Geoscience Canada

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Volume 26, Number 3, September 1999

URI: https://id.erudit.org/iderudit/geocan26_3art05

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Publisher(s)

The Geological Association of Canada

ISSN

0315-0941 (print)
1911-4850 (digital)

Explore this journal

Cite this article

Hall, J. (1999). NSERC Funding of Earth Sciences Research in Canadian Universities: Current Status and Opportunities. *Geoscience Canada*, *26*(3), 141–144.

Article abstract

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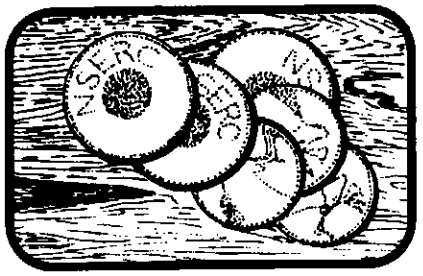

NSERC Funding of Earth Sciences Research in Canadian Universities: Current Status and Opportunities

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SUMMARY
This article outlines current funding of geoscience research by the Natural Sciences and Engineering Research Council of Canada (NSERC), and opportunities for enhancing researchers' access to its programs, especially the University-Industry Program.

RÉSUMÉ
Le présent article présente les grandes lignes de l'état actuel du soutien financier accordé par le Conseil de recherches en sciences naturelles et génie du Canada dans le domaine des sciences de la Terre, ainsi que les moyens mis en oeuvre visant à faciliter aux chercheurs l'accès à ses programmes et en particulier à son programme de partenariat industrie-université.

PREAMBLE

There is an urgent need for greater cooperative effort among the academic, government and private sectors if we wish to sustain, or increase, the level of public funding of geoscience research in Canada. That effort needs to be directed toward the definition of research targets, the pursuit of funding for them, the attraction of excellent scientists to carry out the research, and the enhancement of public awareness of the value of the work. The Canadian Geoscience Council (CGC) provides a forum for discussion of such matters among its member societies and associates, and we welcome dialog also with other groups that have interests in this issue, including those representing geoscience employers. CGC and the Royal Society of Canada will be sponsoring a special session on this theme at the GeoCanada 2000 meeting in Calgary in May-June 2000 (see Calvert *et al., Geoscience Canada,* 1999, p. 145-147). Before then, we must lay the groundwork, of which this article is one element.

This article outlines current funding of geoscience research by the Natural Sciences and Engineering Research Council of Canada (NSERC), and opportunities for enhancing researchers' access to its programs. NSERC provides funds for most non-medical science and engineering research in Canadian universities, including its partial support of collaborative research undertaken with additional support from government and/or industry. NSERC funding is important to all geoscientists, not just because it is the primary sponsor of research in academe, but also because that support provides the resources and mechanisms for training of most professional Canadian geoscientists. Because NSERC is a public body, it is relatively easy to measure inputs and outputs: access to NSERC's budgeting and its history of funding is relatively straightforward, and the deliverables are publicly available and so are potentially usable by all sectors. (The level of funding of geoscience research in the private sector, and how it is changing, is difficult to ascertain, although CGC would be interested in gaining information on this. The level of funding of geoscience research in government can be estimated from public accounts: it is very broadly comparable with the levels provided to academe through NSERC and the universities.) Many of us will be aware of the major cuts in government geoscience, characterized by the 40% budget reductions suffered by the Geological Survey of Canada through the program review of the mid-1990s, and by the narrow escapes from extinction of some provincial geological surveys. The restriction of the view presented here to NSERC-related geoscience research is pragmatic, but the implications for other sectors partnering with academics, and especially for the training of future recruits to those sectors, are serious. So, if you are in government service or work for the private sector, stay tuned: this is for YOU, too.

HOW WELL ARE WE DOING? DOWNWARD FORECAST, NEEDS REVERSING!

NSERC provides funds for research in the universities in natural science and engineering: other research councils are responsible for medical and social science research. NSERC distributed close to $500M during the fiscal year 1998-99. In Figure 1, the NSERC funding envelope for all sciences and engineering research is summarized in the big, bold pie. This is divided into the three main program areas of Research Partnerships, Research Grants and Training (smaller, lighter pies). The amounts awarded to earth scientists from each of these pies is listed below them. A summary for the earth sciences is included in the box inset at the bottom. Most of the figures were taken from NSERC accounts for the 1998-1999 fiscal year. The exception is the University-Industry Program, for which figures have been averaged from 4 years ending in 1998, to provide a clearer view of this program, which is a primary focus of this article. For some programs, it was difficult to extract correct numbers attributable separately to environmental and solid earth scientists: in such cases the earth sciences total is given, undivided. We should note that NSERC's budget has increased in the last two budgets, but this should not be viewed by geoscientists with any complacency. NSERC offers a variety of funding programs. Let's review these in turn.

