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PRESIDENTIAL ADDRESS

Sustainable Resources for Generations: The Challenges and Some of the Contradictions

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PREAMBLE

The Resources for Generations (RFG) Conference of 2018 was an important new venture for Canada's diverse Earth Sciences and Natural Resources sectors, and I am delighted that GAC played an important role in its development and successful implementation. I am equally delighted to have delivered the Geological Association of Canada's Presidential Address for 2018 at RFG to my colleagues, friends, mentors and hopefully also to future leaders who I have yet to meet. It has been an honour to be GAC's President for the past year and I hope that all who attended the conference had a great experience at this multidisciplinary gathering. When I started working on RFG 2018 with Dr. John Thompson (RFG Chair), he said something that has stuck with me ever since:

> *"I believe conferences like RFG have the potential to fundamentally change how we develop our natural resources."*

I naturally agreed with John quickly on this general point, but as I became more involved in the planning of the conference the more I came to understand what he meant, and the more I believed this vision to be true. As usual, John was a step ahead of me! In this article, based loosely on the verbal address of June 18, 2018, I will try to address an important theme from the conference, i.e. the question of "Resources for Future Generations." This theme speaks not only to the science that we employ today in the Natural Resources sector, but also to the concept of *Sustainability* in its broadest possible context.

We all know the definition of 'Sustainability,' as articulated in the 1987 Brundtland report entitled "Our Common Future:"

> *"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."*

I personally think this is a brilliant definition, but it is not always followed literally. In particular, with all the politics and lobbying that arises around any Natural Resources development, we tend to forget that the approach must include both present needs and anticipated future needs. In this article, I will put forward some perspectives on Sustainability as a principle, and its linkages with Geoscience. These include some things that are obvious and self-evident, but also others that may not come to mind so readily. These perspectives are personal, but they come from much experience with the challenges involved in advancing the responsible development of natural resources, particularly in northern Canada. It is probable that not all involved in this sector will agree fully with some of my opinions, and I acknowledge that some represent rather specific concerns and/or interests, but they are put forward with the intent of generating some debate, which I think all will agree is needed. I will start the article with some divergent views from several GAC Past Presidents, and then focus on the state and sustainability performance of the minerals industry (as it relates to current practices), and conclude with some perspectives on the role of Geoscience in this goal of providing "Resources for Future Generations," while also respecting and preserving our precious natural environments.

ABOUT 'RESOURCES FOR GENERATIONS 2018' – WHAT DID IT INCLUDE?

RFG 2018 was one of the first international conferences in Canada "*dedicated to the availability and delivery of resources to sustain future generations*." (John Thompson, Letter of Invitation from the Chair, RFG 2018 Steering Committee). RFG 2018 had six major themes – Energy, Minerals, Water, Earth, Resources for Society, and Education. These are all critical components for sustaining our current standard of living and for the future well-being of our children. In Canada, we find ourselves in a situation where knowledge, technology, science and engineering are increasingly integrated and capable of providing innovative solutions for sustainable development of our natural resources. However, the importance of public opinion and support is increasingly critical in this objective, and this popular influence on decision makers can have a profound effect on the approval and successful execution of major industrial projects. RFG was an ambitious conference and will hopefully help set a path that will result in the long-term and sustainable development of our natural resources and improve our overall performance as a country. Many of my comments in this article relate to the minerals industry (in the broadest context) as

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most of my own career has been involved in this part of natural resources extraction. However, the general principles apply, at least in part, to all sectors involving non-renewable resources, and some that exploit renewable resources.

Some of the Vision Statements associated with RFG 2018 include:

- Humans will need a range of natural resources, including energy, minerals and water, to survive and prosper for the foreseeable future.
- Humans will increasingly value their environment from global to local scales as they appreciate the impact that environmental degradation has on human lives and other species.
- Research across the full spectrum of Earth Science, and related areas of Engineering and Technology, will play vital roles in advancing understanding and use of natural resources.
- Indigenous people have a unique history and valuable knowledge related to natural resources and the environment that must be understood.
- Listening to different views and seeking understanding will provide a basis for a better future.

