GEOLOGICAL SURVEY OF CANADA

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NATMAP
Canada's National Geoscience Mapping Program
Report of a workshop held March 8 - 10, 1990

written by
the Geological Survey of Canada NATMAP Committee

edited by
M.R. St-Onge

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CANADA'S NATIONAL GEOSCIENCE MAPPING PROGRAM

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Continental Geoscience Division

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"In most countries, including the United States, Canada and Australia, the need for high quality geologic maps has outstripped their production. The shortage of accurate, detailed geologic maps seriously impairs the ability of geologists to fulfil our diverse roles in meeting the dual challenges of economic development and environmental degradation. The problem is global. A mosaic of national solutions is urgently required."

Society of Economic Geologists
Newsletter, April 1990, No. 1.

CONTENTS

I N T R O D U C T I O N

INTRODUCTION

by M. R. St-Onge[1]

Geoscientific maps constitute the principal earth science information base required by a host of users ranging from exploration geologists, resource development and planning managers, geotechnical engineers, environmentalists and research scientists for site investigations, environmental assessments, urban planning, economic evaluation and other uses. A widening gap between production of geoscientific maps in Canada and the growing demand for geoscientific information therefore poses a problem of national scope which must be addressed.

The Geological Survey of Canada (GSC) prepared an internal document in January, 1989 outlining a potential GSC National Mapping Program to fill this 'map gap'. As a result of discussions with other mapping agencies in Canada, a group of active geological mappers from the Ottawa office of the GSC prepared a revised program, much broader in scope and potentially involving all mapping agencies in Canada, titled "Canada's National Geoscience Mapping Program (NATMAP): a Proposal" (Section 1 of this report).

This October 1989 document proposed enhancement of geoscientific mapping through coordination of effort among the various mapping agencies in Canada, directed toward: (1) new regional mapping involving complete multi-parameter synthesis of information from surface geoscience; and (2) thematic mapping in three dimensions where economic and scientific interests warrant. NATMAP was also envisaged as promoting development of standards and coordination of digital data systems for geoscientific information, and standards for geoscientific maps and compilations. The document proposed a national coordinating committee to oversee the activities of NATMAP, evaluate project proposals, solicit funding and ensure the most cost-effective and scientifically-effective mapping by pooling of resources of participating agencies.

Seventy Canadian geoscientists, representing a broad cross-section of federal and provincial governments, academia and private industry discussed the NATMAP proposal and nine related topics (Section 2 of this report) at a workshop held March 8-10, 1990 in Toronto. Summaries of the deliberations were prepared by the discussion group rapporteurs and leaders during the course of the workshop. The summaries are presented in Section 3 of this report. The results of a questionnaire on NATMAP, distributed to the workshop participants (Appendix 1), are summarized and tabulated in Appendices 2 and 3.

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[1]Addresses of authors can be found in Appendix 4 (NATMAP Participants)

The participants reached a broad consensus on the overall concept, goals and objectives of NATMAP. This consensus is embodied in the following recommendations.

1) NATMAP should emphasize regional mapping of bedrock and surficial geology.

2) NATMAP should fill 'knowledge gaps' (e.g. economic, geographic, environmental, academic) while striving for greater regional coverage.

3) NATMAP should allow the nature of a problem to determine the regional extent and shape of the area to be mapped, and hence the appropriate scale.

4) NATMAP should establish minimum standards for digital data acquisition, and insist on digital data acquisition in the field. Standards used by the U.S. Geological Survey or others may be suitable for adopting/adapting.

5) NATMAP should establish national cartographic standards, through a study group of the National Geological Surveys Committee, or another group.

6) NATMAP products should be subject to a rigorous peer review process.

7) NATMAP should foster coordination of mapping activities among universities, federal, provincial and territorial surveys.

8) NATMAP should emphasize multidisciplinary studies taking advantage of shared logistics and scientific cadres for data acquisition and integration.

9) NATMAP transect studies (if any) should be spearheaded by geological mapping, and hence complementary to LITHOPROBE, not a replacement for it.

10) NATMAP efforts should be restricted to the continental landmass.

11) NATMAP should use existing and future technology for digital mapping, but development of technology is not specifically part of its mandate.

12) NATMAP should be operated by a small Secretariat based at the GSC in Ottawa, and controlled by a National Coordinating Committee representing all participating agencies. An interim Steering Committee should be set up to establish formal guidelines and procedures in order to implement the NATMAP.

13) NATMAP should lobby NSERC in the strongest terms to classify geological mapping as research and provide funding for it.

14) NATMAP should ensure a future supply of geoscientific mappers by employing undergraduate and graduate students, and providing high quality, on-going field training.

15) NATMAP should not consider compilation products, for example 1:1 000 000 scale bedrock maps, to be a primary product.

16) NATMAP should not undertake systematic regional geophysical or geochemical mapping, although available information will obviously be used, and new information may be generated if essential.

These recommendations define guidelines for the NATMAP initiative, but do not, by themselves, contribute to the solution of the problem which NATMAP was designed to address. Solution of the 'map gap' requires geoscientists on the ground and mapping, which in turn requires allocation of money and personnel. The next step in the NATMAP initiative must be the identification and allocation of the necessary resources, undertaken in the co-operative, consultative spirit characteristic of the NATMAP consensus.

S E C T I O N 1

CANADA'S NATIONAL GEOSCIENCE MAPPING PROGRAM (NATMAP): ORIGINAL PROPOSAL (OCTOBER 1989)

CANADA'S NATIONAL GEOSCIENCE MAPPING PROGRAM (NATMAP): ORIGINAL PROPOSAL (OCTOBER 1989)

by the GSC NATMAP Committee

1. Background Rationale

Geoscientific maps constitute a principal earth science information base. Exploration geologists, resource development and planning managers, geotechnical engineers, environmentalists and research scientists from both the private and public sectors all employ geoscientific maps for uses ranging from short-term studies (site investigations) to long-term projects in research, planning or development (Mankin, 1988). However, in Canada a gap exists and continues to widen between the demands of geoscientific map-users for more up-to-date maps and the production of new maps (Andrews and Lawton, 1988; Canadian Geoscience Council Review Committee, 1988). It is evident that coordination of the mapping programs of the federal, provincial and territorial surveys as well as integration of efforts with other mapping activities in academia and possibly industry would enhance the overall production of geoscience maps in Canada. Such an initiative is outlined in this note and called the National Geoscience Mapping Program (NATMAP).

2. Definition

The National Geoscience Mapping Program (NATMAP) is aimed at enhancing the quality and quantity of geoscience maps in Canada through a variety of mechanisms. It is initially planned as a 10 year coordinated program involving federal, provincial and territorial surveys as well as Canadian universities and other interested groups. In its present form, NATMAP is not intended to provide complete systematic map coverage of Canada. This, however is obviously an ultimate long-term objective of such a program.

3. Objectives

NATMAP aims to enhance the national geoscientific information base by: a) raising the level and profile of mapping activity in Canada; and b) fostering an increase in the coordination of mapping activities amongst federal, provincial and territorial agencies.

The specific objectives of NATMAP are to:

a) Expand and up-date map-based geoscientific information for the Canadian landmass and offshore areas;

b) Improve Canada's regional geoscience map coverage for purposes of facilitating resource assessment and development and for addressing environmental concerns.

c) Introduce mechanisms that will result in a coordination of geoscience mapping in Canada.

4. Range of Activities

NATMAP will support a range of activities to maintain and enhance the Canadian geoscientific information base through mapping. As focal points however, two principal themes are emphasized. The first is the production of more high-quality maps of continental and offshore areas through systematic regional geoscience mapping projects. The second theme is the development of major integrated, mapping-based projects to address a number of key geological problems in Canada.

Regional Geoscience Mapping Projects. Systematic regional mapping of continental and offshore areas, at various scales appropriate to the agency and location, has always been a major activity of the Geological Survey of Canada and the provincial and territorial surveys. Because: 1) such mapping has waned in the last decade: 2) older maps become obsolete as geological concepts change, and 3) obsolete maps are the only surface geoscientific information base for vast areas of Canada, it is proposed through NATMAP to revitalize this essential, on-going activity. With mineral resources constituting a major component of the Canadian economy, it is imperative that the Canadian geoscientific information base be maintained through the production of modern regional geoscientific maps by federal, provincial and territorial surveys. This first theme of NATMAP would include regional mapping projects which have as a principal goal the complete (multi-parameter) synthesis of information from surface geoscience.

Major Thematic Mapping Projects. A large number of the easily-discovered mineral deposits in Canada are now being developed or have been depleted (Andrews and Lawton, 1988). Increasingly, we must turn to science and technology to find more deeply buried resources (Moore, 1989). A multidisciplinary team approach is an efficient way of increasing the breadth of information that can be brought to bear on a particular area. Of particular concern is the need to develop new methods of "vertical mapping" in which modern concepts and technologies are combined to yield third dimensional map information. Such projects are most desirable where economic and scientific interests require a complete and precise knowledge of the distribution of rock units and an understanding of geological processes at the surface and at depth.

5. Participants and Regions

It is envisaged that participants in NATMAP will include the Geological Survey of Canada and other federal agencies, provincial surveys, territorial resource agencies and university groups. In addition, discussions would be sought with industry groups and organizations with a view to eventually involving the private sector in NATMAP. Coordinated projects could be proposed by any member or agency of the Canadian geoscientific community. It is proposed that the individual project proposals would be evaluated by an overall NATMAP coordinating committee (see point c) in Mechanisms). Decisions on project proposals would be based on considerations of scientific, logistic and economic merit as well as on general societal needs. For purposes of NATMAP, the Canadian landmass and adjacent offshore areas would be subdivided into the following broad geological regions, within which project proposals would be considered:

a) Appalachian/Atlantic
b) Canadian Shield (including Hudson Bay platform and St. Lawrence Lowlands)
c) Interior Plains
d) Cordilleran/Pacific
e) Innuitian/Arctic

6. Mechanisms

a) Acceleration of regional geoscience map coverage. Within the context of NATMAP, federal, provincial and territorial surveys would continue to conduct, as a long-term primary activity, coordinated high-standard geoscientific mapping of regions presently known only on the basis of small-scale mapping (Canadian landmass and offshore). For its part, the Geological Survey of Canada would strive to substantially increase the level of funding (presently ~ $10 M) for regional mapping projects in Canada in order to: 1) enhance its fundamental activity of providing regional map coverage; and 2) arrest erosion of the national geoscientific information base caused by declining mapping activity. Similarly, provincial and territorial agencies would be encouraged to seek parallel enhancement of mapping efforts within their respective jurisdictions.

b) Initiation of thematic mapping projects. The federal, provincial and territorial surveys will be urged to allocate new funds to initiate integrated, multidisciplinary, geoscience mapping activities in high-priority target areas. In many instances it is assumed that these projects will be multi-jurisdictional, involving joint venture arrangements between participants (federal, provincial, territorial, university, industry).

c) A national coordinating committee would receive and evaluate proposals appropriate for coordinated (regional or thematic) mapping programs. The committee would comprise experts from various geoscience disciplines from 1) the Geological Survey of Canada, 2) provincial and territorial surveys, 3) other federal agencies, 4) universities and 5) industry (Figure 1). The committee would undertake an annual program review in order to monitor progress on NATMAP projects and aid in the consideration of future activities.

7. Related Activities

a) Activities within NATMAP should be compatible with 1) a strategy to develop coordinated digital and computer based data systems, 2) accepted standards and conventions, and 3) the format for national small-scale compilation programs such as for example, the Geological Survey of Canada's "Atlas of Canada" program. For each of these linkages there are separate initiatives in process, in part under the auspices of the National Geological Surveys' committee.

b) A number of other initiatives and activities within the Geological Survey of Canada and within various provincial surveys will have obvious linkages with NATMAP. At the Geological Survey of Canada, these include FGP (Frontier Geoscience Program), EXTECH (Exploration Science and Technology Program) and the proposed National Rock Properties Laboratory. In the provinces, similar connections will be evident within individual provincial initiatives. Mineral Development Agreements (MDAs) or similar federal-provincial initiatives will provide opportunities for NATMAP-related activities.

The importance of digital systems such as GIS is recognized in the delivery of NATMAP. Discussions as to whether these should be an integral part of NATMAP or constitute a separate but important topic are on-going. It should be noted that there appears to be a difference of opinion concerning this matter within the geoscience community.

8. Funding

Financial participation in NATMAP would be negotiated on an individual project basis. It is anticipated that pooling of resources for selected NATMAP coordinated projects by the Geological Survey of Canada, provincial surveys and other federal surveys will result in more cost-effective mapping by participating agencies. Initiatives such as MDAs would be used

as funding sources, where appropriate. Other mechanisms, such as joint-venture partnerships with industry participants will be investigated.

9. Proposed Schedule

It is proposed that discussions concerning consultation and implementation mechanisms will take place over the fall and winter of 1989-1990. Initial field work for agreed-upon pilot projects could begin in 1990. A proposed schedule of activities is outlined in Figure 2.

10. Examples of Proposals for NATMAP Projects

Summaries of examples of proposals for regional geoscience mapping projects are presented in **Table 1.** Summaries of examples of proposals for thematic mapping projects are presented in **Table 2.** As well, three more detailed examples are given in **Appendix A.** These examples are included to illustrate the wide scope in type of projects that potentially could be considered by NATMAP; they do not constitute a list of approved projects.

11. References

Andrews, A.J., and Lawton, S.
1988: Prospectors need better maps, says PDAC; in Prospectors and Developers Association of Canada Digest, Autumn issue, p.1-2.

Canadian Geoscience Council Review Committee
1988: Preliminary report on the activities of the Geological Survey of Canada.

