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See table of contents

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CHAPTER 8 CHANGING ROLES FOR GOVERNMENT GEOSCIENCE

8 (a) The Geological Survey of Canada

The basic mission of a national geological survey is:

"to ensure the availability of the geoscience information and expertise required to promote the wise use of the nation's natural resources, and the safety, health and well-being of its people" (Price, 1994).

Traditionally, this knowledge base was developed and maintained to serve principally the needs of the mineral and petroleum industries. In recent years, however, greater emphasis has been placed on information requirements related to environmental assessment and remediation, geological hazards, water quality and quantity, and public health and safety. With a growing public awareness of the critical environmental issues facing humankind, resulting from population growth and over-consumption of resources by the developed world, will come a steadily increasing demand for:

"... an impartial, trustworthy national source of geoscience information and expertise." (Price, 1994).

These new societal demands, embodied in the unifying concept of Sustainable Development, will be the central controlling factors which will alter the role and nature of national geological surveys throughout the world in the next century.

The Geological Survey of Canada (GSC) was established in 1842 with a mandate to map and evaluate the mineral and natural geological resources in parts of Upper and Lower Canada. While its area of concern has expanded significantly during the intervening 153 years to include the entire Canadian landmass, both onshore and offshore, its principal mandate remains largely the same - to provide a geoscientific knowledge base for the country. The GSC presently employs approximately 1000 scientists, technicians and administrative support personnel distributed at six sites across Canada. Its budget for 1994-1995 is $110.7 M. In the period 1995-98 the personnel and budget will be cut by approximately 25 and 32%, respectively.

The GSC is an historic institution whose contributions to Canada have been respected and valued for 152 years, and therefore that the future of such an historic institution deserves most careful attention and thoughtful planning. It has produced many of the most distinguished earth scientists this country has known, and the accomplishments of the Survey, in mapping and making known the geological composition and structure of so vast and remote a terrain, and one so topographically diversified, as the Canadian landmass, are respected worldwide.

As with other geological surveys throughout the world, the GSC has undergone several recent reviews of its roles and research priorities. These have been largely prompted by diminishing financial resources as the government tackles the deficit/debt crisis, by a political change at the federal level and by demands for greater autonomy by certain provinces and territories. The Canadian Geoscience Council undertook a review of the GSC in 1989, published as "*Earth Sciences in the Service of the Nation*". Internally, the GSC recently carried out a priority-setting exercise which identified and ranked 44 program components. This was followed by a departmental review, similar to those taking place in the other "economic departments" of the federal government (Fisheries and Oceans, Industry, Transport, Agriculture and Environment); this review is now concluded and in many specific instances it significantly affects the ranking given to program components through the GSC's internal review. Coincident with the departmental review, has been the overall federal science and technology review (see above) to define new S & T strategies for the nation. The release of this latter review was delayed until early 1996.

In general terms, the GSC's response to these reviews has been to: (1) simplify organizationally by combining some divisions; (2) focus on more specific, shorter term needs of its clients; (3) increase its emphasis on "fundamentals" (bedrock mapping and the minerals industry); (4) diminish its involvement with the petroleum industry, since there is little interest in frontier regions; (5) attempt to reconcile overlap and duplication with provinces; (6) increase its international presence in order to provide opportunities for Canadian industry; (7) emphasize revenue generation by the GSC for highly specialized products and services which are unavailable in the marketplace; and, (8) in the longer term, enhance its involvement in environmental programs.

The GSC is anticipating a 30% reduction in its overall budget by 1998, approximately one third of which will come through the cancellation of Mineral Development Agreements with the provinces and the remainder through cuts to other programs. It is estimated that such cuts will result

in 200 to 300 jobs being lost in the organization.

The Natural Resources Canada's departmental review identified five key roles for the department:

- sustainable development of natural resources
- revitalization of the natural resource sector
- national and international leadership
- knowledge of land and resources
- health, safety and the environment.

In this departmental review, programs were assessed based on six criteria:

- Public Interest - *Does the program serve a public interest?*
- Role of Government - *Is there a legitimate and necessary role for government?*
- Federalism - *Is the role of the federal government appropriate?*
- Partnership - *Can the program be transferred in whole or in part to the private sector?*
- Efficiency - *How can the program be more efficiently delivered?*
- Affordability - *Is the program affordable within fiscal constraints?*

The GSC identified 9 Program Blocks, each of which encompasses several individual program elements; in order of priority, these are:

(i) Mineral Resources: Regional Geoscience

(ii) Energy Resources: Regional Geoscience

(iii) Marine Resources: Regional Geoscience

(iv) Land Use and Surficial Resources

(v) Environmental Constraints on Development, Land Use and Public Safety

(vi) Mineral Resources: Exploration Innovation

(vii) Impact of Development on the Environment

(viii) Energy Resources: Assessment and Exploration Innovation

(ix) Arctic Logistical Support

The Future Roles of the Geological Survey of Canada

The Committee met with senior management representatives of the GSC in order to gain a better understanding of their vision for the future of this important element in Canadian geoscience. The following summarizes the impressions conveyed to the Committee during that meeting together with information in various publications, and from consultations with representatives of other sectors.

