CHAPTER 9 POTENTIAL CHANGES IN INTERNATIONAL GEOSCIENCE

9 (a) International Geoscience Programs

Earth science is by its very nature a global enterprise that transcends political or physical boundaries. As has been discussed in earlier sections, the scale (both spatial and temporal) of earth system problems is such that long-term, global experiments and extremely expensive technology (*e.g.*, satellites, ocean-going platforms, *etc.*) will be required for their successful resolution. While individual institutions and nations will all make attempts to address these problems, they are of such magnitude that even the wealthiest of them cannot put together truly global experiments on their own – nor should they for effective scientific planning and implementation of global-scale programs requires a collaborative international efforts. As global scientific research budgets become more constrained, the need for international collaboration becomes even more acute, particularly for Canadian geoscientists. In order to provide scientific guidance for such programs and to facilitate international interactions, a series of international science organizations have been established. In this section we will take a brief look at the nature of these organizations and their potential role in the future of Canadian geoscience.

International Council of Scientific Unions

In an attempt to promote international scientific activity for the benefit of humanity as well as to rationalize the proliferation of international scientific bodies, The International Council of Scientific Unions (ICSU) was created in 1931. ICSU is a non-governmental organization with two categories of membership: scientific academies or research councils which are national, multidisciplinary bodies (83 in number), and scientific unions, which are international disciplinary organizations (20 in number). Representing the geoscience community within ICSU are the International Union of Geodesy and Geophysics (IUGG) and the International Union of Geological Sciences (IUGS).

To achieve its goals, ICSU initiates, designs, and coordinates major international, interdisciplinary research programs such as the International Geophysical Year (1957-1958), International Biological Program (1964-74), or more recently, the International Geosphere-Biosphere Program which is designed to try to describe and understand the interactions of the physical, chemical and biological aspects of the earth system, the changes that are occurring in this system, and the manner in which they are influenced by human actions. More than 40 nations are participants in the program; Canadian scientists have played an active role in the planning and implementing of many IGBP studies.

The National Research Council has been Canada's representative on ICSU since its inception. NRC has established Canadian National Committees for many of the ICSU member Unions, as well as a number of other international governmental and non-governmental organizations. While a mechanism is clearly in place for Canadian participation in international science programs, the NRC has not provided Canadian representation for many geoscience programs largely because federal geoscience activity resides mainly in Natural Resources Canada (i.e., the GSC), not in NRC.

The GSC used to act as the adhering body in Canada for the IUGG and IUGS but in recent years has delegated that responsibility and resources to the Canadian Geoscience Council. The level of funding is, however, modest and it has proven difficult to arrange the funding for Canadian membership on some international geoscience programs (*e.g.*, ODP).

9 (b) Canada and International Geoscience Programs:

As has been repeatedly demonstrated throughout this report, the economic and logistical realities of a global approach to earth science will be tied increasingly to large-scale, interdisciplinary programs that focus on manageable sub-components of the Earth System. Canada has a enormous amount to gain by participating in these projects, not the least of which is access often to millions of dollars worth of data and facilities at a very small fraction of the cost. An example of both the benefits to Canadian geoscience and the problems facing Canadian geoscientists resulting from involvement in international geoscience programs is Canada's involvement in the Ocean Drilling Program and its predecessor the Deep Sea Drilling Project. After twenty-five years of operation and a long list of impressive results (*e.g.*, confirmation of the theory of plate tectonic, discovery that the Mediterranean dried up, critical insights into crustal structure and ocean history), the international drilling program is going strong and still producing exciting results. Most relevant to our discussion here, a program of this magnitude (and thus many of these results) could not have come to fruition without a large-scale, globally focused,

globally funded program. While the magnitude of these programs is often intimidating, future developments in data-acquisition techniques, telemetry, and networking technologies should make such programs more efficient and manageable. The key question is: How well is Canada positioned to contribute to and benefit from these programs?