Mankin, C.J.
1988: Geologic mapping: will needs be met?; Geotimes, November issue, p. 6-7.

Moore, R.
1989: Exploration: past, present and future.; seminar at Carleton University by the Falconbridge Regional Exploration Manager for Western Canada, 19th January.

The NATMAP proposal was prepared by the following committee:

M. St-Onge (CGD) - chairperson
K. Card (CGD)
F. Chandler (CGD)
C. Jefferson (MRD)
A. Jones (CGD)
J. Percival (CGD)
J.-S. Vincent (TSD)

Figure 1:

NATIONAL GEOSCIENCE MAPPING PROGRAM
ORGANIZATION SCHEME
(TENTATIVE)

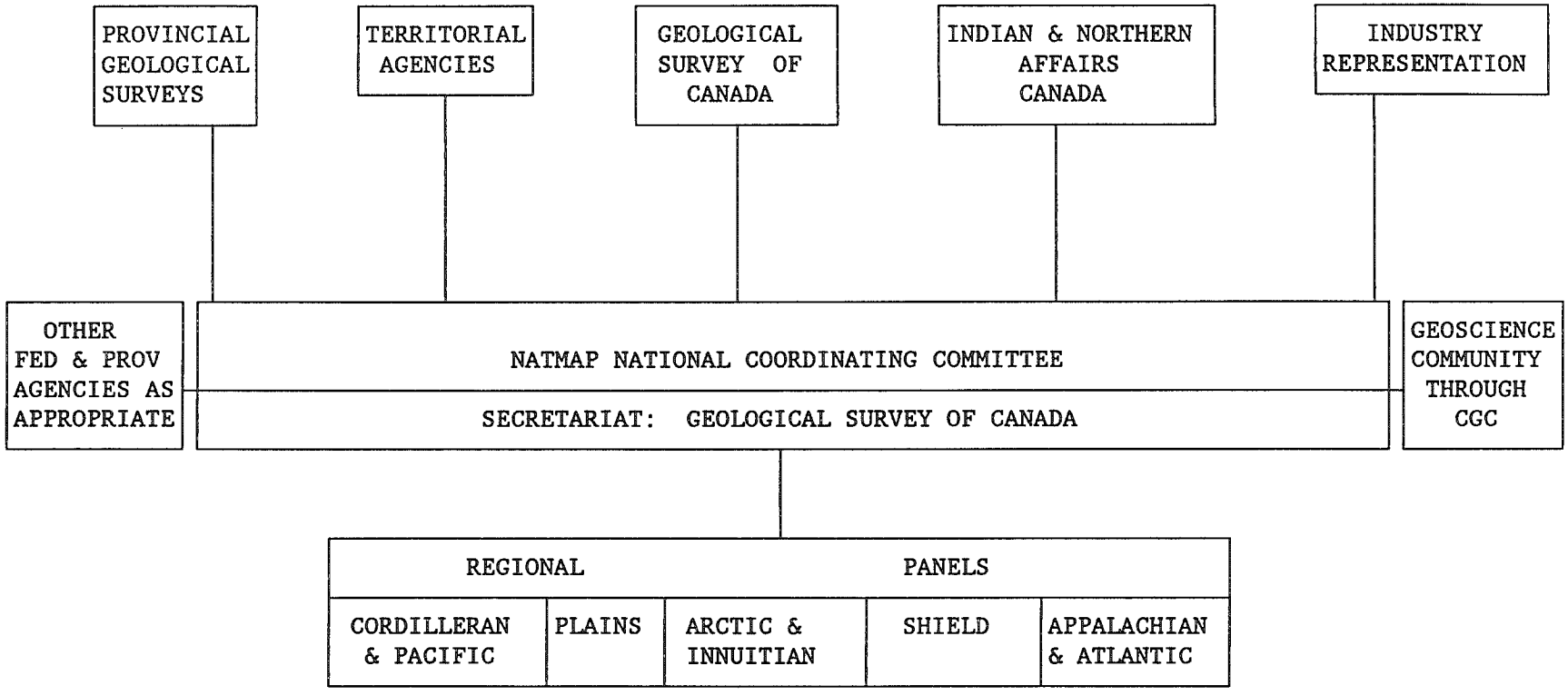

Figure 2:

NATIONAL GEOSCIENCE MAPPING PROGRAM
SCHEDULE OF ACTIVITIES
(Tentative)

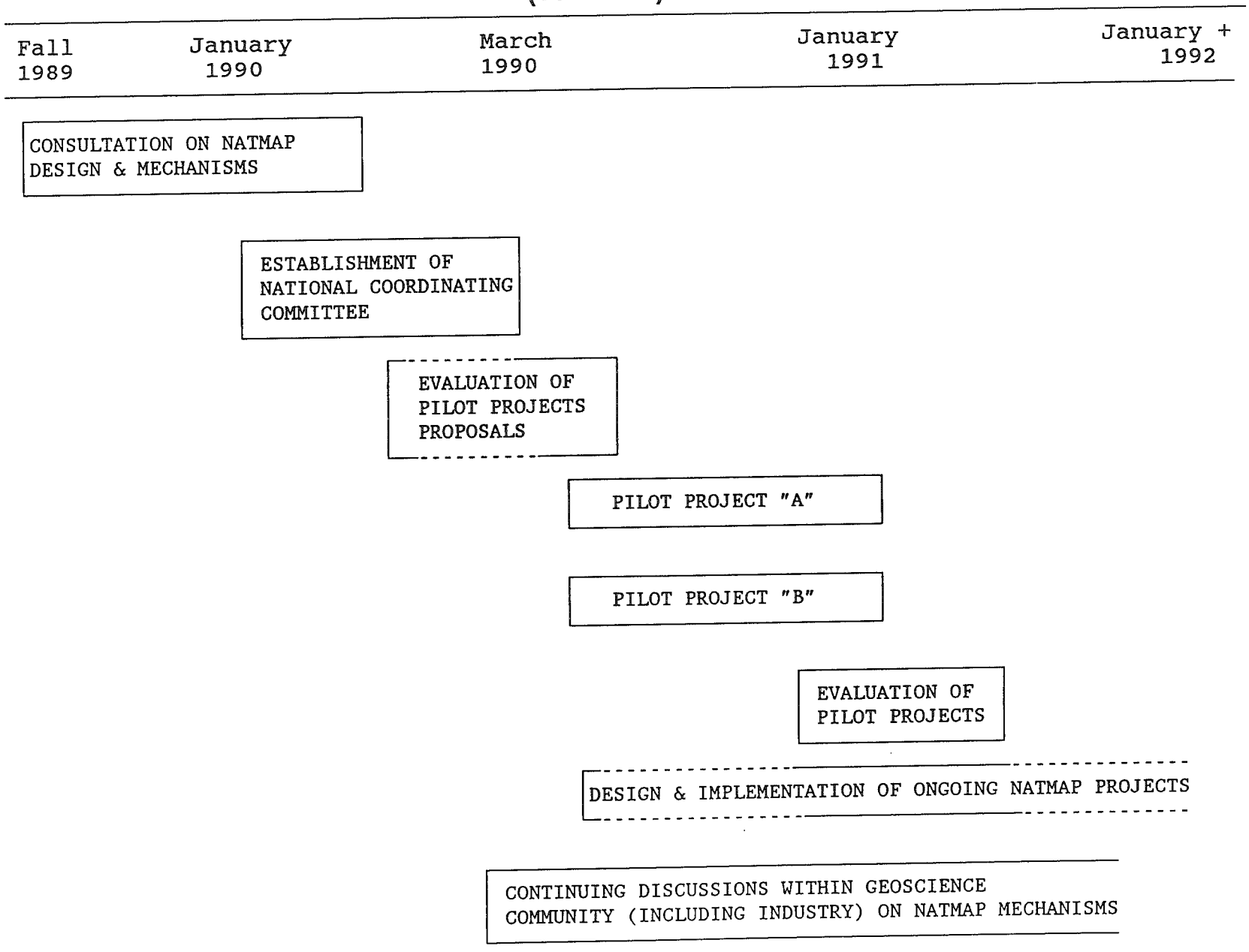

Table 1: Examples of Proposals for Regional Geoscience Mapping Projects

Title	Rationale/Planning	Logistics	Interaction (GSC +...)	Scales (1: x 000)	Timing/ Cost ($ xK)	Highlights
Hemlo-Manitouwadge	high mineral potential, poorly known map gaps	waterways+ back roads	GS of Ontario	1 @ 250 few @ 50	5 years 100/y	Info on major boundaries
Lac de Gras Slave Prov	high mineral potential, poorly known,old map	air, waterways	INAC + GNWT	1 @ 250 few @ 50	4 years 150/y	gives context of Courageous Lake Au
Selwyn Cross Section	ad hoc, assist explor.& springboard future work	air, shared base camp	INAC	3 @ 50	1 year 76	good relations; opportunistic
Atlantic Pr. Basement	perceived low minerals but favourable signs	roads	multi-discipl. Prov + Univ.	X @ 50 Y @ <10	4 years 1500	variable relations, many interested
Turner-Pistol Slave Prov.	NWT MDA, high minerals, archive new expl data	air, waterways	INAC, Chevron, CCRS,GNWT,Univ	2 @ 50 13 @20-10	3 years 15/40/40	like Selwyn but Chevron closed down
Nearshore Pacific	minerals, environment (neotect, sed transport)	ship	sonar/echosnd/ grabs/seismic	3 @ 25	on-going 25/map	sediment transport for oil+chem spills

Table 2: Examples of Proposals for Thematic Mapping Projects

Title	Rationale/Planning	Logistics	Interaction (GSC +...)	Scales (1: x 000)	Timing/ Cost ($ xK)	Highlights
Pacific Seafloor	time to eval. technol.+ plate boundaries in EEZ	ship	acoustic + others	@ 250-50	5 years 2500 cap 5750 O&M	International; different order of scope from others
Labrador Coast	investigate major orogens & boundaries	air, ship, waterways	NFLD+Que geol/geoph	@ 250	5 years 250-300/y	Crosses land-sea boundaries
Ungava Bay	old recon. maps; orogens & boundaries	air, ?ship, waterways	NFLD+Que	@ 250	3 years?	Crosses political boundaries
Slave Megaproject	new data near-critical mass; test & expand models	air, water	GNWT+INAC+ Universities	250+ @ 50	3-5 yrs 250-300/y?	Slave has "come of age"; needs all geosciences
Prairie Sub-Phanerozoic	New minerals + tectonic contacts at Shield edge	air, roads, drill	Prairie Provs Universities Industry	@ 250 4 @ 50/y	5 years 950/y	cross provinces utilize Industry data

Appendix A: Detailed Examples of Proposals for NATMAP Projects

HEMLO-MANITOUWADGE AREA, ONTARIO

Rationale:
- much of the region between Hemlo and Hornepayne, Ontario (48°35' - 49°15'; 84°30' - 86°30') is poorly known geologically but has high potential for gold (Hemlo, Wawa) and base metals (Manitouwadge, Winston Lake).
- mapping of some parts in detail, others only in reconnaissance fashion, shows mineralized volcanic units as remnants in the largely granitoid terrane.

Logistics:
- reasonable access by logging roads, waterways

Activities:
- bedrock mapping at 250 000 scale for the entire area and 50 000 scale for selected areas
- surficial mapping
- geophysical surveys (airborne EM and gradiometer)
- geochemical surveys (lake and stream sediment sampling)

Participants:
- Ontario Geological Survey
- Geological Survey of Canada
- Industry contractors

Time/Costs:
- 5 years @ $100 K per year
- 2 to 3 years bedrock, surficial mapping
- 1 year geophysical, geochemical surveys
- 1 year map/report production

Highlights:

- regional context for Hemlo Au, Manitouwadge Cu deposits
- information on subprovince boundaries

LAC DE GRAS AREA, NORTHWEST TERRITORIES

Rationale:
- parts of this area 300 km northeast of Yellowknife with potential for base metals and gold (Courageous Lake greenstone belt) are known from detailed mapping, other parts only from old reconnaissance coverage.
- mapping will give the basis for interpretation of central Slave Province tectonics and metallogenesis.

Logistics:
- ground traversing with air (fixed wing, helicopter) support

Activities:
- bedrock mapping at 250 000 scale for the entire area and 50 000 scale for selected areas
- surficial mapping
- geophysical surveys (gravity and heat production)
- geochemical surveys (soil geochemistry)

Participants:
- Indian and Northern Affairs Canada
- Government of Northwest Territories
- Geological Survey of Canada

Time/Costs:
- 4 years @ $150 K per year
- 3 years bedrock, surficial mapping, geophysical and geochemical surveys
- 1 year map/report production

Highlights:
- regional context for Courageous Lake Au
- information on evolution of central Slave Province

SUB-PHANEROZOIC PRECAMBRIAN GEOLOGY, PRAIRIE PROVINCES

Rationale:
- little is known about the buried Precambrian basement of Manitoba, Saskatchewan, and Alberta but continuation of terranes such as the Flin Flon greenstone belt and the Thompson belt beneath the Phanerozoic cover and recent discoveries along the edge of the exposed Precambrian (NamewLake, Hanson Lake) indicate mineral potential.
- work along the Phanerozoic-Precambrian contact has been carried out in Manitoba (Project Cormorant MDA-1) and could be extended.

Logistics:
- road, air

Activities:
- geophysical surveys (total field and gradiometer magnetic)
- gravity surveys (from industry?)