The senior management of the GSC is caught between conflicting sectoral opinions. Senior managers in government and some ministers have argued that federal science agencies should be more focussed on applied issues, particularly those which may help Canadian industry to be more competitive, New management systems that demand quantitative, economic measures of success are being introduced. Those pressures influence GSC management to develop a more short-term vision than has been so in the past. To the contrary, many opinions from the industry and academic sectors argue for the GSC programs to be of intermediate- and long-term design; to lead industry rather than duplicate or compete with it. Documents defending eight of the nine GSC program blocks are generally written from a present or very short-term future perspective; as an example, it was not at all clear that geoscience activities (mapping) in support of mineral, energy and surficial resources, and land use would necessarily continue to be accepted by many provinces as a legitimate federal activity given provincial jurisdiction over mineral and energy resources, and the environment. There was little clear distinction presented between many of the present and proposed activities of the GSC and those of the provincial geological surveys. The highly rigorous tests utilized by other federal departments (*e.g.*, Agriculture Canada) to assess the appropriateness of their R & D activities do not appear to have been applied to the programs of the GSC.

Following the Program Review and the advice of the Ministers Industrial Advisory Board, the GSC is now establishing a new long-term approach to research. Activities will be defined in a framework of three programs: National Programs, Regional Geoscience in Federal Lands and Offshore, and Regional Geoscience in Provincial Lands. The first (and largest) will include all thematic research, including that which addresses the architecture of Canada's tectonic elements. These programs will be based on medium- to long-term "leading-edge" research. The second will be focused on the systematic collection and interpretation of geoscience information in the Federal Territories (in co-operation with DIAND and the Territorial governments). The third encompasses new working relationships with the provinces. Provincial surveys will take the lead in designing and executing regional geoscience programs within the Provinces. The GSC will work within their programs, when requested, to provide special expertise and to integrate the information gained into a national framework. NRCan is also developing a White Paper to promote changes that will stimulate the Canadian mining industry.

The GSC senior management appears reluctant to shift the role of the GSC more towards the provision of geoscience information in support of Sustainable Development (*e.g.*, land use, environmental impact issues, alternative and non-fossil fuel energy) (Canadian Geoscience Council, 1989) and away from the traditional roles of supporting the land-based mineral industry and, to a somewhat lesser extent, the fossil fuel industries. GSC management acknowledged the substantial emphasis on Sustainable Development by the current government (*e.g.*, an entire chapter devoted to it in "*Creating Opportunity*", the Liberal Party's "*Red Book*") and by NRCan's Minister and Deputy Minister. Management the need for GSC support to revitalize the Canadian mining sector; it is of interest to note that in comparison to Sustainable Development, mining issues in the "*Red Book*" are mentioned briefly in only a few paragraphs, generally in the context of taxation, environment and land use, investment climate and production costs and not with respect to an increased need for geoscience information. The economic requirement in the short term seems to focus more effort on non-renewable resources and that, despite the evident urgency of many Canadian and global environmental issues, an enhancement of programs providing support in these areas could be postponed. The committee interpreted the GSC's priorities as reflecting a response

to more visible, unified and vocal client groups in the resource sectors than those concerned with the "public good", including issues concerning the quality of life and the environment, and to government pressure to help resolve the nation's fiscal problems. The concept of sustainable development is applied less to the Canadian environment than to the discovery and development of new supplies of non-renewable resources in an environmentally acceptable manner.

Despite a strong commitment by the present government "to promote, not hinder, the research, development and implementation of ... renewable energy ..." (Liberal Party, 1993; p. 64), "energy" within the GSC still appears to be equated with fossil fuels. "Canada has very large geothermal resources in several categories ranging from high-temperature water capable of producing steam-generated electrical power, medium-temperature water for space heating and industrial processing, low-temperature water for space heating through heat-pumps, and hot dry rock." (Geological Survey of Canada, 1991). At the present time low-temperature geothermal energy is increasingly being exploited in Canada for space heating and three Canadian companies are poised to explore high-temperature geothermal resources in western Canada in order to feed Californian demands for low environmental impact sources of electricity. The GSC has, as pointed out in the 1991 Strategic Plan, within the basin analysis, groundwater, and geothermal studies groups, considerable expertise which could contribute to a better understanding of the occurrence and nature of geothermal resources; the geothermal energy program within the GSC was terminated several years ago and has not reappeared in the latest program listing in any form.

