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Building Bridges through Science: Increased Geoscience Engagement with Canada's Northern Communities

PASCALE GROULX
Office of the Chief Scientist, Natural Resources Canada
pascale.groulx@canada.ca

DONNA KIRKWOOD
Chief Scientist, Natural Resources Canada
donna.kirkwood@canada.ca

DANIEL LEBEL
Geological Survey of Canada, Natural Resources Canada
daniel.lebel@canada.ca

Abstract

A decade ago, data uptake by industry was held as the principal indicator of success of the Geological Survey of Canada's Geo-mapping for Energy and Minerals (GEM) program, an initiative aimed at modernizing geological knowledge of the country's North to spur economic growth. Upon renewal in 2013, the geoscience program evolved its approach for engaging local communities, putting principles of geoethics into practice. This cultural shift has not only enriched the GSC as a whole; but has set an example for other science endeavours in the North. It has nurtured enhanced dialogue and relationships, fostered more sustainable economic growth, and helped position the GSC as a more welcome partner to Northern communities.

1. BACKGROUND

Geoethics is defined in the "Cape Town Statement on Geoethics" as dealing "with the ethical, social and cultural implications of geosciences knowledge, education, research, practice and communication, and with the social role and responsibility of geoscientists in conducting their activities" (Di Capua et al., 2017). In Canada, there are good examples in which geoethics principles are reflected in the geoscience research at the Geological Survey of Canada (GSC), part of the federal government's department of Natural Resources (NRCan).

The GSC is Canada's oldest scientific agency. It was founded in 1842 to help develop a viable Canadian mineral industry. As the country matured, provinces and territories established their own geological surveys to advance resource development allowing the GSC to shift its focus to address broader issues of national relevance. This shift is explicitly defined in the Intergovernmental Geoscience Accord (IGA) where roles, responsibilities and principles of cooperation amongst the surveys were first entrenched in 1996 (Duke, 2010). Under the IGA, the GSC is well positioned to exercise its leadership and convene the country's geosciences to collaborate on nationally important themes. This change also brought the GSC in line with the federal government's expectations that its organizations exercise results-focused leadership by placing increasing emphasis on socio-economic contexts at home and abroad.

Today, the GSC mobilizes science to inform public policy development on issues associated with high social impact such as groundwater,

climate change, natural disasters, and mineral and energy supply (Bobrowsky et al., 2017). This shift, increasingly relevant in all aspects of the GSC's work, is also consistent with the growing international trend to apply geoethical ideas, principles, and practices to scientific research about the earth and its mineral resources and landscapes, as well as to mining and sustainable development (Gill and Bullough, 2017; Nickless, 2017; Nurmi, 2017).

2. A GEOSCIENCES PROGRAM FOR THE CANADIAN NORTH

Canada is a geologically resource-rich nation that covers 9,984,670 km^2, approximately 40% of which in is the North (i.e., Canada's three territories and the northern portions of six provinces). This vast expanse has historically represented a daunting mapping challenge. In fact, before 2008, 60% of Canada's North was not mapped to modern geological standards.

That's when the Government of Canada initiated the Geo-mapping for Energy and Mineral (GEM) program as part of its Northern Strategy - a strategy which included a strong position on advancing Canadian sovereignty in the North and the prioritization of Northern Indigenous engagement.

Launched with an initial investment of $100 million over five years (GEM-1: 2008-2013), GEM was then renewed for seven more years through an additional funding of $100 million in 2013 (GEM-2: 2013-2020). Run by the GSC under the purview of NRCan, the program works to promote and modernize geological knowledge in the North to spur economic benefits. In keeping with the IGA, this is achieved in collaboration with provincial and territorial counterparts.

The program also works with national and regional Indigenous organizations, territorial governments, and the federal department of Indigenous and Northern Affairs to help navigate the distinct socio-cultural and economic context of Canada's north.

3. A GEOETHICAL EVOLUTION

3.1 The local context

Socio-economic conditions are challenging in Canada's three northern territories, Yukon, Northwest Territories (NWT), and Nunavut. The unemployment rate is higher and the education level lower than the national norm (The Conference Board of Canada, 2011). Options for economic prosperity in the territories are limited and heavily reliant on the natural resource sectors, with mining overshadowing contributions from all other sectors (The Conference Board of Canada, 2010).