Participants:
- Manitoba, Saskatchewan and Alberta Surveys
- Geological Survey of Canada
- Industry
- Universities
- Drilling and geophysical contractors

Time/Costs:
- 5 years @ $950 K per year

Highlights:
- crosses provincial boundaries
- utilizes industry data
- assesses buried Shield mineral potential
- continues development of subsurface mapping methodology

S E C T I O N 2

PRÉCIS FOR WORKSHOP DISCUSSION GROUP TOPICS

NATMAP WORKSHOP PRÉCIS

DISCUSSION TOPIC #1

THE CONCEPT OF NATMAP
by J.-S. Vincent

1. Background Rationale

Geological maps constitute the principal earth science information base. In Canada, as in other countries, the large number of uses of geoscientific maps in research, planning, and development, is growing markedly. In our country, a gap exists and continues to widen between the demands of geoscientific map-users for more up-to-date maps and the production of new maps. In recent years, calls to satisfy the needs have been emphatically made by numerous lobbyists in the private and public sectors. It is evident that co-ordination of the mapping programs of the federal, provincial and territorial surveys, as well as integration of efforts with other mapping activities of academia and industry, would enhance the overall production of geoscience maps in Canada. The concept of this initiative, called "Canada's National Geoscience Mapping Program (NATMAP)" is the principal topic for Discussion Group #1.

2. Definition and Objectives

NATMAP is aimed at enhancing the quality and quantity of geoscience maps in Canada through a variety of mechanisms. It is envisaged as a co-ordinated program involving federal, provincial, and territorial surveys as well as Canadian universities and other interested groups. In the near future, NATMAP is not intended to provide complete systematic map coverage of Canada. This, however, is obviously an ultimate long term objective of such a program.

NATMAP generally aims to enhance the national geoscientific information base by: (1) raising the level and profile of mapping activity in Canada; and (2) fostering an increase in the co-ordination of mapping activities amongst federal, provincial and territorial agencies. Specific objectives are to: (1) enhance the quality and quantity of geoscience mapping as a primary aid to resource exploration, discovery and management; (2) provide a sound base for resource and environmental policy generation; and (3) improve the general documentation and understanding of the Canadian landmass.

3. Mandate of Discussion Group #1

Our discussion group should:

a) Agree on a statement which would provide a definition of the program and of its main objectives;

b) Make specific recommendations on how best the objectives could be met;

c) Make recommendations on the broad activities which should be the main components of the program (what is in and what is out?).

This last topic was the subject of much deliberation within the GSC NATMAP committee that prepared the initial proposal (see Section 1). Assuming that more and better basic bedrock and surficial geology maps of the landmass are the most desired outcome of the program, issues such as the inclusion or not of offshore mapping, of subsurface mapping involving geophysical programs, of crucial but parallel studies in geochemistry and other fields, of small scale or atlas syntheses etc. must be resolved and be the object of clear statements and recommendations by our group. Similarly, the question of the inclusion or not of the wide field of technical production of maps should be debated.

We will also address some of the questions mentioned above as we deal with the other five main topics for discussion. Nevertheless, it is hoped that our discussion group will concentrate its efforts in providing broad statements and recommendations dealing with the concepts of what we are trying to achieve.

NATMAP WORKSHOP PRÉCIS

DISCUSSION TOPIC #2

CORE ACTIVITIES OF NATMAP

by J.A. Percival

1. Background Rationale

NATMAP is a response to the clear message from industrial associations and others for more map-based geoscience information. A two-fold program is proposed to accomplish this task by: a) enhancing the amount of regional geoscience mapping while improving the quality by fostering interdisciplinary collaboration; and b) initiating major thematic mapping projects designed to acquire and integrate a full spectrum of geoscience information.

2. Regional Geoscience Mapping Projects

These projects are perceived as systematic regional coverage at an appropriate scale (1:10 000 to 1:250 000). The lead agency would be GSC, a provincial or a territorial survey. Proposals could also be considered from outside groups (industry or university consortia). Inter-agency and/or multidisciplinary programs will be encouraged. An example might be a 1:50 000 mapping program suggested by an industry consortium in an area of high exploration activity, where the province/ territory carries responsibility for bedrock mapping; GSC provides surficial geological coverage and aeromagnetic support, and university groups are involved in topical studies of structure, mineral deposits, etc. Several programs of this type could proceed simultaneously under the NATMAP banner each year.

3. Major Thematic Mapping Projects

These projects are perceived as multidisciplinary programs in regions of high interest. Whereas **LITHOPROBE** is spearheaded by seismic reflection transects and focuses on the third dimension, NATMAP projects will be led by surface mapping and include comprehensive use of geophysics and geochemistry as appropriate. Examples of themes might include continental margins and their petroleum/mineral resources, mineralization in volcanic belts, Precambrian and Phanerozoic accretion and terrane boundaries, etc. A project example might be a transect of a geological province, in which systematic bedrock and surficial mapping is carried out over a number of years, supported by regional geochemical surveys, topical studies of geochronology, structure, mineral deposits, etc. and enhanced geophysical coverage in key locations, including seismic and EM imaging of the third dimension ("vertical mapping"). Again proposals for themes and regions of interest would be accepted from all sectors.

4. Important Questions

Questions to be considered within both **Regional Geoscience Mapping Projects** and **Major Thematic Mapping Projects** include:

a) How will NATMAP projects differ from ongoing mapping programs?

b) What scale of mapping is necessary/appropriate?

c) Should the program be restricted to the continental landmass?

d) How will agencies be identified to take lead roles in particular projects?

e) What mechanisms should be established to inform and involve potential university or industry participants?

f) What role will industry play?
- advisory (priorities)
- participatory
- funding

g) What components should be included?
- geology
- surface geophysics
- geochemistry
- other

NATMAP WORKSHOP PRÉCIS

DISCUSSION TOPIC #3

TECHNOLOGIES IN MAPPING
by A. Menzel-Jones

1. Areal Studies: 2-Dimensions

Problems to address: mapping of virgin areas vs. enhanced mapping including scale of mapping, technologies to use and co-ordination.

a) Acquisition of geological data digitally
- state-of-the-art; hardware;software (OGS's FIELDLOG)
- digital geological notes
- common formats, common software, availability (Topic #4: on-line map production)
- laboratory generated geological data

b) Geophysics:

- potential field maps: sufficient? coverage?
- airborne EM maps: sufficient? coverage?
- radiometric maps: coverage?

c) Geochemistry:

- radiometric age dating
- regional geochemistry: types?

d) Remote Sensing:

- type
- applications
- satellite imagery: LANDSAT, RADARSAT
- new satellites
- interaction with Geodetic Survey of Canada

2. Transect Studies: 3-Dimensions

Problems to address: thematic mapping or vertical mapping of relatively well-known 2 dimensional areas. Points to consider are: a) which technologies to use; b) the availability of technologies as one selection criterion; c) the co-ordination of disciplinary results; and d) the interaction with **LITHOPROBE, FGP, EXTECH, GGT.**

a) Geology

- digital acquisition especially of numeric data
- detailed mapping/mineral deposit mapping
- structural studies
- integration of depth information with map information (e.g., cross-sections)

b) Geophysics

- seismic reflection: requires access, expensive, regional vs. high-resolution
- seismic refraction: remote, EARP
- EM: type? regional vs. high-resolution
- airborne geophysics: gradiometer, etc.
- potential fields: adequate?
- paleomagnetism:
- borehole geophysics: scope? availability
- rock properties: database!

c) Geochemistry

d) Geochronology

e) Remote Sensing

- appropriate

3. <u>Ancillary Technologies</u>

- GPS
- remote vehicles?
- databases

- potential fields, rock properties, geochronological ages, palaeomagnetism, geothermal, seismicity, geochemistry, etc.
- remote access to databases

NATMAP WORKSHOP PRÉCIS

DISCUSSION TOPIC #4

DATABASE MANAGEMENT, STANDARDS AND COMPILATIONS
by C.W. Jefferson

The purpose of this workshop is to help attain a definition of NATMAP. The purpose of Discussion Group #4 in particular is to help determine how all-embracing NATMAP should be. To this end, the three aspects listed in the title are to be considered separately.

1. Digital Map Production

   a) Should digital map production be part of NATMAP?

      The present perceived crisis in the rate of publication of maps derives in part from two recent developments: 1) dramatic changes in amount and method of funding (short-term/"soft" vs long-term/A-base); and 2) major advances in technology (resources needed for "tooling up"). Is this crisis real and, if so, would inclusion of digital map production in NATMAP help to solve the problem?

   b) Does digital map production warrant a separate but related national initiative?

      Compilation and digital map production is one facet of the broader question: "what is in / out of NATMAP?". One internal GSC initiative: "a strategy to develop coordinated digital and computer based data systems within the GSC" is addressing this question. Should this initiative be part of another national outreach, separate from NATMAP?

   c) Digital map production and delivery: where and how does it begin?

      At GSC, digitization of bedrock geology is now done mainly in the office (e.g. maps of the eastern Cape Smith Belt by M.R. St-Onge and S.B. Lucas), although many geochemical and geophysical data sets have been recorded digitally in the field. Geoscience applications are being developed for TYDAC's SPANS spatial analysis software and PCI's remote sensed data software. One current proposal at GSC for NATMAP is to test voice-activated computers to record geological data in the field. GSC will also test in the field, MAC-based and IBM-based data collection systems.

A field-portable Autocad-DBASE digitizing system has been developed at the Ontario Geological Survey and is being emulated by the Government of the N.W.T. The Ministère de l'Énergie et des Ressources du Québec (Secteur mines) has a geographic information system for the Abitibi belt of northwestern Quebec and is expanding this to cover the province. The United States Geological Survey has developed digital geological mapping software. Numerous other examples can be cited. Related questions for this discussion group are as follows:

- Should digitization technology be compatible with production?
- Where, when and how should NATMAP start digitizing?
- What role should NATMAP play in the digital data-handling continuum?
- What is the principal national geoscience data base?
- Should coordination mean temporal or technological or both?
- Should more PY's be devoted to technical support personnel?
- Should products be folios with GIS data files available on disk?

2. Standards

a) Should uniform standards be adopted and what should they be?

What are the minimum standards for publication of a final, coloured geological map? Which data are most important on a summary printed map? Some features that this discussion group might consider are:

mineral occurrences and gossans	geophysical anomalies
fossil localities	geochemical anomalies
metamorphic isograds	structural trends

Should the editorial process be strengthened so that maps cannot be published without meeting minimum criteria?

b) How should national and provincial guidelines be accommodated?

Should updated national standards for map symbols be adopted by all mapping agencies in the country? For example the symbol for overturned bedding has opposite meanings for Ontario Geological Survey and GSC! GSC standards for these and other structural symbols are being developed. A project under the National Geological Surveys Committee is encouraging standard usage for map symbols. How should this relate to NATMAP?

c) Should we produce bilingual maps?

Are bilingual maps necessary for some areas? Should this issue be addressed by NATMAP or by individual mappers/managers/ politicians?

3. **Should Regional Compilation Programs be Part of NATMAP?**

One to five million-scale maps are being compiled for the Atlas of Canada Project under the leadership of A. Okulitch. Similar compilations are/have been done for DNAG purposes. The process of doing such compilations has revealed much new information that feeds back to the primary mapping activity. Quarter-million-scale and larger scale mapping activities also involve preliminary compilations.

What scales/types of compilations should be funded under NATMAP?

NATMAP WORKSHOP PRÉCIS

DISCUSSION TOPIC #5

CLIENT NEEDS AND CONCERNS
by F.W. Chandler

1. Who are the Clients?

Some principal clients for NATMAP products are suggested below:

a) Government

1) Federal Government - national resource policy

2) Other government departments, e.g. Health and Welfare, Environment.

3) Provincial Government - mining districts, e.g. mineral resources, pollution, revitalization of depressed mining areas.

4) Local Government - geological constraints to urban planning, pollution

b) Industry - mining exploration, development of mining camps.

c) Special Interest Groups - research institutions

2. What Products Do the Clients Want?

What products other than maps should be generated?

3. How Best Can Clients Let Us Know What They Want?

Advisory committees, access to geoscience NATMAP Secretariat?

4. What Kind of Maps Does Industry Want and at What Scale?

Vary according to needs? - to discuss
Consistent national scales?

5. What Should NATMAP Maps Show?

Geoscience maps of the future will take into account changing mapping and production technologies and different clients with their requirements for different data as well as an increasing variety of data. Data sets that might be integrated on a map produced under NATMAP include, geology, surficial geology, hydrogeology, geochemistry, geophysics, remotely-sensed data, mineral or petroleum potential, hazards.

NATMAP WORKSHOP PRÉCIS

DISCUSSION TOPIC #6

PROMOTING NATMAP
by J.E. Harrison

1. **Identifying and Describing the Product**

   - who needs this program?
   - how will it contribute?
   - who benefits?
     - federal departments
     - provinces
     - industry
     - general public including special interests

2. **Who is Going to Buy (who pays)?**

   - senior officials
     - federal
     - provincial
     - industrial

3. **Who Will be Supportive?**

   - partnerships with
     - industry
     - provinces

4. **Who Needs to be Convinced?**

   - Ministers
   - Treasury Board
   - General public

5. **The Sales Pitch**

   - need to maintain the geoscience base
   - cost benefit analysis
   - information for the environment
   - efficiency through partnership
   - focused on needs

NATMAP WORKSHOP PRÉCIS

DISCUSSION TOPIC #7

MECHANISMS AND IMPLEMENTATION OF NATMAP
by J.A. Percival and J.-S. Vincent

NATMAP is a national program involving participants from throughout the Canadian Earth Science community. Major challenges are anticipated in coordinating 13 government organizations, university and industry workers. It is the function of this workshop to arrive at a workable plan for implementing the program. The following notes provide a guide to the issues encountered by the NATMAP committee over the past year.