In recent years the GSC has entered into various partnerships with provincial governments, industry, universities and other federal government departments in an effort to deliver more effectively national geoscience programs in which the GSC plays an important, and often a lead role. The Committee applauds this approach, particularly well exemplified by Lithoprobe and the National Action Committee on Ocean Mapping (NACOM). Such partnerships have appeared to the Committee to be somewhat ad hoc, however, with no clear overall blueprint in place for the joint delivery of national geoscience programs by several sectors. In some areas (*e.g.*, environment and surficial geology) the GSC has remained particularly insular or has found an infertile ground for collaboration, especially with respect to other federal government departments and agencies (*e.g.*, Agriculture, Environment, Fisheries and Oceans, CIDA); as a result, departments have either gone elsewhere for geoscientific expertise or have developed their own in-house capability (*e.g.*, Canadian Hydrographic Service and mapping of some seabed resources; some soils research in Agriculture Canada). There have been some recent improvements in this situation which the Committee hopes will be significantly expanded in the future. For example, GSC initiated an MOU with Environment Canada to share responsibility for hydrogeological research. Environment Canada now recognizes the GSC's expertise in dealing with toxic substances. The GSC has initiated projects with Agriculture Canada on the "take-up" of toxic metals by crops, and projects with Health Canada on naturally occurring chemicals in groundwater. The GSC has also initiated environmentally related Quaternary geology projects with B.C. (Fraser Delta study), Manitoba (Prairies NATMAP project), Ontario (Oak Ridges Moraine project), and many others.

The greatly increased emphasis on cost recovery and revenue generation by GSC staff is seen as a potentially troublesome course. While senior management assured the Committee that strict guidelines exist regarding the contracting out of GSC services and the lease of government-owned equipment so as not to compete with the private sector, there are pressures local managers to generate maximum revenues and to preserve their present personnel base and programs for as long as possible. Furthermore, the guidelines which are presently in place are expressed within a present not a future context: *i.e.*, the question asked is "Does this activity or lease of this equipment compete with an existing private sector capability?" rather than "Will a continuation of this activity or lease of this equipment inhibit the future development of a viable private sector capability?" The dangers of this course lie not only in possible conflicts with the private sector in Canada. Activities related to cost recovery and revenue generation are most often of a short-term nature; the committee felt that the GSC should be pursuing a more "leading-edge" role in the geosciences with a medium-term or longer focus to most of its research. Cost recovery generates less than two % of its cash flow and it seems unlikely that this activity can be substantially increased without developing conflicts of interest with the private sector.

In response to the recent federal reviews, the GSC has identified an enhanced international role for itself, such as exists in many other national geological surveys, in promoting further opportunities for Canadian industry. For this reason, but also to ensure a strong Canadian presence in international earth-science and related programs, such a role for the GSC is indeed appropriate and is supported. The Committee commends the GSC for its initiative to move in this direction. Two qualifying remarks, however, would seem to be in order. To be truly effective, it would seem necessary for the GAC: a) to ensure that the motivation for, and purpose of, these activities is thoroughly understood and accepted at the divisional level within the GSC; and b) to demonstrate a stronger commitment to these activities by earmarking a larger portion of its own funding for them, thereby becoming less reliant on the support of other agencies (*e.g.*, CIDA) in exploring and executing desirable agreements.

Recommendations

1. The GSC should review its programs with the more rigorous tests being applied in other departments and in a longer-term (5-15 year) context of societal needs broader than the current emphasis on minerals and fossil fuel energy resources.

2. The GSC should significantly enhance over the next 15 years its contribution to Canadian and international sustainable development initiatives (*e.g.*, coastal zone management, geothermal energy, geological hazards).

3. The GSC should reconsider the justification for some of its programs in order to define more clearly federal versus provincial interests. Since resources and environment are mainly a provincial responsibility, then the GSC should be primarily responsible for understanding the broad architecture and geological evolu-

tion of the Canadian landmass; thus any regional geoscience activities (mapping) of the GSC would be focussed to these ends and would not be within programs entitled "Mineral Resources" or "Energy Resources", which are clearly in the domain of the provinces. Consideration could be given to requests by provinces for specific geoscience activities by the GSC on a contractual basis with the proviso that they not divert the GSC from realizing its national program objectives.

4. The GSC should redirect its principal efforts into areas of clear federal domain, especially the offshore and the territories. Programs in the provinces would be undertaken on a contractual basis to optimize expertise and infrastructure. Activities in regions where several levels of government are implicated (*e.g.*, Fraser Delta where federal, provincial, regional and local governments are involved) should be very carefully scrutinized to ensure that a federal presence is absolutely essential and that the expertise required cannot be met by either the private sector or another jurisdiction. As a general guideline, it is felt that the GSC should be where others are not, unless there are compelling reasons to the contrary. The GSC should be leading the nation into new areas - both geographically and intellectually.