These points are highly insightful and speak volumes of where we are as a society in Canada, and they outline the challenges we face as a country in maintaining and further building our natural resources base. The key message is simple: *Nation building is becoming more difficult and more complex*.

CHALLENGES IN NATURAL RESOURCE DEVELOPMENT: THE RELEVANCE OF EARTH SCIENCES

Gone are the days when a minerals company could stake claims, assess the resources and economics of a deposit and then reliably predict when licenses, permits and authorities might be granted for mining development. I know from first-hand experience that in any due diligence evaluation of a mine acquisition proposal, the *permitting risk* (in the broadest context) is one of the greatest factors in determining if a merger or acquisition will or will not proceed. The elevated permitting risk that the minerals industry is experiencing across Canada is one of the most significant issues that the industry is facing in the 21st century, and it has the potential to negatively affect international investment in our country.

I consider myself primarily an Environmental Manager with a geological background. The vast majority of my career has been spent solving problems that arise between Natural Resources development and the environmental, socio-economic and cultural issues that are seen, sometimes automatically, to be in conflict with them. I have found this role to be enormously satisfying over the past 40 years by providing solutions to reconcile seemingly polarized viewpoints. In this context, my background as an Earth Scientist has proved incredibly helpful. I therefore feel that I have some background and experience in these key areas of RFG and strongly feel that the statement John made about the future of Natural Resource development is true; *we need to fundamentally change the approaches that we have inherited from previous generations if we are to meet the needs of future generations*. The second key message is longer than the first, but in essence just as simple: *Sustainability may be achieved by effective collaboration, transparency and information sharing, improved knowledge and clear actions by all involved, working together in an integrated manner*.

During the preparation of this address, I reached out to GAC Past Presidents and other leaders to get some comments around the RFG 2018 theme and how Earth Sciences can contribute to this important subject. The following are some memorable quotes that I would like to pass along for consideration. Please note, I have not included all the material that I received and that at times I have provided some additional thoughts and imposed some 'editorial license.' Nevertheless, the collective wisdom of several Past Presidents was very important for the development of this address, and I offer many thanks to all for their influential thoughts.

- In spite of massive education and information, and the significant influence of social media supporting conservation of resources and sustainable goals, energy and resource consumption is *not* decreasing. Increasing demand means a *continued* need to extract, modify and produce products for consumers and global economies.
- The provision of resources (energy, minerals and water) for the future is one of several critical issues along with climate change, ocean pollution and management of hazards, which are fundamental to human survival and prosperity.
- All of our challenges are underpinned by a knowledge of Earth Science, but most people have a limited appreciation or understanding of the relationships between solving such challenges and the need for scientific understanding.
- Canada is a 'Resource Nation' benefiting from our geology and the extent of our landmass; however, we are also the world's highest per-capita consumers of energy and minerals. Therefore, the contribution that Earth Science can make to discovery, responsible extraction and use of these natural resources is incredibly important.
- Given the Paris Climate Agreement (and background studies), we need to reduce and replace many of the conventional resources that we are currently using; however, this will take time and the approach must be balanced.
- Continued over-population is resulting in massive migration to cities and urban areas, which will put tremendous pressure on local resources such as water and land.
- We need to educate current and future generations about natural resources so that they understand more about the economics and value of these resources, the environmental impact of their extraction, and about the fact that they are not infinite.
- Geoscience plays an increasingly critical role in our society. Whether it is helping to ensure our health, to secure our heritage, to enhance our wealth, or to augment our security, geoscience affects all aspects of our lives. We do this work in the Earth Sciences to protect our water, to cope with our climate, to support construction, to deal with toxic substances, to manage our waste, to prepare for hazards, to