1. Participants

As envisioned, NATMAP will involve federal and provincial/territorial government survey agencies, and university-based researchers. Although there is as yet no formal established mechanism to involve industry personnel, channels could be forged in a NATMAP charter.

2. Inter-agency Cooperation

Formal arrangements between the federal and provincial/territorial surveys will need to be established. It is not yet clear whether one global agreement will suit the needs of all participants or whether individual agreements will be necessary. Should NSERC be approached with a proposal to establish a NATMAP program to support university-based workers?

3. Coordinating Committee(s)

Part of the appeal of a national program is its mandate to cross provincial/territorial boundaries and to assign priorities at a national level. However, this advantage needs to be blended with provincial and territorial autonomy. Is one central coordinating committee with representation from all the estates adequate, or do we need 12 separate provincial-federal and territorial-federal committees? What should be the constitution of such steering committees?

4. Secretariat

The purpose of this office would be to solicit proposals for NATMAP activities, develop a review process and coordinate steering committees. A possible site would be GSC, Ottawa.

5. Proposals

Proposals submitted through the secretariat would be in competition with others. The scope of the competition remains to be established: should it be at the national level or at the provincial/territorial level?

Important questions that will require resolution during the workshop include:

- how can the provinces participate in a national program while maintaining their autonomy?
- how will universities, industry participate?

NATMAP WORKSHOP PRÉCIS

DISCUSSION TOPIC #8

FUNDING MECHANISMS

by C.W. Jefferson and A. Menzel-Jones

1. Background Rationale

NATMAP is conceived as a mechanism to enhance geoscientific mapping in Canada. The question of funding is obviously central to this mechanism. Federal, provincial and territorial geoscience agencies currently allocate significant portions of their budgets to mapping activities of various kinds. The budgets of most agencies, in constant dollars, have been shrinking or at best remaining the same during the 1980s. Thus the allocation of increased funding to mapping activities can only be made at the expense of other activities within these organizations, unless new sources of funding are found.

2. Mandate of Discussion Group #8

a) Discuss, in general terms, the present state of funding for mapping activities in our home organizations;

b Examine ways and means to make more effective use of existing funding (e.g. cooperative programs);

c) Examine possible new formats or mechanisms for funding, e.g:
- government/government joint ventures, e.g MDA
- university groups funded through NSERC
- industrial research institutes; e.g. Mining Industry Technology Council of Canada (MITEC); Australian Mineral Industries Research Association Limited (AMIRA)
- Frontier Geoscience Program, an example where a soft money program was converted to A-base (long-term funding)
- Exploration Science and Technology Initiative (EXTECH) and Western Canada Sedimentary Basin Initiative examples of industry-government collaboration
- Environmental Initiatives, with collaboration possibilities between government departments
- Individual client funding (contracting in)
- Others;

d) Consider how various activities to be included under NATMAP (and discussed under Topics 1-6) would affect funding needs for NATMAP.

NATMAP WORKSHOP PRÉCIS

DISCUSSION TOPIC #9

POTENTIAL PROJECTS

by F.W. Chandler and K.D. Card

1. Background Rationale

Aspects of the question, "What is a suitable NATMAP project?" are dealt with in the précis for discussion topics #1, 2 and 3 (Section 2). Also, key attributes of such projects have been summarized below from earlier discussions within the Geological Survey of Canada. Also appended as examples for discussion, are brief introductions to projects under discussion between the Geological Survey of Canada and the Provinces of Manitoba and Saskatchewan.

2. Attributes of a NATMAP Project

a) NATMAP is envisaged to be a coordinated effort among geological surveys, the universities, industry and other interested groups in Canada to enhance and raise the profile of geoscience map coverage of Canada and improve general documentation and understanding of the Canadian landmass. This allows pooling of abilities and resources, working to National standards, e.g data levelling, legends and map symbols. Thus it permits different government surveys and others to cooperate in tackling projects that cross jurisdictional boundaries and to do so with uniform standards. Consequently projects that lie across such boundaries are prime targets for NATMAP.

b) Because a major aim of the program is to enhance and accelerate regional geoscience mapping of Canada, projects with a significant systematic geoscience mapping component are suitable for NATMAP.

c) As well as regional systematic mapping, (b above) thematic mapping could also be a major component of NATMAP projects.

d) Promotion of new technologies and techniques in mapping is an aim of NATMAP projects.

e) An object of this workshop is to try to identify high priority areas for regional and thematic mapping coverage.

f) Other important criteria in identifying a NATMAP project include; identification in terms of a public good, e.g. resuscitation of a depressed mining area, mining exploration, environmental concern.

3. Two Examples

Bearing in mind the above criteria the Geological Survey of Canada Ottawa office, in conjunction with the Provinces of Manitoba and Saskatchewan is exploring setting up two pilot projects for the field season of 1990. While discussions are only at a preliminary stage, it is hoped that planning between the groups involved will permit components of one or both of these projects to proceed during the coming field season.

a) Snowbird Project. (Geological Survey of Canada - Saskatchewan Geological Survey).

This one lies between the Athabasca basin and the NWT border at latitude 59.5° and longitude 106°. The geology and economic potential of this area are poorly understood; for example rocks previously mapped as supracrustal and plutonic suites have been recently identified as two sets of mylonites, occurring in a triangular area 120 x 120 x 70 km.

An integrated study is under discussion by the Geological Survey of Canada and the Saskatchewan Geological Survey. Aspects to be considered include the age, geometry, tectonic and economic significance of the zone. Mapping scales could range from 1:50 000 to more detailed as appropriate in areas of mineralization. Relevant disciplines might be structural geology, geochronology, gravity, mineral deposits studies and Quaternary geology. The study would also serve as a platform for testing a MAC-based, digital data collection program that could be compared with the performance of IBM-based systems to be tested elsewhere this summer.

b) Seagull Project. (Geological Survey of Canada - Manitoba Geological Survey - Saskatchewan Geological Survey)

Only preliminary discussions have been conducted on this project. It is seen as an extension of Project Cormorant, which was run under the Canada-Manitoba Mineral Development Agreement. Project Cormorant, publication of which is due this spring, was aimed at mapping the hidden Precambrian basement to the Phanerozoic rocks of the Cormorant Lake area (1:250 000 NTS sheet 63K). The mechanisms were geophysics and drilling in consort with examination of the adjacent exposed Precambrian Lynn Lake greenstone belt to the north.

Project Seagull is seen as a similar but more extensive version of Cormorant, possibly stretching from the Thompson Belt to the western limit of the Lynn Lake greenstone belt in Saskatchewan. The Phanerozoic rocks possibly as far south as 45.5°, will be studied by geophysics and by examination of the abundant drill core that is available.

This work would be correlated with ongoing mapping in the Precambrian basement to the north, by the respective provincial geological surveys. Specific structural, metamorphic and granite studies might be considered in addition to further Quaternary geology.

Data from both of the above projects will be of use in interpreting data from imminent LITHOPROBE transects.

4. Other Examples

Other examples, should come to light by discussion within the geoscience community. This issue is discussed under topic seven.

S E C T I O N 3

SUMMARIES OF WORKSHOP DISCUSSION GROUP TOPICS

NATMAP WORKSHOP SUMMARY

DISCUSSION TOPIC #1

THE CONCEPT OF NATMAP

by D. Tempelman-Kluit and A.C. Colvine

1. Background

As the 21st century approaches, Canadians are increasingly concerned with environmental issues and the effective management of renewable and non-renewable natural resources. These concerns include: the quality of air and water; waste disposal; natural hazards; the preservation of wilderness areas; and the development of earth resources. The resolution of these issues requires a systematic and comprehensive current database of geoscience maps. The NATMAP program will be a major contributor to the development and maintenance of this database.

2. Definition

The National Geoscience Mapping Program (NATMAP) is a cooperative, multi-disciplinary endeavour to improve the quality, relevance and completeness of current bedrock and surficial geological database coverage throughout the Canadian landmass, essential to address the broad spectrum of societal concerns in matters of environmental trusteeship, hazards amelioration, and sustainable resource development.

3. Objectives

The Aim: To provide comprehensive, systematic, three dimensional understanding of the bedrock geology and surficial deposits of the Canadian landmass.

The Goals: To enhance the national geoscientific information base by:

a) elevating the profile of geoscientific mapping;

b) providing increased coverage of geoscientific maps throughout Canada;

c) fostering better coordination of mapping activities amongst federal, provincial and territorial agencies;

d) incorporating appropriate university research skills and also active student participation thereby contributing to practical geoscience education; and

e) providing for effective inclusion of industry expertise and input.

Specific Objectives: In the next five years the NATMAP program will:

a) establish mechanisms to facilitate the necessary cooperation to implement the program;

b) identify specific pilot projects to be initiated cooperatively and identify funding sources;

c) carry out pilot projects; and

d) evaluate the products of these pilot projects and modify the implementation of future NATMAP projects.

4. **Benefits**

a) geoscience database standard for Canada;

b) federal-provincial cooperation
build on a strength of the Mineral Development Agreements and improve federal-provincial geoscience cooperation
e.g. wilderness renewal and recreation;

c) development of earth resources
e.g. Canada's depleting aggregate, mineral and hydrocarbon resources;

d) identify areas of potential natural risks and hazards
e.g. earthquakes, landslides, volcanoes, coastal and river erosion;

e) environment
water quality/acid rain, soil and groundwater pollution (herbicides, pesticides) air quality/clean air;

f) international collaboration
e.g. Arctic and boundary sovereignty;

g) interjurisdictional coordination
e.g. radioactive waste disposal;

h) monitoring
e.g. urban expansion; and

i) soil fertility
e.g. plant nutrient sources and soil erosion.

5. **Priority Action Items**

a) GSC should get on with the digital database standards;

b) committee for map standards should get on with its job and complete the task;

c) go for one pilot project in each province and territory; must ensure that projects meet general objectives of cooperation, collaboration, and are multiinstitutional, multijurisdictional;

d) identify other government agencies who should be our customers - determine what we should sell them;

e) make the approach; and

f) make the Canadian public more aware of geoscience contribution to understanding two of society's main problems: environment and resource management.

6. **Formalizing the Organizational Requirements**

a) committee to guide the process;

b) committee to get proposals into the mill;

c) process to judge proposals on equatability, competitiveness; and

d) process to ensure input and representation from provincial geological committee, GSC, university geological departments, PDAC, B.C. Yukon Chamber of Mines, CPA, etc., and all other user interest groups.

7. **Funding Considerations**

a) identify environmental issues and clients; long term shift in political attitudes toward environment will strongly influence world thinking;

b) ensure the honest broker role is acknowledged and maintained; and

c) emphasize the new focus on federal-provincial-university-industry cooperation in the acquisition and use of geoscience data to provide products relevant to client requirements.

8. **Range of Activities**

a) emphasis of NATMAP should be on regional programs of bedrock and surficial geology of the landmass; these should be systematic, comprehensive and regionally balanced;

b) integration of geophysical and geochemical surveys with the geological database would be beneficial; available information will obviously be used or new information

will be generated if essential but systematic regional geophysical and geochemical surveys should be conducted under other programs;

c) NATMAP will use existing and future technology for digital mapping, but development of technology is not a specifically mandated task;

d) compilations such as the 1,000,000 scale bedrock maps are implicit in the mapping function but are not a primary goal of NATMAP; these should be the object of other initiatives; and

e) it is anticipated that as a result of the systematic geological mapping, some problems will be recognized that will require a thematic approach.

NATMAP WORKSHOP SUMMARY

DISCUSSION TOPIC #2

CORE ACTIVITIES OF NATMAP
by M. McMechan and J. Lewry

1. Core Activities

a) The PRIMARY focus of NATMAP should be toward REGIONAL MAPPING and the provision of good bedrock and surficial geology maps.

b) However, while the main priority is to fill 'knowledge gaps' and proceed as rapidly as possible toward greater regional coverage, such mapping should be aimed at or focused on topical themes or problems - e.g. economic, environmental, academic.

c) The projects should be integrated and multidisciplinary in nature.

d) Projects should be of 3-5 years duration and might include a variety of more specialized studies necessary to produce a good geological map and more complete understanding of the geological history of the area.

e) The extent and shape of the map area should be controlled by the nature of the problem and not primarily by the urge to 'fill in' neat quadrangle map sheets.

f) Preliminary project maps should be produced annually, as expeditiously as possible. Final maps and reports must appear as rapidly as possible after the conclusion of field work and ancillary studies.

2. Scope

At least in the initial phases of the program, NATMAP efforts should be restricted to the continental landmass.

3. Scale

Map scales should be chosen as appropriate for the particular problem. No rigid constraints should be imposed.

4. Geological Components to be Included

A good geological map should integrate whatever data are available and/or useful. Systematic geochemical mapping and geophysical work should not be part of the NATMAP program but might be considered locally as deemed appropriate for the particular area, theme or problem.

5. Role of Industry

Industry should have a significant advisory role in setting priorities. It seems unlikely that it would play a major role in 'joint operations' and funding, save on a 'special situation' basis.

6. Leading Agencies and other Participants

The agencies taking leading roles in particular projects will tend to follow naturally from the project approval/selection process. A 'lean' selection committee process is needed, which will also serve, after appropriate consultation, to inform/involve other potential university and industry participants.

7. Student Field Training

NATMAP should incorporate a deliberate policy of employing and involving undergraduate and graduate students with the aim of providing high quality ongoing field training. NATMAP projects should not simply involve a team of professionals. The extra costs of involving a few students for training are relatively small.

