkers, helping to address the challenges of today and tomorrow?

In the provision of answers to these and other related questions lies part of the future of geoscience societies. Failing to address them will leave us vulnerable and poorly adapted to the present and the future.

SUMMARY

Canadian Geoscience 2000—2010

i. Planet Earth has repeatedly reminded us that humanity cannot control everything; e.g. climate/global change, earthquakes, tsunamis, volcanic eruptions, landslides, global energy shortages, and others;

ii. World population growth and emerging economies drive natural resource development in Canada, within a favorable investment climate, but also face constraints and opportunities through emerging climate change policies that will influence the course of geoscience;
iii. Traditional 'natural resource' geoscience remains at the core of earth science in this country, but environmental geoscience has become equally important in our universities and will continue to increase in importance in Canada and abroad; and
iv. Governments and institutions have ramped up their support for geoscience in Canada through the period 2000–2010, in response to economic, environmental and sovereignty issues.

Five major events are yet to be well understood in relation to future geoscience research:

i. The coming into force of professional geoscientist registration and training in most provinces and territories in Canada as a response to the ethics crisis and geoscientists' lobby of the 1990s;
ii. The globalization of Canadian mining and the related geoscience service industry;
iii. The globalization of science;
iv. The impact of the 2008–2009 economic crisis on geoscientist enrolments and employment; and
v. The continuing fragmentation of the geoscience community into a constellation of geoscience societies, associations, committees, and regionalisms, although e-mail and the world-wide web connects everyone more than ever before.

WHERE DO WE GO FROM HERE?

Advancing Geoscience

In conclusion, my final question will be "Where do we go from here?" Are the past trends a guide to the Geoscience of Canada 2020?

i. Will we be driven by global natural resource industry needs – 'geoscience on steroids'?
ii. Will geoscience yet again find itself in a downward cycle in terms of recruiting students, retaining professionals, and attracting research funding?
iii. Will geoscientists increasingly be in the public eye as resource development competes with environmental and human-health protection requirements?
iv. Will we see continued ethical challenges involving conflicts between resource development and environmental protection, or greed and fear in the economy?

I hope that you will agree with me that geoscience will likely still be a frontier science, shaped on the global anvil of the economy as well as by many societal drivers and events, and that it will continue to be, more than ever, critical to the future of Canada and the world. Exploration models developed in Canada find application abroad, and Canadian geoscience expertise is recognized worldwide as an asset worth acquiring to stay at the leading edge of exploration and responsible development.

In exploring and understanding nature for the benefit of the world, and in the protection of natural biological and physical assets for future generations, lie the challenge for the advancement of geoscience, an ever-moving frontier that will continue to define and shape the boundary between societal interests and nature.

As a community, we have to ask ourselves whether we are preparing the younger generation and presently working geoscientists for the challenges that lie ahead. Is the earth science community providing the necessary geoscientific training and development so that mineral and energy resources can be produced economically and in an environmentally responsible manner?

In the answers to questions like these lies a premier role for learned societies such as the GAC. We need to take on this premier role more effectively and we need to become more internationally relevant in the face of all this change. To succeed, we will need the support of all: industry, academic institutions, professional associations and individual geoscientists. Our *lingua franca* is that of geoscience.

As we look toward the future, we cannot escape asking ourselves whether our children will be safer, happier, and healthier, whether they will have learned to tap renewable resources more completely than at present, and to maintain the delicate environmental balance that sustains life on this planet. Given the factors outlined above, advocates for the earth sciences, which all of us need to be, have never had a stronger case to present!

Canadians, especially Northerners, want to know and anticipate the impact of global change on their way of life, to adapt, and even to take advantage of this change where possible. But geoscience also benefits the economy, helps to protect the environment, and reduces the risk of natural hazards. In doing so, geoscience safeguards the Canadian way of life and societal fabric. Clearly, geoscience is relevant to the 21st Century, perhaps more so than ever, as humanity faces multiple challenges at once.

The potential awaiting us, the joining of forces of all geoscience associations, as in the format of GeoCanada 2010, is enormous. Collectively we need to engage the younger generation. If the past is a measure of the future, we will also need to support them in the ups and downs that they will face in their careers, as well as reach out to the rest of society to demonstrate how relevant geoscience is now and in the future. GAC has always taken a leadership role and will continue to do so. We fully support the newly created Canadian Federation of Earth Science in its mandate to unite and be the voice of all geoscience societies.