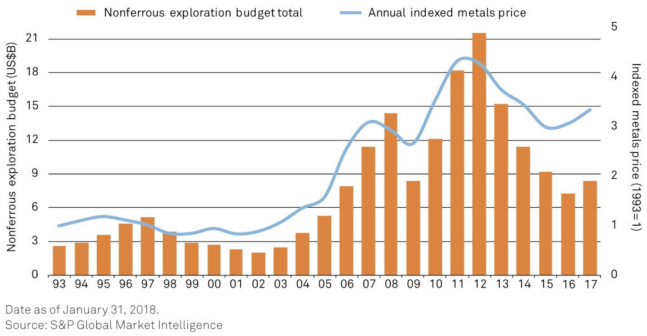

Figure 1. Trends in global exploration spending for nonferrous metals from 1993 to 2017, as compiled by S & P Market Intelligence (2018). Note that the estimates are in dollars of the day, and are not corrected to account for inflation.

ensure our supply of energy and materials, to know and protect our land, to survey and manage our oceans, to understand the history of life, and to comprehend our planet Earth.

- Earth Scientists are best placed to understand the balance among economy, ecology and environment needed to sustain civil society and the natural systems upon which it relies.
- In recent years, the effects of Earth processes, such as earthquakes, landslide, subsidence, and floods, are communicated around the world in a matter of minutes. Society can and should make much better use of our knowledge of Earth's surface makeup and processes to better avoid or minimize natural disaster effects, especially with the dramatic changes associated with the effects of climate change.

So, there we have it. These quotes and thoughts are not attributed to specific individuals, although some appear in previous Presidential Addresses. They have something in common, in that they state that Earth Scientists have a unique training and experience to assess, predict and help manage the sustainable development of our natural resources in the context of environmental management and mitigation of climate change. Some also imply that we have an innate talent for this. But do we?

EXAMPLES OF CHALLENGES IN THE MINERALS RESOURCE SECTOR

It is instructive to review how the development of mineral resources has evolved and changed over the past few decades and to highlight not only the challenges, but also the incredible progress that has been made in Natural Resources development. For a general summary of the state of global mining and exploration, I present here some interesting and instructive charts and statistics extracted from "World Exploration Trends," published by S&P Global Market Intelligence in March 2018 (see Figs. 1 and 2).

- Global spending for the exploration of nonferrous metals increased in 2017 to $ 8.4 billion from $ 7.3 billion (US) in 2016. This is a significant jump of some 15% following a five-year decline and represents the most significant increase in investment since 2013.
- The main focus of exploration has been on gold with some improvements on base metals, although this is not apparent from the general trend shown in Figure 1.
- The prediction for 2018 is that exploration spending will increase by a further 15–20% over the year. However, there continues to be significant market volatility that could have a negative impact on future exploration investment.
- Metal prices continue to trend upward due to an improved global economy and a weaker US dollar.
- Canada and Australia are the global leaders for exploration investment at some 14% each for nonferrous exploration budgets.

These points clearly show a positive global investment trend for minerals exploration, but at the same time producing mining companies appear to be cutting their exploration budgets. Is Canada ready to benefit from this improving global exploration investment market? Are we in a position to maintain a positive investment climate, but at the same time keep sustainability as an important goal of Natural Resource developments?

SCIENCE, ENGINEERING, OUTREACH, AND THE PERMITTING PROCESS

Earlier in this article, I mentioned that I consider myself largely to be an Environmental Manager. In this role, and in varied capacities, I have been involved in the approval and permitting of almost every new mine development across northern Canada over the past 40 years. In my experience, every successful mine approval in northern Canada since the mid-1990s has had the following attributes:

- Rigorous science and engineering has been the core of approvals. Both industry and government (including Assessment Boards) hire consultants to ensure an expert level of review of any mine development proposals. This sometimes leads to 'disagreeing' experts, but it also provides for the development of common ground and solutions for all parties.
- Environmental assessment and regulatory approvals are completely transparent. All stakeholders, First Nations governments and other federal and provincial/territorial governments, as well as the general public, are given the opportunity to fully participate in the process(es). This includes documentation such as "Reasons for Decisions," Public Registries and participation in technical workshops, public meetings, and a fair hearing process. Open communications are maintained throughout the decision-making process. Northern Canada provides a good example where environmental assessment is based on co-management boards that employ a transparent process to drive the review and approval of projects.
- Mineral development proponents are held to account for their environmental and social/cultural performance through a rigorous environmental assessment and regulato-