8. Research Granting Agency Involvement

Granting agencies such as NSERC should be involved in the NATMAP process in an attempt to encourage them to recognize field-oriented studies by university personnel as scientific endeavours worthy of greater financial support.

NATMAP WORKSHOP SUMMARY

DISCUSSION TOPIC #3

TECHNOLOGIES IN MAPPING
by S. Reford and R. Clowes

1. Stages of Development From Technology Standpoint

a) LANDSAT imagery (or equivalent) as available and aeromagnetic data should be acquired prior to commencement of any field mapping.

b) 1) Geological mapping (bedrock and surficial) in unmapped or poorly mapped areas, following a systematic set of priorities.

2) Acquisition and integration of other data where possible, by taking advantage of logistics that are set up, i.e. coordinated multidisciplinary aspects are important. This leads to geoscientific mapping in contrast to geological mapping.

c) Development of thematic projects which address specific geological problems as a secondary stage. All applicable techniques should be considered.

2. Digital Data Acquisition

Standards should be set for data acquisition from the initiation of NATMAP. Information that is acquired must meet minimum standards of quality and must be in previously established standard digital format. This means at least digital incorporation at field camp and probably in some cases, digital acquisition at the outcrop.

The data acquisition systems should not be restricted (e.g. voice activated, digital handbooks, field notes) but output from these should be input into a database which conforms to the standard format. Establish standards at some minimum level for data transfer while allowing scope for innovation. Consider data transmission from the field by satellite as a future possibility. Promote dialogue to minimize the duplication of effort in application of this technology. A committee is needed to establish standards, prepare a document and keep it current.

3. Advantages of Digital Data for the Geosciences

a) Addresses archival problem instantly at the field level.

b) Improves quality control in the field through the capability of merging results from different day's activities.

c) Integration and manipulation of different datasets at the field camp become possible.

d) Digital data acquisition, with basic standards and required data elements, "forces" mapping geologists to consider all aspects of field data.

e) Availability of digital data to users, and production of maps in a more timely fashion.

f) Thematic studies are facilitated and enhanced through a comprehensive digital database.

g) Lab generated data can be entered into the same database as the field data.

4. Logistical Considerations

Coordination - simultaneous acquisition of all geoscience data to make most effective use of limited field resources e.g. geology, geochemistry and gravity all through the same field camp or helicopter support; multiple airborne methods using the same platform (e.g. EM and/or radiometrics with magnetics).

- logistical efforts of different agencies working in the same geographical area.

Use of global positioning system (GPS) - each field person carries a system for 3-D XYZ location; availability expected soon.

5. Geophysics

Strong support is recommended for continuation and completion of the existing national mapping programs in aeromagnetics and gravity.

Aeromagnetic - Evaluate the need for priorities within the context of NATMAP. Indeed, field geological mapping should not be carried out until the magnetic data are available. Note: this requires coordination in planning between the geologists and geophysicists, and thus a lead time is necessary for logistical purposes (e.g. one year).

Gravity - Needs to be acquired in regions where it doesn't exist and enhanced in regions where the coverage is not up to national standards (5 km spacing). Recognize that for some mapping projects, gravity acquisition may be more critical than for others. Possibility of airborne gravity should be recognized and if/when available, could be effectively used in a manner similar to aeromagnetics.

Other geophysics - Require ongoing evaluation of other technologies which may be appropriate (viewpoint of a specific

mapping project). Use all available and applicable methods; don't be restrictive to certain methods e.g. radiometric and electromagnetic methods are good mapping tools, particularly for granite facies; can be applied to specific problems but not required routinely.

6. Remote Sensing

Existing LANDSAT data are very useful and are not being used to the extent that they could be. LANDSAT images should be available and used prior to beginning a field mapping project. Such digital data can be manipulated for geological purposes (e.g. trend analyses, fracture mapping). The trend for merging GIS and satellite data at reasonable costs and ease of use is noted.

7. Interaction with other Geoscience Initiatives

It is important to emphasize that NATMAP is one program element within the GSC, in cooperation with other agencies. There are other program elements, e.g. LITHOPROBE, that should remain as distinct initiatives.

a) LITHOPROBE represents a different element within the GSC and is involved with different primary partners than NATMAP. The LITHOPROBE thematic studies provide a complementary project to NATMAP and will overlap with it in some cases.

b) Some technologies are available or are being enhanced for nearshore studies in the marine environment e.g. Huntec deep tow and Chirp sonar. These technologies relate to extending surficial mapping to the nearshore.

c) The GSC's Exploration Technology Initiative (EXTECH) is at a mapping scale above that appropriate for NATMAP.

d) Global Geoscience Transects (GGT) represent a useful example of standardizing visual presentation formats and the availability and easy dissemination of a digital database (e.g. CD-ROM).

Transect studies are not the primary component of NATMAP but should be considered as an important methodology in some study areas. If carried out, the approach would be different from LITHOPROBE in that it would be spearheaded by geological mapping, supported by all applicable geoscientific methods. In this way, NATMAP would be complementary to LITHOPROBE and not a replacement for it.

NATMAP WORKSHOP SUMMARY

DISCUSSION TOPIC #4

DATABASE MANAGEMENT , STANDARDS AND COMPILATIONS
by A.E. Bourgeois and A. Currie

1. Digital Map Production

a) Should digital map production be part of NATMAP?

Computer based map production should not be part of NATMAP but all projects must be digitally based in order to be fed into a national database.

b) Does digital map production warrant a separate but related national initiative?

Yes.

c) Digital map production and delivery: where and how does it begin?

The technologies involved in digitization and in production are separate and distinct; the data, not the technologies must be compatible. All data should be digitally collected if possible; if not, then map data must always be drafted in layers that are amenable to digitizing; this digital information can be collected by various means - e.g. pcs with database and CAD software, voice activated input, digitizing tablets, GPS recorders, etc. Digital map production is not possible without a digital data base.

At present there is not a "principal National Geoscience Database." A national geoscience information database should be established. This would be a set of linked but geographically separate databases of all the digital data available on the Canadian landmass. Coordination should take whatever form is most suitable to the activity. The issue of PY's is the responsibility of individual agencies, not NATMAP.

The initial hard copy and digital products should be GIS data files from which many products could be generated. The issue of user pay for access to the digital files should be considered.

2. Standards

a) Should uniform standards be adopted and what should they be?

1) Data exchange standards - encoding standards

A single digital system is a recipe for disaster. The adoption of existing data exchange standards is recommended. Several of the commonly used standards could be supported. NATMAP should look at the USGS and other standards with a view to adopting/adapting them.

The NATMAP databases should use a common numeric encoding to identify mapped items (e.g. structural data, rock types, contacts).

2) Documentation standards

The databases should be self-documenting. Text headers must describe the method of mapping used and other relevant information. Someone must be responsible for the ongoing maintenance and coordination of the standards. Secretariat?

3) Data collection and presentation standards

There should be guidelines and minimum standards in order to assist the person who uses the data (e.g. every map should have at least one cross-section; every map should have mineral occurrences and gossans).

4) Data quality standards

All maps in the NATMAP program should be subject to a rigorous peer review process and standards for the control of data quality should be developed.

b) How should national and provincial guidelines be accommodated?

For the purposes of a national digital system encoding standards for map objects as described above would be sufficient. However, the adoption of a national standard for map symbolism is encouraged.

c) Should bilingual maps be produced?

Bilingualism, though an important issue is not a NATMAP concern. Each organization will publish maps in the language(s) it determines appropriate.

3. **Should Regional Compilation Programs be part of NATMAP?**

The existing compilation (1:1 000 000) activity should support the planning aspects of NATMAP. The databases NATMAP develops will facilitate ongoing compilation projects. Compilation is a management tool and therefore essential to NATMAP but not a principal end product.

NATMAP WORKSHOP SUMMARY

DISCUSSION TOPIC #5

CLIENT NEEDS AND CONCERNS

by J.M. Duke and J.M. Hamilton

This section seeks to identify (1): who NATMAP'S clients are; (2) what products (maps) clients will want; (3) what information products should show and at what scales; and (4) how clients can communicate their needs to the NATMAP organization.

1. Clients

Clients for NATMAP products are identified as three main groups; governments, industry and other groups. Three levels of government were identified: federal; provincial and territorial; and municipal. Government clients are ranked (1 to 3) below in decreasing importance.

a) Federal government departments thought to be likely clients of NATMAP products include the following:

1) Energy, Mines and Resources
   - GSC
   - Policy Sectors

   Environment Canada (including Parks Canada)
   Indian Affairs and Northern Development

2) Health and Welfare
   Agriculture Canada
   AECB
   AECL

3) Forestry
   Department of National Defence

b) Among provincial and territorial governments, likely customers will probably include the following:

1) Mines & Energy (Research Councils)
   Utilities (e.g., electrical, gas)
   Environment

2) Highways
   Forestry
   Land Use Planning
   Municipal Affairs
   Health

3) Education
   Tourism/Parks
   Regional Development

c) Similarly, in local government, the following may be important:

Land Use Planning (e.g., waste disposal, aggregates)
Water Supply
Hazards/Health (e.g., landslides, radon)

d) Among industry, the following are likely users of NATMAP products:

Mineral industry (metals, industrial minerals, coal)
Energy (oil & gas)
Environmental (mainly consultants)
Geotechnical (civil engineering)

e) Other groups that may utilize NATMAP products are the following, loosely grouped as special interest groups.

Universities
Environmental
Native Peoples
Rockhounds
"Culture" (museums, archeologists)

2. Products

Products of NATMAP may be grouped under the headings: primary geoscience maps; derived geoscience maps; and other products. (They correspond to column headings in the table on page 51).

a) Primary Geoscience Maps include a number of types as shown below:

A) Bedrock geology
B) Surficial geology
C) Magnetic
D) Gravity
E) Radioactivity
F) Electromagnetic*
G) Drainage geochemistry
H) Biogeochemistry*
I) Drift geochemistry
J) Water chemistry

*Not currently a generally used regional survey method.

b) Derived Geoscience Maps are envisaged to be of the following types:

K) Hazards (seismic, terrain, radon)
L) Metallogenic/mineral potential
M) Others

c) Other Products could include:

N) Databases
O) Digital map files
P) Reports
Q) Physical archives (e.g., sample materials)

3. Scale and Contents

Scales of NATMAP maps will be determined by project. Mapping in "virgin areas" will very often be at 1:250K, more mature areas warrant 1:50K or even larger. There will be "scales within scales": that is, it may be appropriate to map parts of a 250K sheet at 50K. However, a series of standard scales should be adopted, for example, 250K, 100K, 50K, 20K. NATMAP should establish data acquisition density standards appropriate for each scale.

It is proposed that the mineral industry will prefer bedrock geology maps to be provided at three levels of detail. The least detailed should be suitable to depict distribution of formations. At an intermediate level maps portraying distribution of lithologies are highly desirable (often 1:50K is suitable). Mapping of specific mineral deposits is usually at larger scales. Scales or data acquisition density standards for different types of maps are suggested as follows:

Drainage Geochemistry	1/13 sq. km.
Surficial Geology	250K or 50K
Magnetics	50K (1 km line spacing)
Gravity	1/20 sq. km.
Radioactivity	50K (1 km line spacing)
Electromagnetic	tied to radioactivity

Geoscience folios are also viewed as a desirable NATMAP product. These are most effective when the different data sets are available at densities which may be presented at a common scale.

Products must comply with NATMAP scientific and cartographic standards to be established. For example, bedrock geology maps should show mineral deposits and significant occurrences.

4. Client Communication

a) This will likely be both active and passive. Passive communication could be through the following media:

Industrial liaison committees, advisory committees
Informal contacts, geoscience fora
NATMAP Secretariat
Regional feedback

b) Active communication could employ the following vehicles:

NATMAP Secretariat
Communications committees (advertising)
Workshops for nontraditional clients

A table depicting those products desired by various clients is shown on the next page.

1. Governments	PRODUCTS																
Federal	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
EMR																	
- GSC	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
- Policy	x										x	x				x	
Environment		x			x		x			x				x	x	x	x
INAC	x	x	x				x				x	x		x	x	x	x
H & W					x		x			x				x		x	x
Agriculture		x															
AECB	x				x						x					x	
AECL	x				x						x						
Forestry		x														x	
DND			x	x										x			
Provincial/ Territorial	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
Mines-Energy	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Utilities	x	x			x						x					x	
Environment		x			x		x			x	x			x	x	x	x
Highways		x									x						
Forestry		x														x	
Land Use	x	x									x	x				x	
Municipal	x	x									x					x	
Health			x		x			x				x		x	x		
Education	x										x						
Tourism/Parks	x	x											x			x	
Regional Dev													x				
Local	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
Various	x	x			x					x	x						
2. Industry	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
Mineral	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Energy	x		x	x							x			x		x	
Environmental	x	x			x		x	x	x	x	x			x	x	x	
Geotechnical	x	x									x					x	
3. Sp.Int.Gps.	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
Universities	x	x	x	x								x		x		x	x
Environmental																	
Native Peoples					x							x					
Rockhounds	x															x	
"Culture"	x	x															

NATMAP WORKSHOP SUMMARY

DISCUSSION TOPIC #6

PROMOTING NATMAP

by J.E. Harrison and W.H. Poole

1. What is NATMAP?

NATMAP is a program

- that is focused on generating new map based knowledge;
- that will improve the availability of map based knowledge.