RESEARCH GRANTS PROGRAM

The Research Grants Program provides general support for the ongoing research programs of individuals or groups. Below this umbrella, the **Equipment and Major Facilities Access Programs** provide support for equipment purchases and researchers' access to major regional or national research facilities. Earth scientists received $4.2M of the $58M available in 1998-1999 (7.3%). The largest part of this overall program is that of **Research Grants** themselves: $227M, 47% of the NSERC total. These are distributed through 26 disciplinary subcommittees

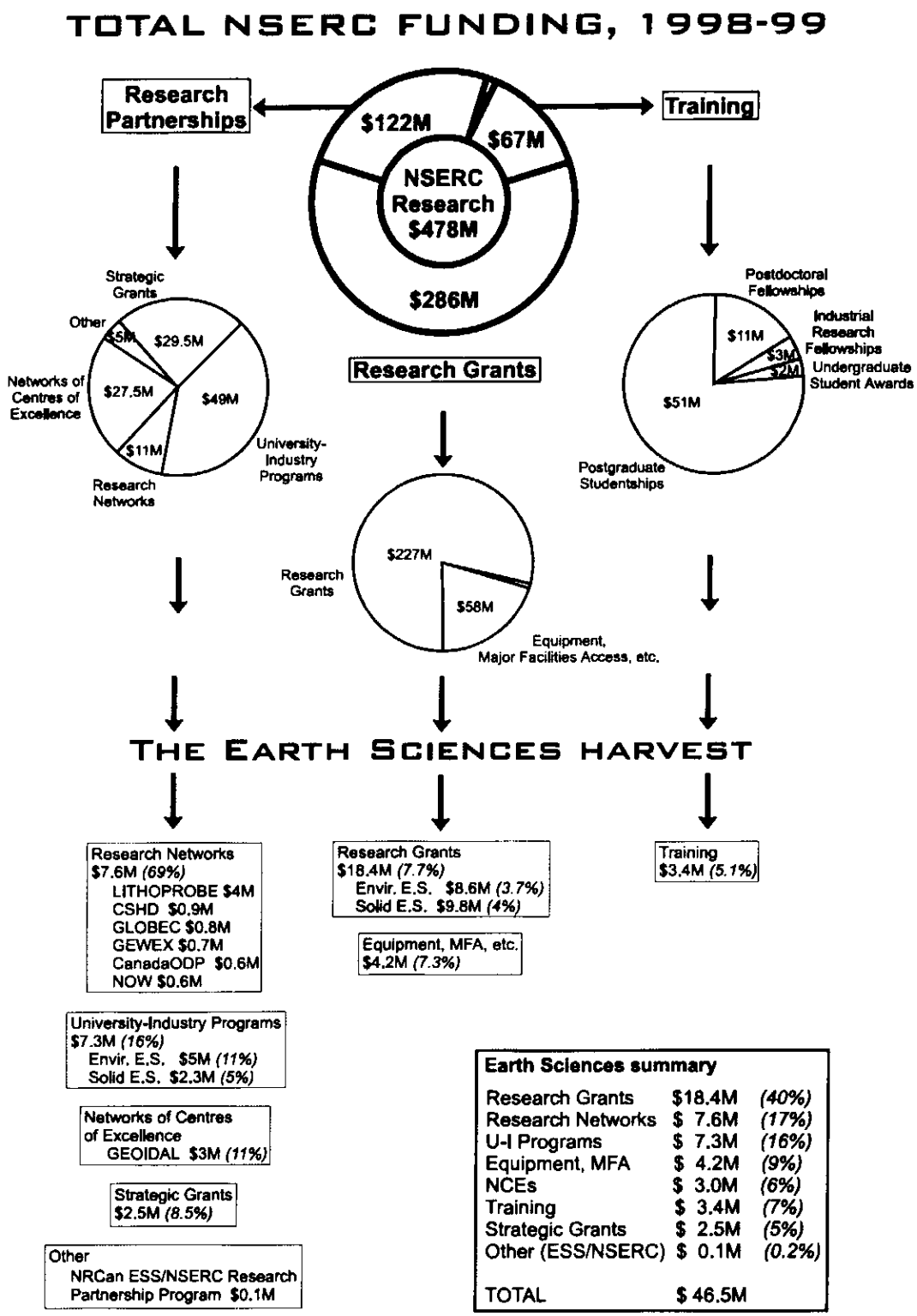

Figure 1 Funding of research by the Natural Sciences and Engineering Research Council of Canada (NSERC), based on 1998-1999 budget year, divided among the various funding programs, and drawing out the earth sciences components (divided between environmental and solid earth sciences, where possible). CSHD = Climate System History and Dynamics; GLOBEC = Global Ocean Ecosystems Dynamics; GEWEX = Global Energy and Water Cycle Experiment; Canada ODP = Canadian component of the Ocean Drilling Program; NOW = Northern Ocean Waters project; NRCan = Natural Resources Canada; ESS = Earth Sciences Sector, Natural Resources Canada; MFA = Major Facility Access; U-I = University-Industry; NCE = Network of Centres of Excellence; Envir. E.S. identifies funds awarded to investigators from the environmental earth sciences grant selection committee; Solid E.S. identifies funds awarded to investigators from the solid earth sciences grant selection committee. In the boxes of the various NSERC programs, the awards to earth scientists are given as percentages of the funding in the specific programs. In the earth sciences summary box (lower right), the percentage of the total earth sciences funding gained under each program is given.

