SUMMARY OF PROVINCIAL GEOLOGICAL SURVEYS ANALYTICAL LABORATORIES

BRITISH COLUMBIA

The B.C. Geological Survey's Analytical Sciences Section is a dedicated in-house facility yith a staff of 7 full time employees and occasional contract help. It is a section of the Geological Survey Branch within the Mineral Resources Division of the Ministry. Its major responsibility is to provide analytical data to Branch geologists. It also is responsible for licensing assayers in the province and meets numerous requests for advice from other government offices on matters of a chemical nature.

ALBERTA

The analytical services used by the Alberta Geological Survey are supplied by the Alberta Research Council's analytical and testing services. These service laboratories consist of the following:

Soils Analytical Laboratory

Analytical Chemistry Laboratory

Coal Analytical Laboratory

Gasoline and Oil Testing Laboratory

Geological Survey Laboratories

Oil Sands Analytical Laboratory

Industrial Services Laboratory

Forest Products Laboratory

These laboratories support in-house programs and their services are also available to government departments and to the private sector provided the special sevices required are not available from commercial laboratories.

SASKATCHEWAN

Saskatchewan Geological Survey does not have a laboratory as such. The only facility is has is a "core storage and study building". About 80% of its analytical work is done by the Saskatchewan Research Council Laboratories and the rest by commercial laboratories.

MANITOBA

The Geological Services Branch Laboratory is an in-house facility with a technical staff of 7 wich supports the department's geologists by providing silicate, base and precious metal analyses on samples collected as part of their mapping and mineral investigations. The laboratory also provides precious and base metal assays to holders in good standing of mineral properties to enable them to evaluate the mineral potential of their claims. Non-routine analytical work is also performed for other government departments and the general public.

ONTARIO

The Geoscience Laboratories Section is a part of the Ontario Geological Survey within the Mines and Minerals division of the Ontario Ministry of Northern Development and Mines. The laboratory employs 30 scientific and technical staff in support of in-house projects of the Survey. It also provides a service to prospectors and developers using a free assay — coupon scheme as provided for in the Ontario Mining Act.

The Temiskaming Testing Laboratory (TTL) is an ancillary facility within the Mines and Minerals Division located in Cobalt. The TTL has a bulk — sampling facility and an assay laboratory suited to the analysis of material from mines in the Cobalt silver camp.

Relocation of the Survey to Sudbury, planned for 1990, will see the Laboratories move into new, custom — designed facilities. They will be capable of providing the environment needed for geoanalytical work on samples for element concentrations ranging from the sub-ppb range to the percent range as well as an expended role in research and development. It is the Government's intention that this will be a centre of exellence in geoanalysis.

QUÉBEC

The Centre de recherches minérales (CRM) is a general directorate of the Mines sector under the jurisdiction of the Ministère de l'Energie et des Ressources du Québec (MER). It has a technical staff of 43 and is an agency of applied research wich provides scientific and technical support to the mining and metallurgical industries with the aim of promoting the growth and economic development of these sectors in Québec.

The CRM is divided into two directorates [Analyse minérale (DAM) and Recherche métallurgique (DRM)] and two branches [Technologie minière (STM) and Secrétariat général et commercialisation (SSGC)].

The DAM provides routine and research analyses as a priority to the DRM and the Geological and Mineral Exploration Directorate of the Mines sector. It also provides mineral analysis and analytical research services to various groups within the mining industry whose activities centre on the exploration, extraction and transformation of mineral resources in Québec.

NEWFOUNDLAND

The Minerals Laboratory of the Newfoundland Department of Mines has a full time staff of 12 scientific and technical people. It is an integral part of the Department of Mines, supporting mainly geological staff of the Mineral development Division, and to a minor extent the Mineral Lands Division. The laboratory director reports to the Senior Geochemist who, in turn, reports to the Director of the Mineral Development Division.

NOVA SCOTIA

The Nova Scotia Department of Mines and Energy has no laboratory. Most of its major projects are carried out in collaboration with scientists from other institutes. The in-house laboratories of these institutes perform any large analytical programs for the collaborative studies. Routine geochemical analyses and small whole rock and other specialty analytical requirements are contracted out to commercial laboratories.

NEW BRUNSWICK

The New Brunswick Geological Survey has a small laboratory which carries out a limited suite of base element determinations on sediment samples collected for geochemical purposes. Other analytical work is contracted to commercial laboratories.

Provincial geological analytical laboratories

	SERVICES OFFERED							
PROV	ANALYSIS MAJOR	ANALYSIS TRACE	MINERAL SEP	OUTSIDE WORK DONE	MATERIALS TESTING	MINERAL IDENT	MANAGER	PHONE NO
B.C.	Y	Y	Y	N	N	Y	Wes Johnson	(604) 387-6249
ALTA	Y	Y	Y	ALL	Y	Y	Michael Gray	(403) 450-5414
SASK	NO LABORATORY							
MAN	Y	Y	N	Y	N	N	John Gregorchuk	(204) 945-3786
ONT	Y	Y	Y	Y	Y	Y	Chris Riddle	(416) 965-1337
QUE	Y	Y	Y	Y	N	Y	Marc Pichette	(418) 643-4540
NFLD	Y	Y	N	N	N	N	Hank Wagenbauer	(709) 576-3312
N.S.	NO LABORATORY							
N.B.	N	Y	N	N	N	N	Les Fyffe	(506) 453-2206