5. The GSC should devote a greater portion of its own budget to international affairs, particularly in a coordinating function, in order to provide opportunities for Canadian industry and to enhance Canadian participation in international scientific programs.

6. The GSC should be structured along well defined national program lines which address truly national needs. These programs should be structured, wherever possible, as joint complementary initiatives with other federal government departments, industry, universities and, provincial or territorial governments, all of which should participate in the formulation of the projects from their inception.

7. The GSC should increase its efforts to develop and maintain national geoscience databases for a wide array of clients.

8 (b) Provincial and Territorial Governments

Provincial Geological Surveys (PGS) exist in nine of the ten provinces (the exception is Prince Edward Island) and their equivalents are found in both Territories. The first Provincial Survey was established in New Brunswick in 1846 and the last being Saskatchewan in 1941. Both Territories formed their surveys in 1969. By 1990 the total expenditure by all the PGS had reached $75 million. McRitchie (1993) has provided a recent and very comprehensive account of most aspects of PGS organization, operations and capabilities. The reader is advised to consult McRitchie's excellent paper which, amongst many other well taken points, emphasizes the difficulty of attempting to generalize about many aspects of the various PGS.

Historical Perspective

The *Constitution Act*, 1982, confirms the assignment to the provinces of the right to exclusively make laws in relationship to mineral exploration, development, conservation and management. Hence most government services related to mining, or to metallic and industrial minerals, coal, oil and gas *etc.* are strictly provincial; uranium is the one partial exception. However, this Act will not repeal those earlier terms of Confederation that stated that the GSC must provide geological mapping in several provinces.

Most PGS were primarily established within Provincial "Departments of Mines", or their equivalents, with most obvious and primary function of the PGS being to encourage the private sector to develop Provincial resources to the benefit of the particular Province or Territory.

Thus the PGS concentrated their activities on supporting mineral and hydrocarbon exploration and development by providing detailed geological maps and reports, systematically documenting mineral deposits and providing advice on how and where to look for various types of mineralization. The amount of emphasis on these different components varies from province to province.

The basic mapping geological/field documentation activity had a further and very important ramification, that of "training". Almost all PGS employed numerous undergraduate geology students during the summer field seasons and at the same time provided much of the logistic and financial support to post-graduate and Academic research on field geology projects. This cooperation was of immense benefit to all concerned, and especially to the Canadian mineral exploration industry, particularly when they came to hire these already competently trained "field" geologists.

With time most PGS have evolved into other technical areas, especially those involving data inventory, both of their own data and that of relevant GSC or academic origin, (*e.g.*, thesis material), and particularly from industry, (*i.e.*, assessment data and core storage). Many PGSs also provided a number of other relevant services to industry such as assays, mineral determinations, age dates, geochemical and geophysical surveys, data compilation maps, seminars, outreach classes, and the popular annual "Open Houses". All of these activities were in response to the PGS prime aim of assisting industry in successful mineral and hydrocarbon exploration and development.

Through the last decade a large proportion of "applied" research on provincial lands or on provincial mineral resources has been accomplished via Mineral Development Agreements (MDAs) which are negotiated between the provincial government and the relevant federal agency (*e.g.*, the GSC, CANMET, *etc.*). The amount of federal funds committed under the mining and minerals technology component of the current MDAs (1990-98) is greater than $26 million. In many cases these cost shared programs have been extremely effective in fulfilling some specific goals by using specialized federal expertise or laboratory facilities, or via such as cooperative programs as NATMAP or EXTECT in order to complete some particular regional or multidisciplinary study involving a variety of specialists.

More recently quite different responsibilities have been grafted on to many PGS/Mines Branches in such areas as legislation, procedures and "policy" (*e.g.*, mineral endowment assessment, land use planning) that are vastly more time consuming and even possibly adversarial to their main clients, the mineral and hydrocarbon industries.

Also it is important to note that many other Provincial and Territorial Government Departments, besides "Mines and Energy", employ geologists to carry out a variety of specialized tasks, for example:

- highways (planning, aggregate resources)
- environment (waste disposal sites, water resources)
- municipal government (zoning, shoreline development)
- agriculture (soils, water resources)
- forestry (soils, road development, slope stability)
- fish and wildlife (water quality, access)
- parks (planning, interpretation)
- "planning" (environmental impacts, mineral assessment, hazards, land use)
- aboriginal affairs (land claim settlements)
- energy (coal, oil and gas)

The degree of coordination and/or interaction between these geologists, and those of the PGS or with geologists in analogous Federal Departments varies widely.

Future Trends

Most provincial governments have large debts and deficits which they wish to reduce. PGSs have seen their future and for many it is quite grim. There may well be greatly diminished "A" base budgets that cover the costs of basic geological mapping at the traditional 1:50,000 (or more detailed scale) and there will be much less expenditure on detailed site specific studies. Thus, there will be much less of the invaluable "training" of undergraduate/graduates in these basic skills.