(grant selection committees or GSCs), to which scientists apply every 4 years. In order to redistribute the funds among the GSCs, NSERC now conducts reallocation exercises every 4 years. This has happened twice in the 1990s, and the earth sciences fared worse than average on both occasions. In the last exercise, just completed (refer to http://www.nserc.ca/programs/realloc/report.htm), each GSC was taxed 10% and the total collected was redistributed on the basis of peer reviews of reports submitted by the GSCs. The two earth science GSCs — environmental and solid earth sciences — decided to submit a joint report (in the previous exercise, the submission of separate reports was deemed to have been problematical because of the overlap of research themes). According to the Reallocations Committee, the report "showed that the scientific contributions of Canada's earth sciences community are excellent and numerous, and that Canada is a leader in this area" but did not "provide a compelling view of emerging areas and priorities for the future." Three groups fared worse, and 17 better. *The earth sciences got back only 60% of what they were taxed.* The federal budget increase meant that the two earth science GSCs did find themselves with an overall increase of just over 8%, but the median increase for all GSCs was 15%. The two reallocations exercises in the 1990s have lost the earth sciences around $1M in research funding relative to other disciplines. In 1998, the earth sciences received more than $18M through research grants to support non-targeted, curiosity-driven research, divided rather evenly between the two GSCs, with 4.0% of the total for solid earth sciences and 3.7% for environmental earth sciences.

Against this yardstick, the geosciences do both much better and much worse with various other NSERC programs.

THE TRAINING PROGRAM

The Training Program provides support for undergraduate industrial and summer students, postgraduate research students, postdoctoral fellows, and industrial research fellowships. Here the earth sciences community receives rather less of this pot (5.1%) than its proportion of Research Grants (7.7%).

THE RESEARCH PARTNERSHIPS PROGRAM

The Research Partnerships Program supports research that is targeted to industrial and societal needs, in either directed or responsive modes. It includes several program areas:

The Strategic Grants Program supports pre-competitive university research in partnership with participants from outside the university sector. It is structured around six research areas that have been targeted for acceleration by NSERC. Earth scientists participate in several of the program areas, particularly that of Environmental Technologies. Those projects in which the main focus is in an area of earth sciences receive $2.5M per year currently, or 8.5% of the annual funding of this program. Because these are often multidisciplinary projects, the amount of funding to earth scientists, as narrowly defined here (GSC 08/09 "types"), is probably somewhat overestimated by that total.

Research Networks fund large collaborative projects. Here the geosciences do extraordinarily well, because of the LITHOPROBE project, the Canadian contribution to the international Ocean Drilling Program (ODP), and several major environmental research projects. *$7.6M — nearly 70% of the annual distribution from this pot — support these very successful geoscience projects.* Indeed, the earth sciences has a long record of success in this program (and its predecessor, the Collaborative Special Projects Grants), through a series of excellent projects, many on environmental themes. This is cause for celebration, but we must recognize that LITHOPROBE is scheduled to end in 2003, and will be receiving progressively fewer dollars during its time to completion. The Canadian financial commitment to ODP is also timed to end in 2003. If we want to replace LITHOPROBE with some other "megaproject," and sustain, modify, or replace CanadaODP, *it is time to act.*

Networks of Centres of Excellence (NCEs) are very large research networks sustained by a joint effort of the research councils and Industry Canada. (LITHOPROBE started before the NCE program, and so does not adhere to all the structural requirements of that program, but is regarded by many informally as being equivalent to a NCE). *Earth scientists are heavily involved in one NCE — GEOIDAL — which is centred in the geomatics community.*

The University-Industry Program supports industrial research chairs and collaborative research and development projects, both of which require private sector contributions which NSERC may match. Grantees from the two earth science GSCs do quite well in this program; together we pull in 16% of this pot, twice the proportion of our pickings from the Research Grants pot. There are significant opportunities in this particular program to which the rest of this article is devoted.