The territories are home to a small population of approximately 119,000 people spread across fewer than 100 small communities in a remote landscape. Geoethics therefore presents an excellent foundation for engaging communities in the North where large portions of the population are Indigenous peoples who have a deep connection to the land and a rich cultural history in the region (Peppoloni and Di Capua, 2012).

In Canada, principles of mutual recognition, respect, and shared responsibility guide federal engagement related to government activities that involve Indigenous lands, resources and in some cases sub-surface rights. These principles are in addition to responsibilities set out under section 35 of the *Constitution Act, 1982* that recognizes and affirms the existing aboriginal and treaty rights of the Aboriginal peoples of Canada. To successfully establish research programs in the North, it therefore is imperative to understand and consider local cultural practices, community history, and Canada's evolving relationship with Indigenous peoples.

3.2 Changing scientific culture through GEM

The GEM program's primary aim was, and remains, mapping Canada's North. Though this mandate has not changed, there has been a progressive shift in how GEM is implemented. As with many public geoscience programs, GEM was originally developed to focus on freely providing public geoscience (e.g., maps and synthesis reports) to stimulate industry investment (Bernknopf et al., 2007; Duke, 2010).

Four years into the program, the government announced its Responsible Resource Development Initiative which would in part "Promote positive and long-term relationships with Abo-

riginal communities in order to improve reconciliation and facilitate greater participation of Aboriginal people in the direct and indirect benefits of new resource projects". The initiative demonstrates the federal policy shift towards increased Indigenous engagement.

When the time came to renew the program, management drew from insights gained during the first years of the program, direction from the evolving policy context, and specifics tools that guide federal action with Indigenous peoples (Government of Canada, 2011).

GEM's management evolved the original approach to also include more active involvement by Northerners. Northerners, including Indigenous communities, were considered as an integral part of achieving GEM's mandate to support a strong Northern economy. This led to a more dynamic engagement approach which evolved into a program firmly rooted in geoethics (Peppoloni and Di Capua, 2016).

Today, the program is entrenched in a belief that the more Northern communities know about geology and the natural resources around them, the better able they are to make decisions about their future. GEM now connects Northern communities with critical data that informs their resource development and land-use decisions, and it invites them to participate in the geo-mapping process.

This approach is building improved relationships between Northerners and government agencies. Northern communities, industry and governments are expected to all benefit from this approach.

4. THE EVOLVING APPROACH

Looking forward, the GEM program now incorporates geoethical Northern engagement throughout its activities such as seeking Northerners' perspectives, undertaking field work, and supporting Northerner's decision making.

4.1 Impact on GEM Leadership

Although the path to achieving results was focused on getting industry to use the new information, an Advisory Group of Northerners (AGN) was formed as a body through which the GSC's senior leadership and Northern representatives could share valuable knowledge and information. Its recommendations were reported to the Assistant Deputy Minister of the Earth Science Sector that oversees the Geological Survey. Original members were primarily drawn from long-standing partners familiar with geosciences, such as industry, territorial governments, and Northern training organizations. Over time and with guidance from the AGN, it became clear that focusing on serving the needs of only one end user - the exploration industry - was not compatible with the sociocultural and economic realities of the North. Increased engagement with Northerners needed to be part and parcel of the renewed program's design for success.

With the program's renewal and the evolving geoethical shift towards greater engagement of Northerners, a revived AGN became a critical mechanism to seek perspectives on how to maximize the program's benefits to Northerners.

The new group brings together a diversity of Northern stakeholders, including community elders, youth, academics, local and territorial government representatives, Indigenous association members, and industry representatives. Meetings occur in person annually and teleconferences support ongoing discussions between meetings. In person meetings leverage creative facilitation techniques such as Open Space Technology that encourage participants' interests driving the discussions (Swanson, 2006), resulting in members identifying and leading working groups on topics they are passionately interested in advancing.

Members' insights focus on issues important to Northerners such as: building capacity of Northern communities; ensuring communications products such as videos, engagement letters, and final reports are suitable; facilitating the use of data and knowledge by Northerners; improving engagement protocols, and addressing Northerners' concerns regarding the field work.

There are several examples of times when the AGN provided concrete insight that reflected its unique Northern perspective. Most notably, the AGN advised on how to involve Northern students in GEM program activities and helped GSC staff by reviewing communications plans

and products to adapt them to Northern considerations and realities.