In consideration of the federal deficit there is a possibility of a complete wind-down of the shared (federal-provincial) cost MDA programs most of which are scheduled to terminate in April of 1995.

In view of these concerns each provincial/territorial government might wish to consider bringing together all of their geoscientific staff into one organization, the PGS. This approach might lessen duplication and would consolidate all the professional skills and databases into one organization.

This unified organization would then be able to provide geoscientific knowledge, advice and data to a wide variety of "clients" both within the government and externally.

Doubtless the mining/minerals/energy industry would remain the single most important client but a fully integrated PGS would also be able to provide a broad range of services to those with problems/interests/requirements in obtaining uniform, reliable, frequently updated, scientifically sound, data bases for "local" (province-wide) knowledge of:

- engineering - roads/dams/development
- development - permitting - closure
- land use planning
- parks, in existing parks this is "education", for new parks help define boundaries
- environmental geochemistry
- geological hazards
- waste storage, site analysis, methodology, monitoring, background levels
- aboriginal land settlements
- mineral & hydrocarbon potential studies
- aggregate/building stone
- ground water - quality/quantity

Most of the topics listed above are people-oriented issues. The Provincial Survey would be the honest broker of quality-timely-useful information to underpin and resolve societal issues. Inevitably in this scenario there will be much less frontier (*i.e.*, where there are no-people) 1:50,000/1:10,000 mapping for esoteric higher mineral potential.

Note also these are local issues of a very applied nature. None, or little, of this valuable and worthwhile activity is at the cutting edge of basic science. Nor is it even synthesis leading to radical new concepts.

This future does not provide much employment to traditional (basic mapping) undergraduate or post-graduate students but it does provide possibilities for temporary employment in those fields of earth science which probably have the most potential for future growth.

In this context future relationships between the PGS and the GSC could possibly be those in which the GSC acts as a supplier of data, information systems, specialized expertise, specialized laboratory techniques, specialized equipment, in space, in air, on land, on or under water, down boreholes *etc*. This GSC interaction with a PGS would be co-managed by specific contracts/arrangements such as that recently signed between the British Columbia Department of Energy, Mines and Petroleum Resources and various sections of the GSC in British Columbia (Tempelman-Kluit and Matysek, 1994). The GSC has embarked on more extensive discussions with the PGS organizations on joint delivery of service.

In its major role of carrying out research in basic science, the GSC would cooperate and involve PGS personnel in regional thematic projects that studied broad scale crustal processes, especially those crossing jurisdictional boundaries (*e.g.*, Lithoprobe, Continental Drilling, NATMAP, EXTECT).

There would be cooperative arrangements between the PGS and the GSC in order to ensure that the total, national geoscience data base had rigorously defined standards, of quality, reliability, relevance and timeliness. Much of this data would originate in the Provinces but the advantages of one, national, central agency to collect, collate and distribute the data is obvious.

8 (c) Collaborative Programs

The size of Canada combined with its low population creates a challenge to provide an adequate coverage of geoscience databases and of maps at various scales. The nature of the Confederation presents a challenge and an opportunity for collaboration between the federal and provincial survey organizations. As noted in the two preceding sections of this chapter, the total resources of the Geological Survey of Canada is approximately $110 million and 1000 staff in 1994, while the combined resources of the provincial and geological surveys is approximately $70 million and 600 staff. Comparative figures for university geoscience departments are not formally assembled but are estimated at $100 million (base and external funding) and 800 regular faculty and staff. The long and distinguished history of the GSC is well known as is its historical leadership of the Canadian geosciences. The growth, diversifica-

Table 8.1 Federal/ Provincial Mineral Development Agreements (1990 and later)