I invite you to join the GAC and our other Canadian geoscience societies in facilitating the scientific well-being and professional development of its members, the learned discussion of geoscience in Canada, and the advancement, dissemination and wise use of geoscience in public, professional and academic life. The GAC needs advocates and volunteers to help in this signally important task, and in this GAC needs to build on the strength of its members.

As I complete my term as GAC President, I wish the best to Dr. Stephen Johnston, our incoming president. I hope that you will share your support with mine, and help him to lead our association on the challenging

and exciting path ahead.

May the next decade be good to us all, and may GeoCanada 2010 have planted the seeds for a better future.

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REFERENCES

Association of Professional Engineers, Geologists and Geophysicists of Alberta, 2009, 2009 value of professional services, 74 p., [http://www.apegga.org/pdf/SalarySurvey/VPS2009.pdf.]

Canadian Association of Petroleum Producers, 2010, Crude Oil Forecasts and Market Outlook 2010 (40 p.): [http://www.capp.ca/forecast/Pages/default.aspx#FFS16EPkOGEM]

Canadian Association of Physicists, 2009, Five-year and joint CASCA/CAP memberships coming in 2010: CAP News, v. 9, No. 1, Oct. 2009, p. 1.

Canadian Council of Academies, 2006, The State of Science and Technology in Canada, 227 p., [http://www.scienceadvice.ca/uploads/eng/assessments%20and%20publications%20and%20news%20releases/sandt/complete%20report.pdf]

Canadian Federation of Earth Sciences, 2010, Mission and membership statement:. [http://www.geoscience.ca/index.html]

Canadian Federation of Earth Sciences, 2008, Human resource needs in Earth Sciences in Canada – A preliminary Survey (17 p.): [http://www.geoscience.ca/CFES_HR_requirements_Canadian_earth_sciences.pdf]

Canadian Mathematics Society, 2009, CMS 2009 Annual report (48 p.): [http://cms.math.ca/Reports/annual/2009.pdf]

Council of Chairs of Canadian Earth Science Departments, 2010, Enrolment report for 2009, Accessed May 2010: [http://cccesd.acadiau.ca/rep2009.html]

Lebel, D., (ed.), 2009, Geoscience needs for geothermal energy development in western Canada: Findings and recommendations: British Columbia Ministry of Energy, Mines and Petroleum Resources, Petroleum Geology Open File 2009-03, 18 p. [http://www.empr.gov.bc.ca/OG/oilandgas/GeothermalGeoscience/Pages/default.aspx]

Lydon, J., 2005, An overview of the economic and geological contexts of Canada's major mineral deposit types, *in* Goodfellow, W., *ed.*, Mineral Deposits of Canada: Geological Association of Canada, Mineral Deposits Division, Special Publication 5 (also available on-line at [http://gsc.nrcan.gc.ca/mindep/hist/index_e.php#prrs]).

Mining Association of Canada, 2009, Facts and figures: A report on the state of the Canadian mining industry (43 p.): [http://www.mining.ca/www/media_lib/MAC_Documents/Publications/2009/2009_F_and_F_English.pdf]

Natural Resources Canada, 2010, Canadian Exploration and Deposit Appraisal Expenditures Slump in 2009, Optimism for 2010: Information Bulletin, March 2010. Catalogue no. M31-7/2010E-PDF, [http://www.nrcanrncan.gc.ca/smmmms/pubrpubr/pdf/Exploration10Eweb.pdf]

Natural Science and Engineering Research Council, Presentation to CCCESD, December 2009: [http://cccesd.acadiau.ca/NSERC_notes09.ppt]

Organisation for Economic Cooperation and Development, 2009, International co-operation in science: Chapter 4.3 *in* OECD Science, Technology and Industry Scoreboard 2009, [http://www.oecdilibrary.org/docserver/download/fulltext/9209031ec047.pdf?expires=1278080526&id=0000&accname=freeContent&checksum=FDBE28D2B122E28B7925AB0E4DE4D7E8]

Scouts Canada, 2009, Scouting now: An action plan for Canadian scouting, Version 2 (42 p.): [http://www.scoutingnow.org/] (accessed April 2010).

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