The potential role that Canada can play is evident if we look at the level of involvement of individual Canadian scientists in the initial formulation and planning of each of these programs. Canadian scientists have been key players in the organization of many programs and others have been sought out to serve on their international advisory panels. Clearly the international community recognizes the contribution that the Canadian scientific community has to make. It has been more difficult, however, to establish official Canadian representation in some of these programs and, in particular, to establish official Canadian national research efforts.

For example, while Canada is now a member of the Ocean Drilling Program, the Deep Sea Drilling Project operated for more than fifteen years without official Canadian representation. The Canadian geoscience community suffered from this and is only now beginning to recover. Canadian interest in participation in ODP came from several fronts. There was a ground swell of interest from the Canadian geoscience community (from academia, government and industry) made up in part by scientists who had participated in DSDP (even though Canada was not a member) but were frustrated by the inability to guide the program to problems of interest to Canada and by others who realized the opportunities of gaining access to the world's most sophisticated drillship and laboratory facilities. There was also the realization that if Canada was to be considered seriously in the international geoscience community, it must demonstrate that it was willing to share some of the fiscal responsibility for the community's major effort.

Despite the general acceptance of the need for Canada to become a member of ODP, in the absence of a formal mechanism for joining such organizations, the process of becoming a member was extremely difficult.

Several meetings were held in which representatives of a number of Federal Government departments participated (GSC, DFO, NSERC, Environment Canada, Foreign Affairs, Industry Canada) along with others from academia and industry. Approval for the scientific opportunity was not in question, but rather which agencies would pay the $3 million per year membership fee. Ultimately, all except Environment Canada made contributions, with the largest share falling to the GSC. Later financial crises forced Canada to seek a partner to share the cost; and Australia (at a one-third share) filled this roll. Now Canada and Australia are seeking another partner because Canada has to further reduce its level of participation (with the corresponding reduction in scientific involvement). The resulting perception is that Canada does not have a satisfactory system, and seemingly a commitment to adequately fund its international representations in interdisciplinary programs.

This is unfortunate because, since joining ODP, many Canadian scientists have been active participants in the scientific planning of the Program as well as in its shipboard and shore-based research programs. These scientists have become members of a global network of more than 1000 scientists and have gained the ability to influence the scientific direction of the world's largest marine geoscience program. For each Canadian-sponsored proposal that is selected for drilling, (eleven drilled to date and four highly ranked for future drilling), two months of shiptime, worth approximately US$7 million, as well as the resources of many scientists from universities and institutions from around the world, are brought to bear on a Canadian-defined scientific problem.

In addition to the immeasurable scientific benefit gained from ODP participation, there have been numerous other, direct financial benefits, including money spent by ODP during several Canadian port calls (over $3 million), the contract to print the volumes summarizing the results of ODP in Manitoba ($800,000 per year), and Canadian technicians and logging contractors working on the JOIDES Resolution ($300,000 per year).

The ultimate conclusion is that as has been concluded by numerous review panels, we have gained both scientifically and financially much more than it has cost us.

The problem associated with ODP is not unique. A small Canadian World Ocean Circulation Experiment (WOCE) program has been funded and, after a long and sometimes painful process, a Canadian Joint Global Ocean Flux Study (JGOFS) program has now been funded, though many years behind the international community. Individual Canadians are active participants in InterRIDGE and the Nansen Arctic Drilling Program, but at present their involvements are ad-hoc with little official sanction. The Canadian Continental Drilling Program, a subset of an international program, has likewise yet to receive approval and funding.

The problem seems to lie in part in identifying a clear mechanism or agency for establishing official Canadian participation in international programs. In most developed nations doing serious ocean science, the majority of the research is done at academic institutions. In Canada, however, the majority of ocean science is done in government laboratories under the direction of several different departments. As multidisciplinary programs evolve, we are thus faced with the task of coordinating the interaction of several federal departments. Past experience has shown that this can lead to lots of "buck passing" and "finger pointing"; everyone is interested but each thinks that another department should pay.