Province/ Territory	Amount $ M	Cost sharing	Period	Programs	Budget ($ x 1000)	Sharing formula % Can/Prov
British Columbia	10	50/50	1991/95	Geoscience	5,000	44/56
				Technology	2,850	63/37
				Economic Development	950	37/63
				Public Information	550	45-55
				Evaluation, Administration	650	62/38
Alberta	10	50/50	1991-95	Geoscience	6,000	42/58
				Others	4,000	—
Saskatchewan	10	50/50	1990-95	Geoscience	7,350	37/63
				Mining and Processing	1,350	100/0
				Economic Development	400	75/35
				Public Information	350	64/36
				Evaluation and Administration	550	68/32
Manitoba	10	50/50	1990-95	Geoscience	5,500	54/46
				Technology	2,000	75/25
				Economic Development	1,400	28/72
				Public Information	350	71/29
				Evaluation and Administration	750	46/54
Ontario	30	50/50	1991-95	Geoscience	—	—
				Mining & Mineral Technology	—	—
				Information Transfer	—	—
				Exploration Technology	—	—
				Industrial Minerals	—	—
Quebec	100	50/50	1992-98	Geoscience & Mineral Exploration	44,000	50/50
				Mineral Development	32,750	50/50
				Research & Innovation	21,000	50/50
				Communications & Administration	2,250	50/50
New Brunswick	10	60% Can. 40% N.B.	1990-95	Geoscience	4,000	60/40
				Technology Development	3,750	50/50
				Development Opportunities	500	60/40
				Public Information	500	50/50
				Evaluation & Administration	1,250	58/52
Nova Scotia	9	55% Can. 45% N.S.	1990-92	Geoscience	3,172	57/43
				Minerals Technology	2,160	76/24
				Economic Development	1,827	22/78
				Mineral Investment Stimulation	500	100/0
				Public Information	573	35/65
				Administration	768	52/48
Newfoundland	17.5	70% Can. 30% Terr.	1991-96	Geoscience	9,000	48/52
				Minerals Technology	3,500	29/71
				Economic Development	1,000	50/50
				Mineral Industry Assistance	2,000	50/50
				Public Information	930	59/41
				Administration & Evaluation	1,070	11/89
Northwest Territories	8.2	70% Can. 30% Terr.	1991-96	Geoscience	7,500	70/30
				Technology	—	—
				Information	200	—
				Prospectors Assistance	300	—
Yukon	1.01	70% Can 30% Yukon	1990-91	Geoscience	3,650	100
				Geochemistry	5,500	100
				Mining Research & Development	750	96/4
				Administration	200	—

tion and sophistication of provincial geological surveys has been a more recent phenomenon, more characteristic of the last two decades and partly nurtured by the federal-provincial Mineral Development Agreements; MDAs are part of a wider Regional Economic Development Agreement (ERDA).

Historically, each geological survey has expanded most of its resources pursuing its perceived mandate. Collaboration between surveys has often been arranged between individual researchers whereas major, systematic, collaborative programs have been few. The principal exception has been the Mineral Development Agreements. These have been cost shared programs, mostly 50/50 but up to 70% federal share. The value of many MDAs has been about $10 million over 5 years, but with the Quebec, Ontario and Newfoundland MDAs being valued at $100 million, $30 million and $17.5 million, respectively. The nature of these programs and budgets is shown in Table 8.1 (Committee of Provincial Geologists, 1993). The MDA program has in part been a method of securing new funding and in part redirecting existing effort. In some cases, it has led to truly collaborative programs but in others the federal and provincial agencies undertook their own components with limited interaction.

The present federal government has recently announced that their funding for the MDA programs will be terminated in 1995. This will be part of the budget reduction identified by Natural Resources Canada but it will have ramifications for each provincial survey and result in a significant program and staff reduction for most surveys. It will further result in the cancellation of this major vehicle for formal collaboration. In 1992, NRCan (then EMR) cancelled their Research Agreements Program that provided modest (about $10,000) research grants to university faculty members to undertake projects of interest to NRCan. This cut to the Grants and Contributions budget eliminated the main collaborative program between the GSC and academia. Similar grant programs in the Department of Fisheries and Oceans and in Environment Canada are now also being eliminated.

The Committee considers that the extent of collaboration in the past was less than appropriate to efficiently manage this scale of public investment. Further it is clear that in 1995, and for the short term, institutions will have less funding and may be less amenable to sharing resources.

Our recommendation is that the federal and provincial surveys initiate a new attitude and objective to the sharing of resources and to the careful planning of regional and national programs. The GSC is apparently developing a Ministerial Accord to define respective roles. The surveys share basic objectives (except for aspects of mapping scale and regional responsibilities) but the attitudes of competition, duplication of effort in certain areas, and concern for priority in the announcement of programs and scientific results have all been deterrents to close collaboration. Given the financial state of the national and provincial debts, the growing intolerance by the public of wasteful governments and bureaucracies, and the potential for missed opportunities with declining financial resources, the Committee advocates a new era of coordination and long-term planning of geological surveys that also involves the academic community and industry. Some specific examples may illustrate the present problems and future opportunities.

a) The GSC has participated generously and effectively in some collaborative programs (*e.g.*, NATMAP, Lithoprobe) but taken unilateral precipitous decisions in others (*e.g.*, Ocean Drilling Program).

b) The GSC has recently undertaken a new program priority exercise, seeking some external input. However, the final decisions on priorities were primarily internal; the Committee of Provincial Geologists and the Ministers Industrial Advisory Committee to the GSC (MINIAC) were advised of the outcome, and not substantially involved in the final formulation.

c) The GSC includes some national laboratory facilities (*e.g.*, in organic and isotope geochemistry, paleontology, geochronology). Such concentration of physical or intellectual specialization cannot be attained by provincial geological surveys or is highly dispersed within the university community. These facilities should be managed and marketed in a new spirit of cooperation, efficiency, and maximization of use and talent.