4.2 Impact on Science Culture

Through their "boots on the ground" activities, GSC geologists have an opportunity to share their interest in and respect for the land with local communities. They act as impartial information brokers, sharing data and knowledge freely and equally with all interested parties. Common practice is to share results openly, ensuring that communities and industry can access the information at the same time.

To support engagement opportunities, tools and guidelines were developed to help GSC teams engage Indigenous communities. These include a strategy, guidelines, an annual critical path, and engagement plans. The key to mainstreaming engagement considerations as part of the field work planning was establishing an agreement amongst the GSC field teams on a critical path and engagement plans.

The annual critical path helps teams plan their engagement by setting out timelines for key phases of engagement leading up to a proposed field campaign. The critical path takes into account the timing required for logistics planning and permits applications while accommodating the rhythm of life in the communities. Respectful and meaningful engagement includes recognizing when community members are more likely to be away living on the land and not available to answer calls, correspond, or attend meetings (see Fig. 1).

The Engagement Plans are at the core of planning community engagement and are based on research, analysis, and validation as recommended in the updated federal guidelines (Government of Canada, 2011). The research and analysis phase seeks to cross reference proposed scientifically relevant sampling sites with community interests and rights. Research helps the teams learn about the communities and can reveal the landscape of overlapping settled and unsettled land claims, self-governing nations, traditional land use, organizational structure, and history. The analysis phase then compares the proposed field work with the community-related information to identify who and how to engage in a way that respects community governance. Validation with Northerners is critical because the available resources for research can be outdated and personal connection is very important to Indigenous communities.

Figure 1: *Annual Critical Path for Engagement by Field work teams.*

The teams rely on several approaches to validate information, including working with territorial government colleagues, regional Indigenous organizations, and directly calling the community to confirm names and positions of key community leaders. Engagement plans are iterative and evolve throughout the project as teams are expected to be responsive to community feedback and adjust the engagement intensity accordingly.

Plans are created at the outset of each Northern research activity. They track progress to ensure that suitable engagement activities are conducted during three distinct periods:

Figure 2: *GEM field school hosted in Taloyoak, NU.*

Pre-field work

Pre-field work activities include correspondence exchanges and community visits. These aim to introduce the program, present proposed field plans, gather feedback on how best to respect culturally sensitive sites and discuss hiring opportunities. Critical lessons learned include using plain language to describe the proposed science and anticipating questions from local communities, such as "What is the government doing here?" "Are they going to impact our land, wildlife, or way of life?" "Will there be benefits for us?" Teams make use of town hall community meetings, social media platforms, community radio presentations, and outreach tables set up in local grocery stores, for example. GSC staff sometimes offer training in communities, such as a field school hosted in collaboration with the Canada Nunavut Geosciences Office. The team held half-day workshops that were open to the community and provided an overview of basic elements of geological research such as geo-caching, surficial and bedrock geology, GIS, among other topics (see Fig. 2).

Field work

The teams work with community organizations during pre-field work engagement activities to validate a hiring process consistent with their governance, often through their Hunter and Trapper Organizations. GEM staff hires locals to work in and manage the field camps, and hire local helicopter operators, wildlife monitors, field guides, and translators. Through these participation opportunities, local residents become more aware of the field work and can then share their experience with the community. Researchers also take advantage of being in the community to conduct school and community visits, host open information sessions, workshops, and presentations to provide an update on their research activities. For instance, the Naskapi Nation and the Fond Minier du Québec invited a GEM program scientist to spend a day with students, presenting basic concepts of geology with displays of ore samples, and reviewing the elements used in many consumer products. They also discussed careers related to Northern scientific research, mineral exploration, and the mining industry.

Between and after-field work

Regular communications and visits provide an opportunity to update the community on revised plans and share preliminary results. At an outreach event in Colville Lake, NWT, for example, the science crew presented display-quality specimens of local rocks and fossils collected during the field season and donated them, along with several sets of topographic maps, to the local community. Additionally, all GEM projects publish an annual report that is shared with relevant communities. Upon request by the community, GEM scientists may even return to an area when the project is complete to present results and help ensure that GEM knowledge can be used by the community. Through early and ongoing engagement, GEM's project teams have connected with over 60 communities and have visited over 30 of them since the launch of the renewed GEM program in 2013. GEM fieldwork-related engagement has increased opportunities for open communication, enhanced understanding, and trust - all known mechanisms for building and strengthening relationships among stakeholders (Almany et al., 2010) (see Fig. 3).