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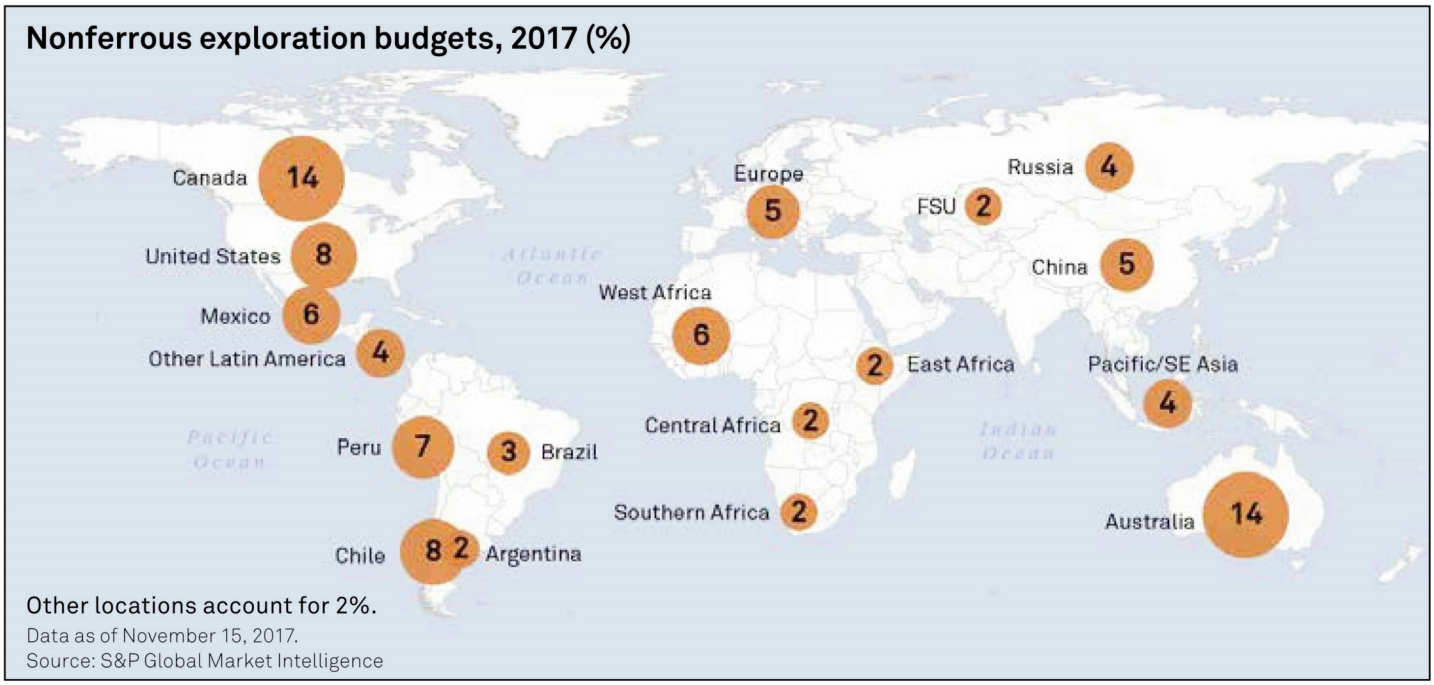

Figure 2. The global distribution of exploration expenditures for nonferrous metals in 2017, as compiled by S & P Market Intelligence (2018).

ry approvals system. For example, a mine development proposal can require over 200 approvals *after* a multi-year environmental assessment process. It is important to note that environmental assessment was at one time limited to a planning process intended to provide guidance for the issuance of licenses and was required only for projects that received federal funding. In today's world, approvals of mine development projects from start to finish (including both environmental assessment and subsequent regulatory approvals) can take at a minimum 3 years, and many require more than 10 years.