2. Why do we need NATMAP?

Why NATMAP is needed is also an analysis of how NATMAP can be promoted. The following list sets out the framework for developing a set of selling points which could be used to promote the program to those who might participate or fund the program.

a) wise management of the landmass
   - economic benefits
   - environmental benefits
   - resolution of environmental vs economic benefits.

b) to meet increasing demand
   - more coverage (quantity)
   - higher level knowledge
     - world class deposits/fields
     - modern level of knowledge
     - new use demands (i.e. environment for industry).

c) role of governments
   - produce Public Goods
   - information infrastructure
   - continuity of information
   - integrity of information
     - standards
     - archiving

d) to increase efficiency
   - "efficiencies of scale"
   - sharing information and skills
   - critical mass
   - sharing
     - equipment
     - specialized personnel

e) to develop standards
   - participating by government/industry/university

3. Documenting the Benefits

There is a need to support the selling points developed in 2 with hard information. As NATMAP develops, part of the initial research should be devoted to gathering statistics and anecdotal information to support key arguments supporting the program.

Promotion of NATMAP will require data on:

a) Economic Impact
- general (% GDP of resource industry, etc.)
- mineral industry (how big it is, how it relates to NATMAP)
- energy - how it contributes to Canadian economy
- construction (planning) - the broad uses of maps for everything from dams and roads to urban planning
- renewables - forestry, agriculture

b) Environment Impact
- health - environmental geochemistry, etc.
- hazards - earthquakes, landslides, other hazards.

c) Impact on Policy - environmental reviews, resource assessments.

d) Sovereignty and Security - NATMAP in the north.

4. Players/Resources

Many participants will be able to contribute resources to NATMAP. In some cases there will be existing program resources which can be fit into a NATMAP framework, new resources, people resources, resources in kind, and even moral support. A key consideration with respect to university resources relates to the problem of training mappers. It was felt that a key contribution universities could make would be to work with NSERC to reemphasize mapping. At the same time NATMAP could commit to expanding student programs to try to revitalize the manpower at its base. The following outlines the players.

Governments:
- Federal
  - Geological Survey of Canada
  - Other government departments
- Provincial/Territorial
  - Provincial surveys
  - Other provincial agencies
- Industries
  - mineral
  - energy

- Universities
  education (students)
  research

5. **Target Audience**

The following list for target audiences for promotion of NATMAP includes (not in order in which they should be approached).

- Ministers (customer)

- Industry (users)
  Associations
  Leaders

- Other government departments

- Non-government Organizations
  Environment

- Universities/NSERC
  Manpower

- General Public
  Geoscience in general not NATMAP in particular

NATMAP WORKSHOP SUMMARY

DISCUSSION TOPIC #7

MECHANISMS AND IMPLEMENTATION OF NATMAP

by J.A. Percival and H.S. Swinden

1. Inter-Agency Cooperation

Liaisons between different governmental agencies already exist outside the NATMAP structure. Therefore there is no need for formal NATMAP arrangements.

2. Coordinating Committees

a) A national committee (Board of Directors)numbering ~20 representatives from major user/client groups, should be established to oversee NATMAP activities.

b) A secretariat (~10) working committee should be established (at GSC?) to review proposals, make recommendations for proposals, and manage operational aspects of NATMAP, such as establishment of standards.

c) Participants: 1) Province/Territory; 2) GSC; 3) Universities; 4) Industry. Participants may individually or collectively present proposals to the Secretariat. Proposals would normally include: location, rationale, personnel, management structure, funding type (e.g., Fed-Prov/Terr; Univ-Fed; etc.). Therefore separate Federal-Provincial agreements or MOU's would not be necessary. Prior to submission of a proposal, informal communication among agencies should be active.

Under this system, the provinces'/territories' autonomy is maintained but their access to GSC activities is increased. University groups participate by: 1) submitting individual or joint proposals with other organizations; 2) contract services to proposals by other agencies; and 3) an academic representative on the National Committee. Industry participates by: 1) submitting individual or joint-venture proposals; 2) as client input to GSC or provincial/territorial proposals or priorities; and 3) representation on the National Committee.

3. Recommendations

a) Utilize mechanisms in the EMR/GSC Communications Committee to raise the profile of geological mapping.

b) Stimulate NSERC to: 1) recognize mapping as research; 2) contribute to NATMAP through operating grants to mapping research; and 3) recognize the value of NATMAP in training field-based researchers.

NATMAP WORKSHOP SUMMARY

DISCUSSION TOPIC #8

FUNDING MECHANISMS

by A. Menzel-Jones, C.W. Jefferson, W.G. Jeffery, and D.W. Pollock

The mandate of the group was to consider potential funding mechanisms for a NATMAP initiative. Given that the budgets of most mapping agencies, in constant dollars, have been shrinking, or, at best, remaining constant during the 1980s, the allocation of increased funding to enhance mapping activities can only be made at the expense of other activities within these organizations, unless new sources of funding are found.

1. Executive Summary

a) There was overwhelming acceptance of the concept of a centralized NATMAP secretariat.

b) MITEC (or equivalent organizations) might not itself fund NATMAP activities per se, but by leverage funding it could support other activities in the GSC or provincial surveys which would then free up monies for re-allocation to NATMAP.

c) Proposals for NATMAP activities should come from all four partners; federal government, provincial government, industry and university.

d) The secretariat should be prepared to seek out and take immediate advantage of timely funding opportunities, e.g., the environment.

2. Available Funding

The present funding levels, and the applicability of these funds to NATMAP, within the four organizations concerned with mapping are:

a) GSC: NATMAP type mapping activities represent approximately $10M of the GSC's operating budget, excluding salaries.

b) Provincial Surveys: The total MDA funds were of the order of $110M for a 5 year period, with the federal contribution representing some 65% of this figure. Thus, the total funding from all provincial surveys for mapping activities is of the same order ($10M/year) as for the GSC.

c) Industry: Much of the mapping undertaken by industry is very large scale, non-systematic, and non-standardized, and is undertaken to evaluate a property. It is a policy of the provincial surveys not to undertake a compilation of assessment data and publish it, because of these factors. However, these data are many and they represent a potential data source that should be explored. Some "traditional" mapping is done by companies, mostly in northern Canada, and thus there are some good maps which may or may not become available. NATMAP should encourage participation in the project by industry of possible contributions in kind of these maps.

d) NSERC: The policy of NSERC is not to support "mapping" per se, and thus there is no money for formal mapping. NSERC views EMR as a complementary agency and wouldn't want to compete. Notwithstanding these remarks, obviously NSERC does support mapping activities by some university faculty, but these academics are often required to hide these baseline mapping endeavours under a different guise. However, there are a number of points that can be made to NSERC to try to convince that agency of the need for baseline data, and that "mapping" is at least as intellectually challenging as naming a new particle. For example, "Global Change" - how can you measure change unless you have a baseline to measure change from? NSERC's policy towards its funding being made available for government activities is obviously undergoing change. A concrete example is the 50 cent dollars that NSERC contributes to support appropriate EMR Research Agreements. Some Research Agreements are for "mapping" activities that would suit NATMAP criteria.

3. Ancillary Issues

a) Cost of NATMAP: If the primary objective of NATMAP is to map the nation, then the question arises as to how much this will cost and can it be achieved given the present levels of funding. The rough estimates (from Davenport) would indicate that complete coverage of Canada requires $500M to $1B in 1990 dollars. With $20M per year available, and assuming that agencies can at least keep abreast of inflation (!), obviously it would require 25 - 50 years, with the latter being more likely.

b) Who should Map: Should it be entirely the mandate of the various governments to conduct regional scale mapping? The consensus from the group was that governments are expected to provide the baseline data. This concept, the "public goods option" of government, is that government(s) are required to produce information of use to the general public, which is of broad interest and which is not specifically targeted on one particular

industry. This attitude compares with previously held beliefs by government(s) that (a) "if industry benefits then industry should pay" and (b) "the place for science is in universities". Mapping puts in place the infrastructure to enable the economic framework of the country to be built. Accordingly, it was generally agreed that NATMAP must be a core program of the geological surveys.

c) Contributions: How are provinces and territories encouraged to contribute funds to NATMAP? The MDAs worked as a mechanism for joint venture funding. When the concept of NATMAP was considered, it was thought that there would not be any MDA-2s, but now that these appear to be on track (at least in some provinces), then obviously MDA is one vehicle for co-operative funding of a potential NATMAP project. Two perceived difficulties with MDA-2s are (1) there is less money than in MDA-1s, and (2) under MDA-2s there is a lower percentage of funds for geoscience projects. The provincial surveys are looking for ways to fund more mapping, and any appropriate leverage mechanism should be explored.

d) Initiation of projects: Projects could be initiated by one or more of the four main constituencies.

4. Ways and Means of Making More Effective Use of Existing Funding.

There was overwhelming acceptance of the concept of a NATMAP secretariat which would provide a co-ordinating function and would also set up peer review panels to consider the proposals put forward. The secretariat would also seek out advantageous funding opportunities.

5. Possible New Mechanisms for Funding.

The Mining Industry Technology Council of Canada (MITEC) is still in its formative stage, but could potentially entertain "mapping" proposals. The mechanics of MITEC are that

a) a proposal comes in,
b) it is put before technical panel, if the panel accept it then
c) it is circulated widely to industry to seek funding, if it is supported then
d) the work is undertaken.

The comment was expressed that if industry is expected to contribute in a real sense to mapping activities, then it would want to be sure that the funds are not available in the geological surveys. If mapping has a high priority in the surveys, then other activities should have a lower priority.

The Australian Mineral Industry Research Association (AMIRA) employs a geologist who evaluates the proposals. Revealingly, of the proposals that come forward which represent follow-on work, some 80% are supported, whilst generally only 50% of totally new proposals are supported. The list of AMIRA topics is thematic and is very diverse.

One concept discussed was that MITEC opens up leverage for joint venture funding of various kinds, BUT that in general the projects supported would not be those that fall under the NATMAP umbrella. However, if these leveraged funds could support some other activities within the surveys, then this would free up monies for re-allocation to NATMAP activities.

The Frontier Geoscience Program (FGP) may be a role model as an example of increasing a survey's "A-base" budget. Would a proposal to Treasury Board be entertained? One has to have political acumen and consider the landscape of the day. Also, there is a possible credibility question - one cannot hope to get more money to continue to do mapping which the GSC should have been doing for the last 148 years. The changes that have occurred, e.g., the digital technology revolution, must be considered in order to justify enhanced funding. Also, can NATMAP take advantage of the current emphasis on the environment by proposing enhanced surficial mapping in specific areas? Obviously, a component of environmental mapping must be an identifiable part of NATMAP.

Another potential political funding mechanism is the "Mineral Industry Land Use Strategy" under which certain areas considered for protected status are mapped.

Generally, opportunities must be seized! The fact that the surveys represent the "Honest Brokers" must be exploited. However, it is important that standards be maintained as part of the task. For example certain minimum standards required to assess mineral potential should be articulated. Given that resource assessment is required prior to establishment of new national parks, and that the GSC has a good working relationship with Parks Canada, standards should be maintained so that such assessments can contribute to NATMAP.

NATMAP WORKSHOP SUMMARY

DISCUSSION TOPIC #9

POTENTIAL PROJECTS

by F.W. Chandler, K.D. Card, R.J. Macdonald and G. Mossop

1. Desired Criteria

a) NATMAP is seen as a coordinated effort among geological surveys, the universities, industry and other interested groups in Canada, to enhance and raise the profile of geoscience map coverage of Canada and improve general documentation and understanding of the Canadian landmass. This allows pooling of abilities and resources, and working to national standards, e.g. data levelling, legends and map symbols.

b) Because a major aim of the program is to enhance and accelerate regional geoscience mapping of Canada, projects with a significant geoscience mapping component are the essence of NATMAP.

c) NATMAP aims to focus on regional mapping, generally leaving expensive techniques such as deep reflection and refraction seismic works outside its scope.

d) Emphasis is given to mapping virgin areas, but where appropriate, needs of local user may dictate other priorities.

e) Preference should be for systematic areal rather than thematic mapping. A multiparameter (layered) approach is favoured.

f) The program will be helpful in permitting projects that cross jurisdictional boundaries, consequently such projects could be prime targets for NATMAP.

g) Projects should meet societal needs, be timely, aim at a three-year time frame, have a high likelihood of delivery, a reasonable budget and conform to NATMAP standards as set.

h) New technology and technique development are desirable but are not specific aims.

i) Line managers of the participating agencies should be responsible to the NATMAP review committee for project management.

2. Project Design and Proposal

The design of and proposal for a project may contain the following components:

a) Title and summary of project/highlights
b) Background
c) Objectives/scope
d) Rationale (to establish priority by testing against NATMAP criteria a to i, above)
e) Project description/methods/logistics
f) Statement of products
g) Timeframe/schedule
h) Participating agencies and personnel/roles/management
i) Budget/funding sources
j) Benefits/clients
k) Related projects

3. Comments on two Outline Proposals.

Outline proposals for two projects, SNOWBIRD and SEAGULL were presented at the Toronto workshop by representatives of the Geological Survey of Canada. It was realized that a mechanism had not yet been established under the terms of NATMAP for the approval of projects, and that the projects might not fit criteria to be developed at the workshop. However the projects were brought forward with the thought that (a) they would serve as a focus for discussions of desired project attributes and (b) it would be useful to have project proposals available in case the NATMAP organization felt it appropriate to commence the field program in the summer of 1990. Comments made on the outline proposals by Discussion Group #9 are given below.

a) Snowbird

This proposal is favoured by the fact that previous mapping of the area is inadequate. Its economic stimulus is gold in shear zones. This three year project is however strongly theme driven, fits few NATMAP criteria and is perhaps suitable for theses. There are other areas in Saskatchewan, poorly mapped, which should have preference for NATMAP projects.

b) Seagull

Under the feather edge of the Phanerozoic in Saskatchewan three massive sulphide ore bodies have been found. Thus a geophysical and drill core interpretation of the Precambrian basement beneath the Phanerozoic from the Thompson Belt extension in Manitoba, west to the Hanson Lake block in Saskatchewan, would be carried out. Its aim would be to construct a geological map as a guide to exploration. As this is mapping of virgin territory, it is seen as a reasonable candidate for NATMAP.