4.3 Impact on funding tools

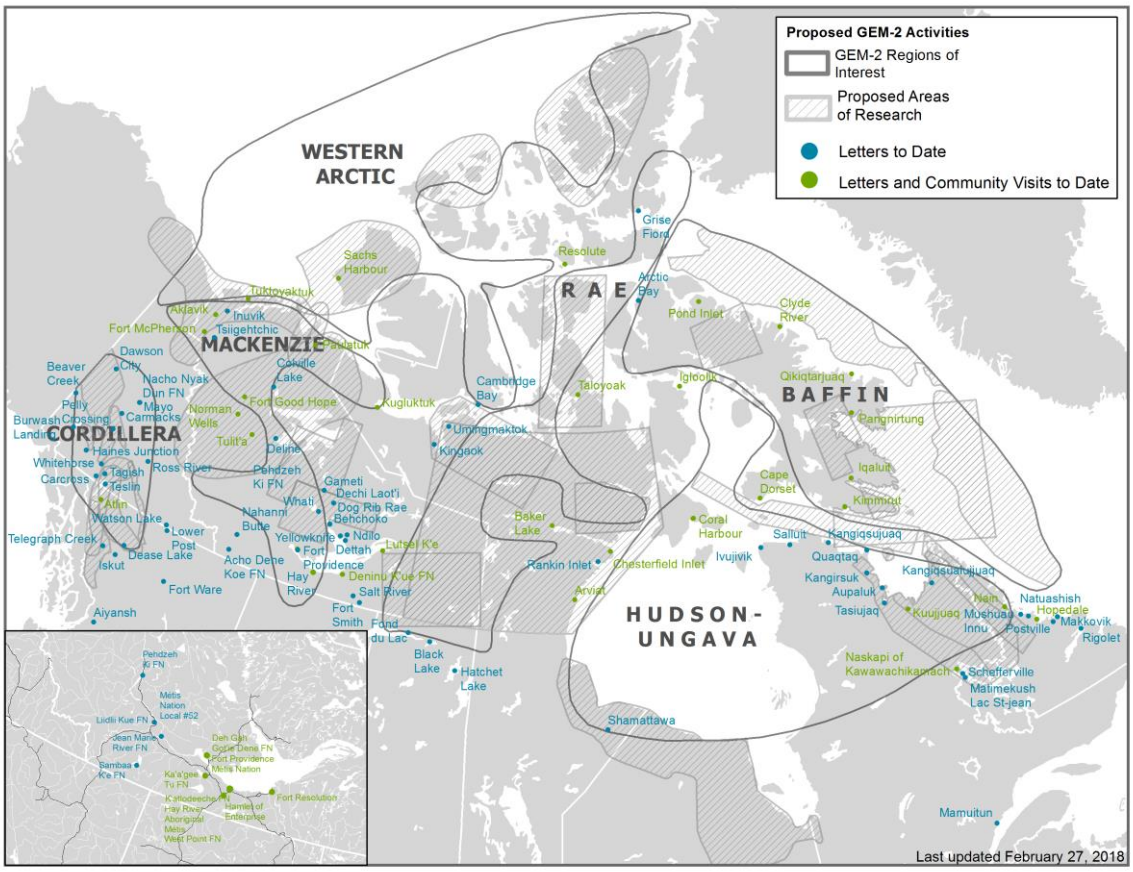

Figure 3: *Map of Communities in Northern Canada engaged since GEM program renewed in 2013.*

Grants were originally only provided to geoscience academics. As the program evolved it recognized that allocating grant funds differently could be a way to provide Northerners with tangible benefits. A special stream of program funding was therefore dedicated to support the development of approaches and tools that facilitate the use of geoscience data and knowledge by Northerners. Northern organizations are well positioned to identify the ways in which GEM data is most relevant to their decision-making. Four calls for proposals were issued, inviting Northern institutions to submit applications for projects that supported their ability to incorporate GEM data into their decision-making processes. The program funded projects that are led by Northern institutions such as colleges and Indigenous organizations. A total of 16 projects were supported through direct investments of nearly $1M.