The approval process for mining projects does not always end with a positive decision. Also, there have been numerous court actions over the past 20 years that challenged the decisions made during these approval processes, and these litigations have added to investment uncertainty in Canada.

Indigenous issues and concerns have become incredibly important for Canada and the minerals industry has worked very hard to improve their engagement and consultation practices, as well as to develop fundamental partnerships with First Nations communities and their government structures. This has resulted in a mosaic of agreements, such as Cooperation Agreements and Impacts and Benefits Agreements (IBAs) across the country, which start at the exploration stage and then follow right through to production. These types of agreements include training and employment opportunities, environmental monitoring, traditional knowledge studies and protocols, cash payments, capacity building, royalties and others. The map in Figure 3 shows the extent of active agreements across Canada. Although the full details may not be apparent from this summary map, it indicates that this aspect of Natural Resource development is now almost universal.

In summary, Canada has one of the most transparent and rigorous approvals systems in the world for Natural Resources proposals, such as mines, pipelines and hydro projects. Nevertheless, it is clear from observations that this process is far from simple and far from getting simpler. New mining projects are inevitably beset by controversy. This brings us to another key message: *Why is there still so much controversy when new mining projects are proposed, and how can geoscientists help to ensure that discussions and decisions reflect accurate science and not misinformation?*

PERCEPTIONS AND MISPERCEPTIONS IN RESOURCE DEVELOPMENT

When was the last time that the media reported a positive public reaction to a mining project? It simply does not happen. But why is this so?

The approvals process for mining projects has improved dramatically over the past 30 years and the environmental and social performance of the minerals industry has also improved dramatically. The preceding section shows that the current environmental assessment and regulatory approvals process is rigorous, thorough, expensive and, above all, inclusive. Yet there remains a perception out there that Canada cannot make decisions over major projects in a timely and progressive manner. Why is this?

- Perhaps it is generally accepted by the general public that government decisions and their institutions cannot be trusted.
- Perhaps Non-Governmental Organizations (NGOs) have provided such a strong voice to oppose such projects that a larger (but silent) supporting constituency may have no effective voice.