It was felt that full scale projects should not proceed under the auspices of NATMAP until they could be evaluated along with other proposals by a committee set up by NATMAP.

A C K N O W L E D G E M E N T S

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The GSC NATMAP Committee wishes to thank several people who have assisted and guided us in the last 15 months in preparing two versions of the NATMAP proposal and in planning the workshop. Chris Findlay is acknowledged for knowing when to let the active scientists define aspects of a new program and when to intervene to avoid disaster. He did both equally well. Roy McLeod, Diane Bouchard and Jody Wagner were invaluable in editing and preparing NATMAP related text and in organizing the logistics of the workshop and the pre-workshop information packages. We are indebted to the various discussion group leaders and rapporteurs for contributing with their active participation to a very constructive workshop. We thank Ken Babcock, John Hamilton, Chris Findlay, Mitchell Reynolds and Robin Riddihough for their lively and interesting presentations. To all our colleagues at the GSC and elsewhere who have provided ideas and suggestions (of all sorts!), our thanks for participating in an essential discussion on a matter of national importance.

Finally the GSC NATMAP Committee deserves to be identified:

K. Card - Continental Geoscience Division (CGD)
F. Chandler - Continental Geoscience Division (CGD)
R. Gibb - Geophysics Division (GEO)
C. Jefferson - Mineral Resources Division (MRD)
D. Lavoie - Centre géoscientifique de Québec (CGQ)
A. Menzel-Jones - Continental Geoscience Division (CGD)
J. Percival - Continental Geoscience Division (CGD)
M. St-Onge - Continental Geoscience Division (CGD); Committee Chairperson
J.-S. Vincent - Terrain Sciences Division (TSD).

A P P E N D I C E S

Appendix 1

POST-WORKSHOP NATMAP QUESTIONNAIRE

PLEASE COMPLETE BEFORE THE END OF THE WORKSHOP BY CIRCLING YOUR PREFERENCE(S) OR WRITING IN NEW ANSWERS

QUESTIONS

1. Objectives of NATMAP?

   a. fill gaps/update 1:250k surficial and bedrock geol. maps;
   b. fill gaps/update 1:50k geology, bedrock and surficial;
   c. produce associated geochemical/geophysical maps;
   d. initiate multidisciplinary, 3D where possible, studies;
   e. as d. with data digitally available as well as hard copy;
   f. establish a coop. positive milieu in which feds/provs/univ/indust. can incr. prod. of well designed maps- an enabling mechanism;
   g. produce more, monolithologic factual maps; esp in urban areas;
   h. develop digital technology + standards; transfer to all.

2. Range of activities?

   a. primary activity of areal surface geological (bedrock and surficial) mapping;
   b. regional scale geoscience mapping;
   c. develop strong inter-agency cooperation;
   d. vertical and thematic mapping as well as regional mapping;
   e. repository for Industry data which may be lost;
   f. everything but uni-disciplinary maps;
   g. trimmed-down uni-disciplinary maps to increase area covered;
   h. initiate key field research projects to develop digital mapping technology, transfer technology to all.

3. Technologies?

   a. field observations supported by other techniques;
   b. digital data capture and preliminary display in the field;
   c. satellite navigation/positioning;
   d. remote sensed data;
   e. satell. communication, transmit dir. to central database;
   f. all currently available to and including production;
   g. deep drilling + f;
   h. laser coupled probing to bedrock;
   i. people (trained human minds; technical staff support);
   j. GIS but no remote-sensed data (too expensive?).

4. Database management, standards and compilations

   a. compilation as one of many end products of NATMAP;
   b. compilation as required to prepare for field mapping;
   c. digital map production in NATMAP;
   d. digital map production a separate concern but integrated;
   e. compilations as separate initiative from NATMAP.

5. How to promote?

   a. by publishing maps;
   b. design it to answer the needs of users (med. and long term);
   c. highlight use for environmental base-line data;
   d. b. + clearly identify the beneficial outputs to users;
   e. discuss with geologically oriented groups; one full time representative prepared and free to travel;
   f. videos, movies, promo. group (e.g. Chief Geol. Office of various mapping agencies); reach out to lay popul. (incl. politicians (provincial and federal);
   g. strong outside support/lobbying;
   h. use recommendations of review committee(s);
   i. talk + get coord committee in place and working, show results;
   j. high-profile successful pilot project(s) that are good and lead to exploration activity success.

6. How to implement?

   a. coop. priority setting among gov'ts, users and academia:
   b. national fed-prov program (through NGSC):
   c. do what we are doing now; more of the same
   d. impartial review/coord comm (CORCOM) sets specs & prior:
   e. by publishing maps and by encouragement and support of operational levels; minimal high-level coordination:
   f. provs submit proposals for 5-yr pilot project(s) to CORCOM which reviews and determines future of NATMAP:
   g. d. + dispenses new funds to deserving projects:
   h. initial pilot project let by very competent geoscientist:
   i. federal- only steering committee & national competition, like NSERC strategic grants - targeted:
   j. same as i. but federal/provincial/industry steering committee & national competition:
   k. separate federal/provincial (10) and federal/territorial (2) steering committees:

7. How to fund?

   a. industrial foundation or association:
   b. taxes and levy on industry:
   c. only internal reallocation of funds:
   d. mainly reallocate: portion from non-government partners on individual projects:

e. N/A; NATMAP not a funding agency but a coordinating agency:
f. primary source federal; possible matching prov. funding:
g. new money critical: industry or Feds. but not MDA or Provs.
h. MDA II money

8. Potential projects?

a. pollution potential studies for urban and industrial areas (natural sources/pathways):"
b. Lithoprobe type:
c. a) complete airborne geophys. recce and surf. geochem recce before new geological mapping; b) interpret the above in conjunction with available geology and remote sensed data: c) revision (detailed) geological mapping in parallel with detailed geophysics and geochemistry in areas of special interest; d) selected drilling with geophysics:
d. determine + fix deficiencies of old bedrock mapping; add new:
e. variety of pilot projects of digital map production followed by continuation of map production by the most successful pilot systems:
f. too early for this - establish overall NATMAP program first:
g. focus on areas of poor or non-existent data, e.g. southern Grenville and Trans-Hudson Orogen in Labrador. Balance between areas of immediate concern to industry and those with uncertain or long-term potential:
h. thematic compilations, e.g. Canadian Appalachians (terranes, deformation, metallogeny, deep structure, plutonism, etc.)

We would like to receive this second set of questionnaires from all participants of this Workshop, to help judge it's success and help us to continue planning a National Geoscience Mapping Program. Thank you.

GSC NATMAP Committee

Appendix 2

SUMMARY OF NATMAP QUESTIONNAIRE RESULTS

by C.W. Jefferson

1. Introduction

Two questionnaires were distributed to participants, one before and one after the NATMAP workshop in March. The first listed general questions and requested optional written responses. The 15 replies were used as a basis for constructing the second questionnaire (Appendix 1), which required circling and prioritizing preferred answers listed by topic. Of the 45 replies received for the second questionnaire, many were not prioritized and most indicated several options for each topic. Such replies are assigned equal value, in Appendix 3.

Because of these factors, all results of the questionnaires are given in Appendix 3 and discussed below by topic number. Where the workshop title differs from that on the questionnaire, the workshop title supersedes the latter, which is preserved in Appendix 3. For each answer the % of respondents is indicated in brackets. A final section compares results of the two questionnaires. Although the questionnaires did not allow full presentation of all arguments, their results help identify the main opinions and contentious issues of the workshop. These results also represent the views of far more than those who attended the workshop, because many representatives discussed the issues with their office colleagues before attending the workshop.

2. Objectives of NATMAP

Two main thrusts for NATMAP are indicated: (1) fill map gaps at 250k (84%) and 50k (62%) scales; and (2) develop a cooperative positive milieu for mapping in Canada (68%).
Digital technology is supported by two separate questions: multidisciplinary maps digitally available (31%) and develop digital technology and standards (24%). "NO" votes (4%) and comments temper the digital technology issue by suggesting that NATMAP should USE the technology and develop standards but not necessarily develop the technology.
Associated / stand-alone geophysical and geochemical maps are circled in 31% / 6% of responses respectively.

3. Core Activities/Range of Activities

Results here complement those of topic # 1. (1a) primary areal geologic mapping (75%) and (1b) regional geoscience mapping (67%) are the main field activities; (2) interagency cooperation (60%) is the main office activity favoured by the respondents.

Smaller percentages favour vertical and thematic mapping (24%) and use of NATMAP as a repository for Industry data (22%).

Few (9%) consider development of digital technology as an important activity. The questionnaire does not pose the separate question of digital standards, however questionnaire comments state that interagency cooperation is technically possible only if national standards are developed, accepted and adhered to.

4. Technologies

Field observations (no elaboration given) by geoscientists are regarded by 75% of respondents as the key technology. Digital capture in the field (60%) is rated as the most important "hardware" technology, with about 1/3 of respondents favouring use of satellite positioning (36%), remote sensed data (31%), and all available up to and including production (31%). Only 29% circled trained minds (people) as important to NATMAP. The strongest negative write-in vote of the entire questionnaire (9%) is posted against drilling.

5. Database Management, Standards and Compilations

Responses to the question of `compilations (in or out?)' are split among: (1) one of many end products (29%), (2) as required for field mapping (38%), and (3) separate initiative (40%). The results suggest that some compilations might be part of NATMAP but other compilations may not be right for NATMAP.

Digital map production is also evenly split between IN (38%) and OUT (36%) of NATMAP.

Write in comments noted that small-scale compilations would be one of a number of natural by-products from digital handling of NATMAP data.

6. Promoting NATMAP

High profile pilot projects (64%), publishing maps (58%) and answering user needs (58% & 47%) are deemed most important to promote NATMAP. Strong outside lobbying (47%), highlighting the use of geoscience maps for environmental studies (42%) and getting the coordinating committee working (40%) are also well received. Use of review committees (27%), discussions with geological groups (22%) and presentations to the general public (20%) are less favoured.

7. Mechanisms and Implementation of NATMAP

Cooperative priority setting among governments, users and academia has the greatest support (51%) in this topic. Other variations on this theme have moderate support: national federal-provincial program (22%), impartial review/coordinating committee (27%) and federal + provincial committee with national "NSERC"-style competition (31%). Suggestions involving less

coordination are less favoured: provincial submissions (16%), publishing maps with minimum high-level coordination (13%), federal committee with NSERC-style competition (9%), and more of the same (4%).

8. Funding Mechanisms

Most answers indicate that the mapping agencies should start NATMAP by better coordination of funding now available, . This would be accomplished by: (1) primary Federal funding +/- Provincial matching (49%), (2) mainly reallocation of existing funds with partial non-government partners on individual projects (42%) and/or (3) coordination, not funding, by NATMAP (36%). A significant number of write-ins (24%) suggest tapping environmental concerns. Less support is expressed for raising new Industry or Federal funding (16%) and applying to an industrial foundation or association (13%). Little support is recorded for MDA II (7%), and Levy on Industry (4% for; 2% against).

9. Potential Projects

Results of this topic reinforce messages received on topics #1, 2 and 6. Answers focus on (1) areas of non-existent or poor data (51%), (2) update old bedrock mapping (42%) and (3) completion of reconnaissance geophysics and geochemistry before new geological mapping (31%). Many (33%) think it is too early to consider specific pilot projects; however 90% of these also indicate the three main choices above (when NATMAP is ready).

10. Comparison of Pre- and Post-Workshop Questionnaire Results

Comparisons are made here within the context that each questionnaire was constructed differently (see Introduction). Only 15 respondents completed the first questionnaire; 45 the second. The first and second questionnaires give the same general results for topics 2, 4, 6, 7 and 8.

Regarding Topic 1, the first questionnaire gives significantly more support to multidisciplinary, 3D and digital objectives than does the second. This may represent selective sampling, in the first questionnaire, of those who like to write research proposals, and therefore volunteered more than other constituencies (the "silent majority"). The same is noted for topic 9.

Regarding Topic 3, the main difference is the far greater support given to "field observations" in the second questionnaire. This may be a result of questionnaire design. Only one of the initial respondents was of a mind set to propose "field observations" as a technology, however once reminded that field observations are a technology, a large proportion on the second questionnaire agree that this technology is fundamental.