5. RESULTS

5.1 Culture change at a leadership level

The AGN provided an opportunity for dialogue with senior leadership and served as a sounding board on the Northern perspective. Engaging GEM's most senior leadership directly with Northerners had a multiplier effect, as decisions trickling down from management affect the entire program. The AGN's most significant impact is beyond any specific insight it provided on products presented to it for review. The AGN influenced the culture of the program's leadership on how to see and understand the program from a Northerner's perspective. The evolution of the program is a testament to that evolution in a culture that starts at the top and can become hardwired throughout the program.

5.2 Culture change in field work planning

Engagement plans have led to significant cultural changes within the science at the GSC. Engagement plan development is a team effort and allows for open discussions amongst scientific team members, engagement officers, managers, and executives. Each team member provides their input while making the link with Northerners perspectives. Engagement officers with a background in Indigenous relations, lead the research and analysis to identify relevant communities, and ensure that everyone has the opportunity to contribute insights from their experience and make connections with the communities in question. Scientists provide geoscience targets for field work relevant to their hypothesis, and are challenged to explain their approach in plain language. They also identify Northerners' perceptions of the kind of sampling, camp set up, and equipment used (including helicopters). They suggest how communities could be involved, for example including serving as the base for the field camp. Project managers use the plan to help manage budget and field planning implications and prepare for regional engagement. The accountable executive approves the plan and uses it to understand the local community context. Engagement plans ensure that all team members are on board, understand the rationale for engagement activities, and can adapt the project's intensity based on community response. Returning to communities has been particularly noted by Northerners as a sign of respect and openness.

5.3 Culture change in funding

Adding a funding stream, that directly supported Northern institutions' use of GEM data and results, paid dividends. GEM funding and knowledge supported the development of the Qaujisarnik Nunamik Education Program (QNEP) at the Nunavut Arctic College's Environmental Technology Program. Students there create maps that link geoscience, Inuit knowledge, and other relevant data together in an engaging and informative way. This educational program has been offered since 2014, and expanded in 2016 to include professional

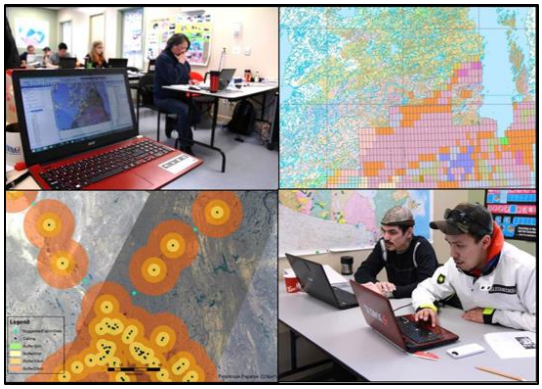

Figure 4: *QNEP students from Arctic College working on generating GIS maps.*

GIS users and an instructor training program so that Nunavummiut can teach the course throughout the territory (see Figure 4).

In the Northwest Territories, the *ʔehdzo Got'ıę Gots'ę́ Nákedı* (Sahtú Renewable Resources Board) compiled and integrated existing GSC - published geocience data and Dene/Métis landscape traditional knowledge into the online Sahtú Atlas. Program funding also supported workshops to help schools and communities learn about this user-friendly mapping tool.

Further west, the Teslin Tlingit Council, a self-governing First Nation spanning the Yukon-British Columbia border, integrated geoscience data as part of its digital map of areas with potential for mining and energy development.

These new knowledge application opportunities are just a few examples of the program's support for communities' land-use and resource development decision making. Communities can use the tools to reconcile resource-based opportunities in relation to Indigenous knowledge and values

6. CONCLUSIONS

Prior to GEM, there was a geoscience gap for most of the North. In many areas, the geology was poorly understood and there was insufficient evidence to support investment resource decisions. Since 2008, the program has closed more than 40% of this knowledge gap, and continues this work with significant input from Northerners despite the challenging logistics of the North.

Though there were engagement opportunities between public geoscience and Northerners during the first phase, these were significantly bolstered and considered essential during GEM-2. In large part due to the fact that approximately half of GSC staff are involved in delivering the program, Indigenous engagement before, during, and after field work is now more part of the organization's culture and a key consideration in program planning exercises.