The problem appears to be getting worse lately. Our government laboratories have a number of very talented ocean scientists. Unlike their academic colleagues, however, they work for departments with specific and often evolving mission statements. There is no question that the mandates of these departments incorporate many of the objectives of the large-scale interdisciplinary programs, such as those described. Over the past few years, however, there has been a growing trend for the work of the Government laboratories to become more focused and "client-oriented". There is an ever-shrinking small number of relatively poorly funded and equipped academic researchers who are free to take the long-term outlook necessary for addressing global research issues.

What can be done about this? We need to identify a body that can serve to coordinate Canada's role in international Earth System research programs, act as the focal point for the organization of Canadian national programs, and serve to lobby the highest levels of government for worthwhile research causes. This body should be made up of representatives of the various constituencies (government departments, academia, and industry) and have a

budget of its own, but not be dependent on, or responsible to, any one department. Ideally there would be new (perhaps Green Plan) money for this effort, but if a zero-sum game must be played, funds could be tithed from the supporting departments. The body would review proposals for Canadian participation in (or initiation of) various interdisciplinary Earth System projects and, for those deemed meritorious, establish a budget and maintain some oversight authority. The body should not be charged with managing the Canadian national programs but should rather facilitate their organization. Once established, the Canadian national programs would have management structures of their own.

Within such a body, NSERC should be a representative of the academic community. We must encourage NSERC to accept its responsibility as the primary sponsor of basic research, and many of these interdisciplinary programs are fundamentally concerned with basic research. NSERC should also attempt to encourage an occasionally insular academic community to participate actively in these programs. NSERC has taken a very important step in this direction by its increasing support for the Collaborative Research Grants Program.

To the dismay of some, but to the benefit of many, and particularly to the benefit of our science, these large-scale, interdisciplinary programs are forming the foundation of our future research efforts. Given that few, if any, nations can forge ahead with global or large regional science programs independently, there is a clear need to better plan and manage such programs jointly. European nations have improved this planning process over the last decade. Though these programs may become bogged down in a bureaucratic quagmire, they can, if organized and managed properly, bring together specialists from often disparate disciplines and forge new alliances and lines of communications that would have been unimaginable ten years ago. This process of cross-fertilization can, with little extra effort, give rise to the critically needed system integration (often by just putting these people together in the same room) and, as this process is witnessed by younger scientists, can lay the groundwork of the training for future "system scientists". Taken to an idealistic extreme, the final output and impact of these large-scale, interdisciplinary programs, may very well be greater than the sum of their individual contributions.

9(c) International Industrial Competitiveness and Marketing of Geoscience Services

In Chapters 2 and 5, data are provided that indicate the importance of exports of resources to the Canadian economy and of the increasingly international operation of the earth resource and environmental industrial sector. The present surge of mineral exploration work in South America and Asia by Canadian companies and by geophysical, geochemical, and environmental service companies is but one example.

In an increasingly competitive market, it is essential that Canadian companies enhance their global competitiveness. Many companies will regard this as an internal corporate matter. However, in other countries (*e.g.*, US, UK, France, Germany), there is a much more coordinated approach to generating a competitive edge. National geoscience surveys and universities commonly assist individual companies, or consortia, in providing contacts and specialized personnel, advice, and facilities. The Geological Survey of Canada in recent years has embarked on a limited program of support. As suggested in Chapter 7, the GSC, working with the provincial surveys and university geoscience departments, could coordinate a more ambitious program.

International industrial competitiveness involves many more facets than can be covered in this present report (*e.g.*, venture capital, trade regulations, taxation), and the reader is referred to a variety of recent broad studies on this topic (*e.g.*, Sparrow, 1990; National Advisory Board on Science and Technology, 1991; Halliwell and Bellini, 1992).