d) Meetings of GSC Management Committee with the Provincial Chief Geologists occur only twice a year; the Minister's Industrial Advisory Committee (MINIAC) to the GSC meets only about twice a year; the GSC Management Committee meets with the Executive of the Canadian Council of Chairs of Earth Science Departments (CCCESD) only once a year. Many of these meetings have pro-forma agendas and rarely are able to develop new strategies of cooperation.

e) The recent (1994, 132 p.) draft Strategic Plan of selected Geoscience Needs for British Columbia was successfully developed by the GSC (especially through the Cordilleran and Pacific Geoscience Divisions) and the B.C. Geological Survey. The two surveys were able to establish priorities and objectives for mapping projects with specific program and staffing responsibilities, and an estimated level of resources required. Regrettably, there was little direct input by industry or academia in the formulation of this Strategic Plan. A second input phase involving industry and academia is the critical difference that the Committee sees between the existing collaborative planning and that to be characteristic of a new era and attitude.

f) Financial carrots are commonly required to help consummate collaboration. As noted above, the cancellation of the MDAs and former EMR and some provincial Research Agreement Programs are all detrimental. The GSC did initiate an Industrial Partners Program, but with a cap of $50,000 per project. Direct industry contributions to surveys or academic projects have been traditionally modest in scale and number, but more generous as in-kind and logistic support.

In considering what mechanisms could evolve to facilitate a new era of collaboration, the Committee envisaged the following examples:

- A regular national geoscience forum and ongoing infrastructure managed by CGC to define a vision and strategy and to outline major programs for Canadian earth sciences.

- That the geoscience community be able to debate specific ideas, proposals and programs through dedicated panel discussion sessions at major national meetings (as initiated at the GAC/MAC Joint Annual Meeting, Victoria, May 1995).
- That national subcommittees with representatives of all sectors consider wide access, effective management, and resource allocation for a variety of national/regional laboratory facilities, field stations and other research platforms (Barnes, 1993), and networks of specialist advice; particular attention should be paid to national and international marketing of potential services where not in direct competition with the private service sector.
- That major field programs be planned openly, allowing input from all sectors and remaining flexible to accommodate new participants, proposals and facilities. The planning for specific Lithoprobe Legs could be taken as a model. Such plans should be published or be available on-line or through open-file.
- National geoscience societies should play a special role to gather views and identify new trends in their respective disciplines and to feed these into a new policy network managed by CGC. The CGC would be funded at a higher level by the federal and provincial surveys, by the member societies and by NSERC in order to play this role. Initially it could be for a 5-year trial period. A smaller model is for the funding of the Royal Society of Canada to manage the Canadian Global Change Program. It brings individuals and groups together from the government, industry and academic sectors and through a wide spectrum of meetings and workshops, facilitated the development of collaborative and coordinated programs. The funding for specific research programs was attracted from other sources.
- It can be safely predicted that with diminished resources the demands for accountability of expenditures will continue to increase. In a more complex era of collaboration, it may be especially necessary to ensure regular, systematic, external peer reviews of agencies and programs. Such reviews have been regularly performed for Lithoprobe and ODP; the CGC has established review committees to examine various facets of the organization and programs of the GSC, and likewise for some provincial surveys (*e.g.*, Alberta, B.C.). Most reviews have been published. In a new spirit of collaboration it would be healthy to charge the CGC with developing a more systematic format and strategy for conducting such reviews. Whereas these may not be mandatory, the Committee anticipates that all provincial and federal surveys, university departments, major industrial organizations and larger collaborative programs would adhere to a coordinated program of external peer reviews, self-funded, and managed by the CGC. Such reviews should be relatively standardized, rigorous, comparable within sectors, effective without being overly bureaucratic.

Within the limitations of this broad overview study, the Committee considered what were the present and appropriate future roles of federal and provincial geological surveys as an example of geoscience undertaken in the government sector. We have not attempted to comment on the challenges and trends in government geosciences across all departments and agencies, but rather to focus on principal units.

At the provincial level, two principal groupings occur. The larger surveys in Quebec, Ontario and British Columbia each have a moderate to well developed infrastructure and capability to fulfill their mandates. In the other provinces and territories, the smaller survey organizations have benefited from, or been dependent upon, the work of the GSC. In nearly all provincial surveys, the principal task has been direct or indirect support of the mineral exploration industry, largely by the provision of 1:50,000 geological maps with priority given to work in areas of perceived high mineral potential. Increasingly, most provincial surveys are working with other of their provincial government departments or agencies in the delivery of a wide array of geoscience programs or contributions to other activities and policy advice. These include fields/issues of coastal zone management, water and groundwater resources, waste management, land use, forestry, and remediation of mines, quarries and waste disposal sites. They could be involved increasingly in the future with hydro utilities, offshore placer and aggregate mining, agriculture, urban geotechnical issues, tourism, and a wider spectrum of environmental problems.