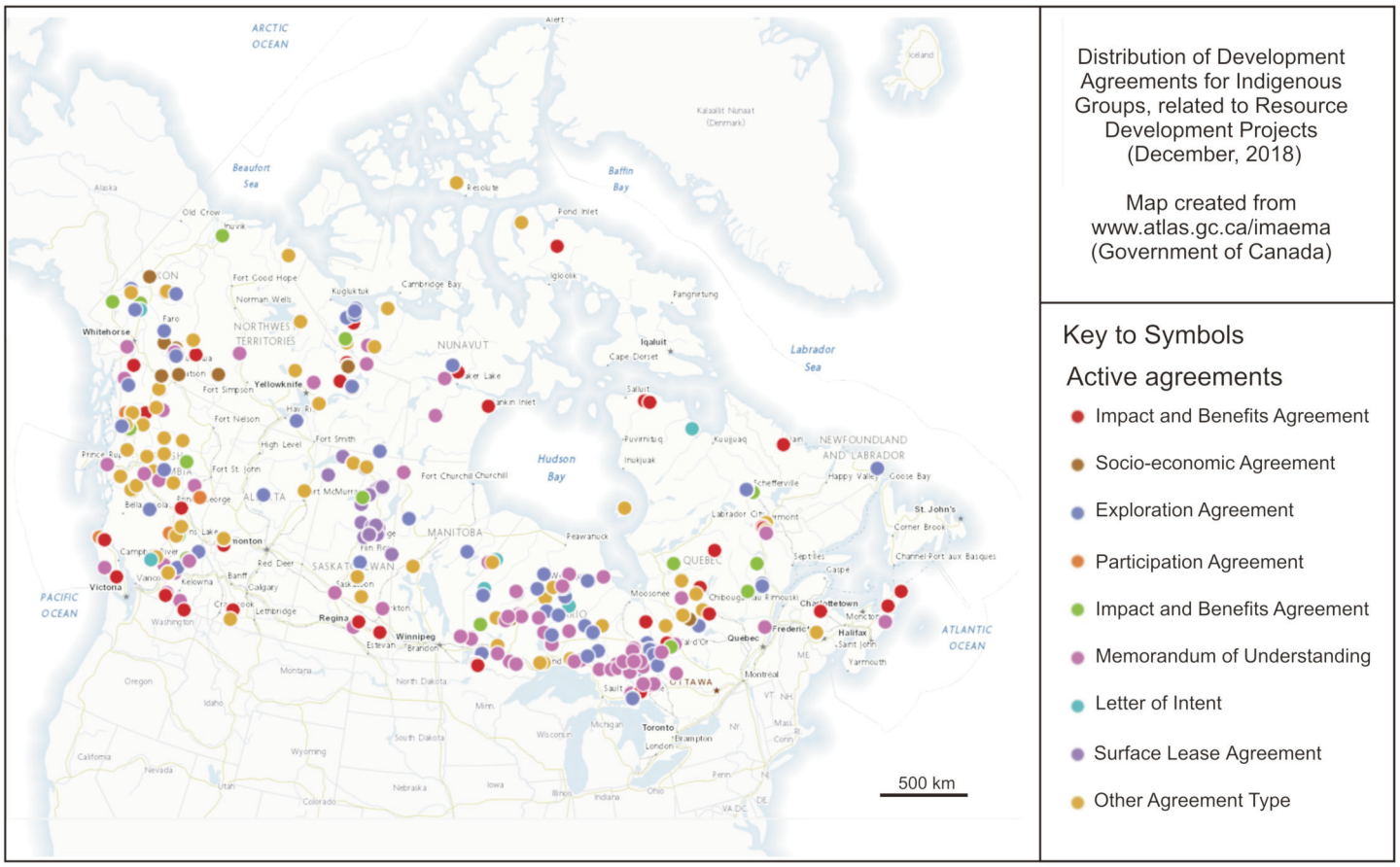

Figure 3. A summary map showing the diverse locations and nature of negotiated agreements with indigenous peoples across Canada; published online by the Government of Canada, Department of Indigenous Affairs and Northern Development (www.aadnc-aandc.ca).

- Perhaps the magnitude of societal benefits, and the rigour associated with the approval and management of modern Natural Resources projects over their life cycle has not been effectively communicated to all stakeholders.
- Perhaps society is simply going through a 'cynical' phase in which little or nothing is believed in the face of so-called 'fake news' and increasing governance through tweets rather than reasoned statements that include explanations.

Whatever the exact reason, we continue to experience challenging times with regard to the public perception of Natural Resources projects. However, I believe that we are well down the road to achieving sustainability due to the improved performance of both government and industry. The example of the minerals industry is instructive, and it leads us to another key message: *It is incredibly difficult to permit any Natural Resources Project in Canada and it should be difficult.*

ADDRESSING THE CHALLENGES – A ROLE FOR GEOSCIENTISTS

Canada is blessed with natural resources that have provided us with economic certainty and comfort, even in times of widespread global recession such as the global financial crisis of 2008–09. We need to keep developing such natural resources in a sustainable and thoughtful manner, and must build our natural resources inventory to meet the demands of the future, including renewable energy sources. We need to be constantly improving our performance in mineral exploration, in responsible Natural Resources development and in the mitigation of the environmental and socioeconomic impacts that accompany such projects. How can Earth Sciences and indeed science in general help with the above challenges?

The following is a great comment provided by former GAC President Stephen Johnston (personal communication, 2018) that I consider most appropriate as a framework for closing this address:

> *"We are continuing to educate and train excellent Earth Scientists. Today's students are going out and doing a better job than ever before of combining traditional 'geological' knowledge with cutting-edge technology in order to find and develop energy, minerals and water resources. But it is no longer enough for Universities to churn out 'geologists' aimed entirely at resource development. We cannot continue to send geologists into industry without them understanding the Earth System and unable to speak to the challenges presented by global warming and our role in climate change. University professors cannot continue to view their role as simply educating the next generation of Earth Scientists. We have to turn our attention to educating not just our students, but also the public at large for society to face up to the challenge of providing*

our children and their children and all future generations with safe and responsible natural resources projects."