Through the program, science diplomacy by the GSC has played a role in defining a renewed relationship with Northern populations. GSC leadership have supported this objective by taking a deliberate and adaptive approach of combining levers like grants and partnerships, advisory mechanisms, and procurement. The GSC's mandate to map the North remains the same, but its methodology has changed. Using a more geoethical approach has brought a richness to geoscience programs, created better relationships with communities, fostered economic growth in the North, and helped position the GSC as a more welcome science partner in Northern communities.

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REFERENCES

Almany G., Hamilton R., Williamson D., Evans R., Jones G., Matawai M., Potuku T., Rhodes K., Russ G., Sawynok B. (2010). Research partnerships with local communities: two case studies from Papua New Guinea and Australia. Coral Reefs 29, 567–576.

Bernknopf R.L., Wein A.M., St-Onge M., Lucas S.B. (2007). Analysis of improved government geological map information for mineral exploration: incorporating efficiency, productivity, effectiveness, and risk considerations. Geological Survey of Canada Ottawa.

Bobrowsky P., Cronin V.S., Di Capua G., Kieffer S.W., Peppoloni S. (2017). The Emerging Field of Geoethics, pag. 175-212. In: Gundersen L.C. (Ed.). Scientific Integrity and Ethics in the Geosciences, p. 336, American Geophysical Union, Wiley, ISBN 978-1-119-06778-8.

Di Capua G., Peppoloni S. and Bobrowsky P.T. (2017). The Cape Town Statement on Geoethics, doi: 10.4401/ ag-7553. In: Peppoloni S., Di Capua G., Bobrowsky P., Cronin V.S. (Eds.), Geoethics at the heart of all geoscience, Annals of Geophysics, Vol 60, Fast Track 7.

Duke J. (2010). Government geoscience to support mineral exploration: public policy rationale and impact. Prospectors Developers Association Canada (PDAC), http:/ / www.ngsccanada.com/ files/ Government_Geoscience_Duke_PDAC.pdf (accessed 11 May 2018).

Gill J.C. and Bullough F. (2017). Geoscience Engagement in Global Development Frameworks, 10.4401/ ag-7460. In: Peppoloni S., Di Capua G., Bobrowsky P., Cronin V.S. (Eds.), Geoethics at the heart of all geoscience, Annals of Geophysics, Vol 60, Fast Track 7.

Government of Canada (2011). Aboriginal consultation and accommodation: Updated Guidelines for Federal Officials to Fulfill the Duty to Consult. Government of Canada, Public Works and Government Services Canada, Integrated Services Branch, Government Information Services, Publishing and Depository Services.

Nickless E. (2017). Delivering Sustainable Development Goals: the need for a new international resource governance framework, doi: 10.4401/ ag-7426. In: Peppoloni S., Di Capua G., Bobrowsky P., Cronin V.S. (Eds.), Geoethics at the heart of all geoscience, Annals of Geophysics, Vol 60, Fast Track 7.

Nurmi P. (2017). Green Mining - A Holistic Concept for Sustainable and Acceptable Mineral Production, doi: 10.4401/ ag-7420. In: Peppoloni S., Di Capua G., Bobrowsky P., Cronin V.S. (Eds.), Geoethics at the heart of all geoscience, Annals of Geophysics, Vol 60, Fast Track 7.

Peppoloni S. and Di Capua G. (2012). Geoethics and geological culture: awareness, responsibility and challenges, pp. 335-341, doi: 10.4401/ ag-6099. In: Peppoloni S. and Di Capua G. (eds.). Geoethics and geological culture. Reflections from the Geoitalia Conference 2011, Annals of Geophysics, Special Issue, 55, 3.

Peppoloni S. and Di Capua G. (2016). Geoethics: Ethical, social, and cultural values in geosciences research, practice, and education, pp. 17-21, doi: 10.1130/ 2016.2520(03). In: Wessel, G.R., and Greenberg, J.K., eds., Geoscience for the Public Good and Global Development: Toward a Sustainable Future: Geological Society of America Special Paper 520, ISBN: 978-0-8137-2520-8.

Swanson J. (2006). A Model For Aboriginal Facilitation: An Open, Empowering Way To Get Consensus And Action : Introducing Open Space Technology. The Journal of Aboriginal Management.

The Conference Board of Canada (2010). Mapping the economic potential of Canada's North. Conference Board of Canada.

The Conference Board of Canada (2011). Building Labour Force Capacity in Canada's North. Conference Board of Canada.