ANALYSIS OF UNIVERSITY-INDUSTRY RESEARCH FUNDED BY NSERC

Averaging figures for new awards made over the last 4 years (1994-1998), earth scientists have received more than $7M per year from the University-Industry Program. Most of this is matched by industry contributions of similar proportions. Together, these funds constitute a significant proportion (about 16%) of NSERC-related support for earth science research in Canadian academe.

Environmental earth scientists do twice as well as solid earth scientists, earning approximately $5.0M per year from this program. For the environmental group, more than 60 companies supported 62 projects during the 4-year period. The companies involved have diverse foci: 9 mining companies, 13 oil companies, 8 environmental service/research companies, and 31 others from the power corporations, through chemical manufacturers, to electronics companies. Environment Canada partners with private sector companies in some of these projects, especially those in areas in which the private sector is not considered to be sufficiently robust. It is reassuring to learn that our environmental scientists are doing so well. Using the level of Research Grant earnings as a benchmark, their relative performance in the University-Industry programs is second to none, placing them well ahead of chemical and metallurgical engineering, civil engineering, and the broad areas of communications, computing, and associated electrical engineering.

Solid earth scientists have fared a little less well, garnering only $2.3M per year. Other comparative figures are that, in the same period, 78 companies (41

mining, 31 oil, and a handful of others) supported 50 projects, 32 in the general area of mining, 13 in petroleum, and five in environmental science. Relative to their Research Grants benchmark, this group fares better than average, but not exceptionally well.

Most graduates from solid earth science degree programs in Canadian universities find employment in the "non-renewable" resource industries, and this provides a strong linkage between those industries and the universities. Consequently, the relatively low level of success in the University-Industry Program is somewhat surprising and a little disappointing. The mining industry appears to support more than twice as many projects (on the exploration side), as does the petroleum industry. Analysis of the latter indicates good support of a number of projects in sedimentology and stratigraphy, multi-company support of a small number of very well-funded geophysical research consortia, but only one (multi-company-sponsored) project in structural geology, one in organic geochemistry, and none in petroleum systems nor in geodynamics/basin modelling.

OPPORTUNITIES FOR ENHANCED CO-OPERATION

It may be surprising that the apparent order of success (as measured by numbers of funded projects) in the University-Industry Program support is environmental (first), mining, and petroleum. To some of our colleagues, the result may be reassuring; to others, it should be a challenge! It is beyond the intended scope of this article to interpret the results, but there are some obvious questions to ask.

- Is there research industry would like to get done but is unable to find an adequate supplier capacity in the Canadian university community?
- Is industry finding that capacity elsewhere, in specialist service companies, in government science organizations, or in institutions outside of Canada?
- Is the Canadian academic community making its research capability adequately known to potential industry clients?
- Is the spectrum of capability in geoscience in Canadian universities misaligned with industry needs for research?
- Are definitions of research different between industry and academe?

These questions beg others, of course. Industry has obligations to shareholders that force strong competition, so that confidentiality is often a requirement of the research it sponsors. University faculty are obliged to publish research. Do these differences make life difficult at the interface? Yes, but these contrasting obligations are often bridged successfully by agreements for limited-term confidentiality, although such arrangements are not always practicable. Why doesn't academe focus more on industry problems? Often, industry research has to be very narrowly focussed, meaning that a problem must be solved within a very limited set of parametric variation. Academic research is usually driven by rather broader "process" questions, and the need to attract the brightest minds into our discipline (to the ultimate benefit of the private sector that employs many of them after their academic careers). Nevertheless, there are huge areas of overlap between good academic (*i.e.*, publishable) research and valuable industrial research.

Stronger communication among the sectors — including debate about the issues raised above — is likely to help us identify opportunities for more effective co-operation. It is important that this debate takes place. NSERC has an imaginative spectrum of funding programs that we can tap more effectively than we do now, but better communication among the sectors is needed to build the necessary momentum. Note that the Earth Sciences Sector of Natural Resources Canada has just created with NSERC a 5-year "Earth Sciences Research Partnerships Program," with each contributing $0.5M, but requiring third partners to be found to match each organization's funding. So here is another opportunity for us to pursue. There is no shortage of them: we just need to work harder together to address them.

The Canadian Geoscience Council offers a forum for discussion of such issues, including its sponsorship of the sessions at GeoCanada 2000 (29 May-2 June 2000, Calgary) on earth science research for the 21st century. CGC welcomes input from employers on these matters, in assisting it to bridge to groups such as the Council of Chairs of Canadian Earth Science Departments (CCCESD), which is already formally represented at the CGC table. Please contact CGC through me on these matters.

ACKNOWLEDGMENTS

I wish to thank Elizabeth Boston and Rita Carriere, both of NSERC, and their colleagues, for their extensive help in extracting the data summarized in this article. Elizabeth Boston, Alan Morgan, Paul Robinson and Roger Macqueen provided valuable commentary on earlier drafts of the manuscript.

Accepted as revised 20 July 1999