Provincial geological surveys generally find it difficult to tackle the range of responsibilities, demands and opportunities. They are constrained by the specific mandate of their government department (typically requiring a focus on mineral (and energy) resources), by their budget, and by the training and interests of their management and staff (commonly in mapping and mineral resources). These all combine to limit the flexibility to respond to the wider range of applications and policy advice that earth sciences can contribute to the provinces. Small numbers of geoscientists are commonly present in other provincial government departments or agencies (*e.g.*, Environment, Hydro, Transportation/Highways, Forestry, Agriculture). With further federal transfer of responsibilities and programs to the provinces, it is likely that the latter will require the provision of much more geoscience information and policy advice (*e.g.*, on environment, health, safety, waste disposal, water resources).

With such a range of size in provincial geological surveys, the Committee can only make a few overall recommendations including:

- that each provincial geological survey lead in the coordination of geoscience database development within their own province;
- that each provincial geological survey attempt to work effectively with other departments/agencies in their province in order to develop the full potential contribution of the earth sciences;
- that geological mapping be primarily at the scale of 1:50,000 for the provision of detailed geoscience information to all sectors and to the public; that this mapping the compatible with standards established by the Geological Survey of Canada thereby allowing a transfer of data into national databases and for 1:50,000 maps to be compiled readily into 1:250,000 maps;
- that collaborative programs be established with the Geological Survey of Canada, similar to the recent

BCGS/GSC agreement for British Columbia, to NATMAP projects and between provinces, and involving academia and industry in the planning through final publication phases;

- that formal agreements be established, particularly with the Geological Survey of Canada, to share and/or utilize the intellectual talent and analytical and other specialized facilities (e.g., in geochemistry, paleontology, geochronology, geophysics);
- that provincial geological surveys diversify to work with a wider range of clients and to deliver a wider spectrum of geoscience information and services as allowed by their legislated mandate, and to work with other agencies to crease and coordinate broad geoscience databases;
- that provincial geological surveys focus on local to regional studies, with short to intermediate time frames, and particularly address issues of mineral, energy and water resources, and environmental protection, health and safety.

The federal Geological Survey of Canada is in a unique position to coordinate national geoscience information and develop geoscience databases, to provide specialized information and policy guidance; and to help interpret the complex nature of the Canadian landmass to a knowledge thirsty public. The GSC cannot accomplish these tasks alone and must develop a new network of clearly differentiated responsibilities and partnerships with provincial geological surveys as well as with academia and industry. It must recognize its role as a facilitator and coordinator rather than as the principal, dominant agent. Some specific recommendations, parallel in many respects to those listed for provincial geological surveys, include:

- that the GSC lead in the development and coordination of national geoscience databases;
- that the GSC attempt to work more extensively with other federal departments/agencies in order to develop the full potential contribution that earth sciences can make to the nation;
- that geoscience mapping be primarily at the 1:250,000 scale, with 1:50,000 mapping only completed in special situations and primarily under contract to or in formal collaboration with provincial geological surveys;
- that the GSC develop formal agreements with each province/territory (building on the recent BCGS/GSC draft agreement) to ensure common objectives, maximum efficiency, reduction of overlap, and shared costs; such agreements should have open planning through final publication phases that encourage the participation of academia and industry; the GSC has special responsibility for federal lands and in particular the Canadian offshore;
- that the GSC establish advisory boards familiar with the range of special facilities (*e.g.*, in geochemistry, paleontology, geochronology, geophysics) to consider how such facilities can be better managed and marketed to and shared with, the research community without undue completion with the geoscience service sector;
- that the GSC diversify to work with a wider range of clients and to deliver a wider spectrum of geoscience information and services as allowed by its legislated mandate, and to work with other agencies to create and coordinate broad geoscience databases;
- that the GSC focus on large regional and national programs, and contribute to relevant international programs, with intermediate to long time frames, and to particularly address issues of broad interest to the public, industry, the geoscience research community and to government (*e.g.*, scientific coordination (*cf.* Decade of North America Geology publications)); regional earthquake hazard; regional geological, geochemical and geophysical surveys to provide national map coverage; long term environmental monitoring; collaboration with industry and academic researchers to develop important scientific concepts, models and databases (*cf.* mineral deposit modelling; basin modelling; biostratigraphic and geochronologic timescales and correlations; development of national geoscience standards and information systems);
- the GSC should coordinate and disseminate information of international geoscience opportunities (with the aid of the Canadian International Development Agency (CIDA), the International Research and Development Corporation (IDRC) and other agencies); this activity can be largely as on-line bulletin board service that could be of value to Canadian industry, particularly the smaller geoscience service and consulting companies.