NATMAP WORKSHOP QUESTIONNAIRE RESULTS (15 pre-workshop, 45 post-workshop returns) by C.W. Jefferson

1-9: TOPICS (Workshop Titles in parentheses) a-z: options as on questionnaire #2	% YES PRE	% YES POST	% NO POST	WRITTEN COMMENTS RELATED TO SPECIFIC OPTIONS
1. OBJECTIVES (Concept) OF NATMAP				
a. fill gaps/update 250k surficial and bedrock geological maps	13	84	0	The objective is how to mount the most cost-effective blend of tools (geosciences) needed to answer the questions posed by users. Scale variable with project (3 similar comments).
b. fill gaps/update 50k surficial and bedrock geological maps	13	62	2	This and 250k mapping should be all digital. A 1000-year project.
c. produce associated geochemical / geophysical maps	7	31	0	Fill gaps /update with geophysics=geochemistry=geology. Sampling at densities consistent with mapping objectives (add-ons).
d. initiate multidisciplinary, 3D where possible, studies	20	15	2	
e. as d with data available digitally as well as in hard copy	53	31	0	As a. & b.; data digitally available; not multidisciplinary. All data should be digitally available in a, b, c as well.
f. establish a cooperative positive milieu in which feds/provs/univ/industry can increase productivity of well designed maps - an enabling mechanism	7	68	0	Map areas should be based on established priorities. Primary and derived digital maps enable and promote NATMAP.
g. produce more monolithologic factual maps; especially in urban areas	7	6	4	Perhaps the option should be monodisciplinary maps.
h. develop digital technology + standards;	7	24	4	Do not develop "digital technology"; just (1) ensure use of digital transfer to all technology + (2) use standards.
i. equal weights of geology + geochemistry + geophysics	0	4	0	
j. complete drainage geochemistry	0	6	0	Industry cannot do this to national standards.
k. produce more maps at various scales	27	*	0	*Left off questionnaire #2 (considered a given).
2. RANGE OF ACTIVITIES (Core Activities)				
a. primary activity of areal surface geologic (bedrock and surficial) mapping	13	75	0	Mount the process of documentation in an orderly fashion within the imposed, time + economic (py $) constraints.
b. regional-scale geoscience mapping	7	67	0	With thematic and vertical as needed.
c. develop strong inter-agency cooperation	13	60	0	
d. vertical + thematic + regional mapping	7	24	2	Where necessary.
e. repository for Industry data, prevent loss	13	22	0	
f. everything but uni-disciplinary maps	7	0	0	
g. trimmed-down uni-disciplinary maps to increase area covered	7	2	2	
h. initiate key field research projects to develop digital mapping technology, transfer technology to all	7	9	2	Use variety of available digital technology; develop ascii code standards for data transfer with National Geological Surveys Committee.
i. emphasize geoscience not geology	0	2	0	
j. complete drainage geochemistry	0	4	2	Not at the expense of a balanced geoscience program.
k. immediate nearshore included	0	4	0	To maximum 100 m water depth (verbal). Add marine areas of environmental and hazard concern.

1-9: TOPICS (Workshop Titles in parentheses) a-z: options as on questionnaire #2	% YES PRE/POST	% YES POST	% NO POST	WRITTEN COMMENTS RELATED TO SPECIFIC OPTIONS
3. TECHNOLOGIES? (in Mapping)				
a. field observations supported by other techniques	7	75	0	Use appropriate technologies/specializations at appropriate times.
b. digital data capture and preliminary display in the field	27	60	0	And design of multiple, but linked, databases for GIS. Poor question sequence because b includes c-j. Not necessarily in the field.
c. satellite navigation / positioning	33	36	0	Eventually.
d. Remote Sensed Data (RSD)	13	31	0	Use it.
e. satellite communication, transmit directly to central database	7	7	4	Eventually; base should be field camp where mapping is done; data should be plotted, integrated, interpreted and field-checked before leaving the field; during the course of mapping.
f. all currently available up to and including production	40	31	2	Include aeromagnetic, gravity, electromagnetic + other techniques where justified. Whatever seems appropriate to reduce costs and/or improve the quality of mapping.
g. deep drilling + all currently available up to and including production	7	4	9	And seismic. Include shallow and deep seismic where appropriate for mapping but drilling should be separate initiative.
h. laser coupled probing to bedrock	7	7	2	
i. people (trained minds + technical staff)	27	29	0	
j. GIS but no RSD (too expensive?)	7	16	0	RSD too cheap!
k. digitize in field or office	0	4	0	Ultimate goal complete digital treatment in the field.
l. digital data available to public	0	7	0	All write-ins.
m. GIS + RSD	0	9	0	GIS + RSD (two similar write-ins). RSD "too cheap". RSD may be another (like Aeromagnetism) 1:250k reconnaissance mapping tool of the future.
4. COMPILATION AND DIGITAL MAP PRODUCTION (Database Management, Standards and Compilations)				
a. compilation as one of many end products of NATMAP	20	29	0	Discipline mapping activities by using appropriate data standards/collection & processing technologies.
b. compilation as required to prepare for issues field mapping	53	38	0	Digital map data, production, compilation should be part of a NATMAP project, but not stand-alone themselves (3 similar).
c. digital map production in NATMAP	60	38	0	As technology is available. This is but one of many products possible if digital approach is used from the beginning! Part of direct output of digital acquisition.
d. digital map production a separate concern but integrated	27	36	0	
e. compilations as separate initiative	0	40	0	Small-scale compilations as separate initiative and natural by-product from NATMAP.
f. separate observations from interpretations	0	4	2	In geology even "direct" field observations involve some interpretation and generalization on the spot. Observation and interpretation are a continuum; the field geologist is usually the most competent to make initial interpretations.
5. CLIENT NEEDS AND CONCERNS - Not covered as a separate topic by questionnaires.				
6. HOW TO PROMOTE NATMAP (Promotion)				
a. by publishing maps	13	58	0	To get the answers out (to those asking the questions) in an intelligible manner so the contributions/solutions (maps & resultant perspectives) will be appreciated (& create a longer-term dependency). To sell you must have something in hand to demonstrate the usefulness and need for related maps.
b. design NATMAP to answer the needs of users (medium & long term)	20	58	0	In language that user can understand.
c. highlight use for environmental Base-line data	7	42	0	Interpret the maps we produce to the public users who are interested in the environment.

1-9: TOPICS (Workshop Titles in parentheses) a-z: options as on questionnaire #2	% YES PRE/POST	% NO POST	WRITTEN COMMENTS RELATED TO SPECIFIC OPTIONS
d. b. + clearly outline beneficial outputs to users	13 47	0	
e. discuss with geologically oriented groups; full-time representative free to travel	13 22	0	"OK".
f. videos, movies, promo. group (e.g. Chief Geologists' offices of various mapping agencies), reach lay population (include Federal and Provincial politicians)	7 20	2	But feel out the response/effort. Waste of time and money.
g. strong outside support / lobbying	7 47	0	e.g. industry.
h. use recommendations of review committee(s)	7 27	0	
i. talk and get coordinating committee in place and working, show results	7 40	0	Same as a. and j.
j. high-profile successful pilot project(s) that are good and lead to exploration activity success	13 64	2	Great wish. Relate to a: publish maps. Change "pilot" to "all". Scary; must recognize the overall high quality of "average" government mapping; need to enhance the entire mapping effort. Do not only encourage the select few but also improve general mapping morale by fostering teamwork success. And must be well organized and timely.
k. all of the above	0 2	0	All of the above.
7. HOW TO IMPLEMENT (Mechanisms & Implementation)			
a. cooperative priority setting among governments, users and academia	13 52	2	We are not Japan! This will not work. Need holistic approach involving entire community from general public through politicians to geoscientists.
b. national federal-provincial program via National Geological Surveys Committee	13 22	2	This or g with 12 separate committees.
c. do what we are doing now; more of the same	7 4	0	
d. impartial review/coord committee (CORCOM) sets specifications and priorities	13 27	4	Led by very competent geoscientist. Question mark.
e. by publishing maps and by encouragement and support of operational levels; minimal high-level coordination	7 13	0	
f. provinces submit proposals for 5-year pilot project(s) to CORCOM which reviews and determines future of NATMAP	7 16	42	Not 5-year; does not determine future of NATMAP. Any agency submits proposals.
g. d + gives new funds to deserving projects	20 13	0	
h. initial pilot project led by very competent geoscientist	7 29	0	See above Topic 6j and comments.
i. federal-only steering committee & national competition, like NSERC strategic grants - targeted	17 9	0	
j. same as i. but federal/provincial steering committee & national competition	0 31	0	
k. separate federal/provincial (10) and federal/territorial (2) steering committees	0 13	7	Initially. Do not create a single monstrous coordinating committee - compartmentalize the selection & decision flow; keep private sector committee totally separate from the 13 government negotiations.
l. streamline selection process	0 11	0	All write-ins; try to keep selection process streamlined and simple.
m. develop funding first, delivery second	0 2	0	Wait till funding mechanism(s) are clear then develop delivery system.
n. GSC Secretariat 2 p.y.	0 4	0	Set up GSC secretariat - 2 py including promotion (discuss with geological groups).

1-9: TOPICS (Workshop Titles in parentheses) a-z: options as on questionnaire #2	% YES PRE/POST		% NO POST	WRITTEN COMMENTS RELATED TO SPECIFIC OPTIONS
8. HOW TO FUND (Funding Mechanisms)				Any way reasonable and responsible.
a. industrial foundation or association	7	13	0	
b. taxes and levy on industry	7	4	2	ERROR! ERROR!
c. only internal reallocation of funds	33	9	2	NATMAP could be done by re-establishing priorities at the GSC; it has always been a mandate for the GSC to map Canada.
d. mainly reallocate; portion from non-government partners on individual projects	7	42	0	Add provincial funding.
e. N/A; NATMAP not a funding agency but a coordinating agency	7	36	0	True now but hope NATMAP leads to new resources for mapping. Internal reallocation (c) + coordination role (e) go together. Project must strive to raise own support, then NATMAP approval and/or funding contingent upon NATMAP approval.
f. primary source federal; possible matching provincial funding	13	49	0	
g. new money critical: industry or federal but not MDA or Provinces	7	16	0	
h. MDA II money	0	7	0	
i. new money from environmental concerns	0	24	0	All write-ins; not on either questionnaire.
j. new money from industry matched in some proportion(s) by Federal + Provincial funding; not MDA	0	2	0	Write-in; not on either questionnaire.
k. all possible (write-in)	0	9	0	All write-ins; not on either questionnaire.
l. other government agencies (write-in)	0	2	0	Re-allocation of funds from other government agencies, e.g. Health and Welfare, EPA, Defense.
m. "niche" funding by specific user (write-in)	0	2	0	Design in modules (i.e. Environment, Energy, Minerals) to be "Niche" funded.
9. POTENTIAL PROJECTS				
a. pollution potential studies for urban and industrial areas (natural sources/ pathways)	7	20	0	
b. lithoprobe type	7	4	0	
c. 1) complete airborne geophysical reconnaissance and surficial geochemical reconaissance before new geological mapping; 2) interpret the above in conjunction with available geology and remote sensed data; 3) revision (detailed) geological mapping in parallel with detailed geophysics and geochemistry in areas of special interest; 4) selected drilling with geophysics	7	31	4	For selected area, integral part of mapping. Scratch drilling with geophysics (2 similar write-ins). write-ins). Use or influence priorities for collection. Use or influence priorities for collection Scratch "areas of special interest". Prime concern = geological mapping & geological map production supported by other geophysical / geochemical data.
d. determine and fix deficiencies of old bedrock mapping; add new	7	42	0	
e. variety of pilot projects of digital map production; then continue production by the most successful pilot systems	7	16	2	Change "map production" to "field data capture" (2 similar write-ins).
f. too early; establish overall program first	7	33	0	Too early for 1990 but plan some properly for 1991.

1-9: TOPICS (Workshop Titles in parentheses) a-z: options as on questionnaire #2	% YES PRE/POST	% NO POST	WRITTEN COMMENTS RELATED TO SPECIFIC OPTIONS
g. focus on areas of poor or non-existent data, e.g. southern Grenville and Trans-Hudson Orogen in Labrador. Balance between areas of immediate concern to industry and those with uncertain or long-term potential	7 51	0	But scratch Grenville & Trans-Hudson.
h. thematic compilations, e.g. Canadian Appalachians (terranes, deformation, plutonism, metallogeny, deep structure, etc.) ...	27 9	2	Prospective districts (districts with mineral potential). Desirable but also done outside NATMAP.
i. request submissions from all constituencies	0 7	0	
j. no drilling	0 13	0	
k. first: database standards; second: pilots	0 13	0	

10. GENERAL WRITE-IN COMMENTS ON SECOND QUESTIONNAIRE

a. Take Finland as the model! Emphasize the GEOSCIENCE, more than traditional geology. Should be balanced, complementary, multi-parameter earth science mapping program directed to widest possible range of customers.
b. Strength of environmental movement must not be underestimated, could support NATMAP. Environmental concerns/users critical to success of NATMAP. J.Q. taxpayer relates to the world we live in (environment) far better than to mining industry. In fact, most urban dwellers are probably against new mines especially in a wilderness area. e.g. see Mountain Equipment Co-op News Letter re mining exploration roads & wilderness in NW B.C.
c. Suggest that title be changed to National GEOLOGICAL Mapping Program.
d. Promote by interpreting the maps we produce to the public users who are interested in environment.
e. Promote by doing a pilot project or use information now available to digitize & show uses of different levels of information.
f. Prime concern = geological mapping & geological map production supported by other geophysical/geochemical data.
g. Complete geophysical & geochemical mapping before geological mapping.
h. First establish database/GIS structure, standards and physical existence, then begin pilot projects that will contribute to it.
i. It is obvious that GSC must rationalize within itself where it is going. NATMAP will only be successful if it is kept simple and focused (2 similar write-ins).
j. If you ask DIAND (NWT Geology Div) for money - don't expect much. For a geology group with one full-time field geologist and a total of 11 permanent p.y.'s to get into bed with the GSC on a NATMAP project is rather like asking them (NWTGD) to get into bed with an elephant.
k. To sell NATMAP have to a) generate a need; b) create a dependency; c) expand business by cultivating new users; d) exploring new needs, e.g. land-use committees; through active representation...block planning committees; technical inter-agency review committees - hydro, environment, agriculture, water resources etc.
l. Development, acceptance and adherence to mapping standards is of utmost importance.
m. GSC should determine broad division of endeavours.
n. NATMAP implementation: (1) do not create a monstrous coordinating committee; (2) compartmentalize the selection & decision flow into a variety of separate committees; (3) establish committee structures.

Appendix 4

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