I think this says it all. Our youth are charged with the responsibility of not only being great geoscientists in the traditional sense but also the much broader challenge of being stewards of the Earth, and demanding that all Natural Resources development be carried out in a sustainable manner. This will require continued and systematic financial support from government and a 're-thinking' of how we train our Earth Sciences students. Skills such as managing risk, effects assessment, communications, facilitation and mediation and understanding other perspectives through listening will be critical for future government and business leadership.

I also believe that we must do a much better job at integrating geoscience disciplines at the university level to equip our youth for the professional world. For example, there are strong environmental linkages between host-rock mineralogy, surface water and groundwater processes, Quaternary stratigraphy and geochemistry in terms of metal leaching and acid-rock drainage. The latter, commonly abbreviated to ARD, is central to many challenges to mine approvals centred upon their potential impacts beyond extraction sites. A trained geoscientist with a strong grounding on the science and linkages can provide a more reliable prediction of environmental effects to assess this issue, and implement appropriate mitigation and monitoring. This is just one example of how there is a need to connect subjects that are often taught in artificial isolation.

I have always found that my geoscience background gives me a tremendous advantage in managing the environmental assessment process and regulatory approval of mine development proposals. There is perhaps no subject in which so many disciplines connect in unexpected ways, or in which an understanding of time-scales beyond those of humanity are so important. This leads me to a final set of three key messages that cannot and should not be seen in isolation.

- *Integrated Geoscience is required to provide the necessary scientific support for wise decisions with Natural Resources development. Universities and colleges have the responsibility to critically look at themselves and how they train our future geoscience leaders.*
- *Geoscientists have the future challenge of "building our reputation and social license" like our mentors – Logan, Dawson, Fortier and Bostock, to name just a few. They had this in the form of strong support of their expeditions that were so fundamental in building our country.*
- *Geoscience has a strong role within the national dialogue around Natural Resources development, and how this fits into a world struggling with climate change, water shortages, pressures on land usage and maintaining relationships with Indigenous peoples. Geoscience can provide integrated solutions for a wider effort to facilitate the change to renewable energy sources that is needed for the future maintenance of global climates.*

CONCLUSIONS

Amongst the several key messages that I have tried to convey in this article, the following points are perhaps the most important as conclusions.

Firstly, Natural Resources development must keep raising the performance bar to achieve true sustainability over the long term. Secondly, although we are on the right path towards this goal, there remain many clouds on the horizon. Irrational politics in an increasingly polarized world could easily take us off the track of investing wisely and considering the long-term impacts of short-term decisions. This may seem to be a strong statement but I believe it is a real concern, particularly for the western world, and particularly if the consensus of science is ignored. Thirdly, effective communication is required amongst *all* stakeholders to ensure there is a balanced debate about new Natural Resources projects that are so important for the future of Canada. Last, but certainly not least, geoscience and geoscientists have critical roles in providing leadership for the assessment and approval of future Natural Resources projects.

The members of the Geological Association of Canada will be well aware of many of the issues discussed in this address, and many will understand the challenges that societies such as ours face in a world in which demographics, priorities and the nature of careers are changing more rapidly than ever. Organizations such as ours have a critical role to play in addressing many of the challenges noted in this article, and it is very important that they remain (or become) active, healthy, inclusive and especially more youthful. I have enjoyed my year as President of the Geological Association of Canada, and hope to contribute more to it in years to come. There is much room to contribute through us to the wider growth of geoscience in Canada, and it is ever more important to see our discipline as an integrated whole rather than several specialist clans that sometimes compete when we should really cooperate to realize a wider vision of what we do and why it is so important.

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