EQUIPMENT USED

PROV	SAMPLE PREP	XRF	XRD	AAS	ICP/OES SEQ	ICP/OES SIM	FIRE ASSAY	OTHER
B.C.	Y	Y	Y	Y,3	N	N	Y	OES
ALTA	Y	Y	Y,2	Y,2	N	Y	N	GC/MS IR NMR ION CR
SASK	NO LABORATORY							
MAN	Y	N	N	Y,2	N	N	Y	OES
ONT	Y	Y,2	Y	Y	Y	Y	Y	ICP/MS
QUE	Y	Y	Y	Y,4	Y	Y	Y	INAA ELE MIC ION CR IR
NFLD	Y	N	N	Y,2	Y	N	N	IR
N.B.	N	N	N	Y	N	N	N	COLOUR'C
N.S.	NO LABORATORY							

XRF: X-ray fluoresence;
XRD: X-ray diffraction;
IR: infrared;
OES: D.C. arc emission spec;
ICP/OES: plasma emission spec;
GC/MS: gas chromatography mass spec;
ION CR: ion chromatography;
ICP/MS: plasma mass spec;
NMR: nuclear mag. resonance.

MINERAL DEVELOPMENT AGREEMENT SUPPORT FOR REGIONAL ECONOMIC DEVELOPMENT; THE IMPORTANCE OF GOVERNEMENT GEOSCIENTIFIC ACTIVITIES

INTRODUCTION

Canada is one of the most advanced and competitive mineral and metal producers in the world.

For more than 150 years, the mining industry has been directly responsible for opening up many of the frontiers within the Dominion*, and continues to be one of the principle engines driving regional economic development and prosperity.

Many parts of the country owe much of their current economic activity to mining and mineral processing. Indeed, throughout much of Canada, mineral production constitutes the only viable economic activity capable of sustaining the current infrastructure and affirming a territorial presence.

Regional disparity in mineral endowment is a reality. Nevertheless, all Provinces have the potential to benefit from mineral exploration and the development of new mines and quarrying operations, whether it be short term benefits related to exploration activities, or the longer term rewards accruing from firmly established industrial centres and their attendant transportation/processing/manufacturing appendages.

Currently, the Canadian mineral and metals industry is faced with strongly competitive challenges as a result of the introduction of substitute materials, and a fall off in the level of demand for metals stemming from the introduction of new and more effective production technologies.

In addition to a slowdown in the rate of world economic growth, rapid growth in resource extraction in Australia, Brazil and other developing countries has dramatically decreased Canada's share of world mineral and metal production and increased price competition on world mineral markets.

Despite substantial cost-cutting, productivity gains and corporate restructuring, the minerals industry is still faced with low profitability and must continue to be resourceful and innovative in order to raise its productivity and lower production costs.

Under these circumstances it is essential that Governments at both Federal and Provincial levels work cooperatively with the private sector to see that maximum benefit is derived from the resources and expertise resident in their respective organizations in pursuing the goal of regional resource development.

Governments have made a major contribution by providing a reliable geoscientific data base that can be used by industry to guide and focus its exploration for new mineral deposits. The value of such data bases has been acknowledged repeatedly by industry and was recently summarized by J. Alan Coope in a presentation to the 42nd Provincial Mines Ministers' at Charlottetown, P.E.I., September, 1985.

PREVIOUS GOVERNMENT INITIATIVES (First Generation)

Since the early seventies the Government of Canada, together with the Provinces, has utilized various mechanisms for combining the expertise of the Federal and Provincial Geological Surveys in support of mineral developments.

Substantial advances in documenting Canada's mineral endowment were made as a result of cooperative agreements mounted between 1970 and 1982 with Federal funding allocated through the Department of Regional Economic Expansion (DREE). Other agreements (NORTHLANDS,

*see: W.A. Padgham's presentation a "Transportation and Its Effect on Mineral Exploration" given at the 43rd Provincial Ministers of Mines meeting in Banff, September 1986.

KIRKLAND LAKE INITIATIVES PROGRAM, NORTHERN ONTARIO RURAL DEVELOPMENT COMMUNITY BASED GEOLOGICAL SURVEYS, URANIUM RECONNAISSANCE PROGRAM, NEW BRUNSWICK SUBSIDIARY MINERALS AND FUEL DEVELOPMENT AGREEMENT, and the MANITOBA INTERIM MINERAL AGREEMENT, to name a few, and programs such as the NON-RENEWABLE RESOURCE EVALUATION PROGRAM (NREP) experimented with a variety of approaches, most facilitated by a transfer of funding to the Provinces who then undertook the task of autonomous program implentation with Federal contributions constrained to a management or technical advisory function.

Throughout this period the Federal Government negotiated minerals agreements with all provinces excepting Alberta, Quebec, B.C. and P.E.I. with joint expenditures totalling close to 84 million dollars.

MINERAL DEVELOPMENT AGREEMENTS (1984-1990) (Second Generation)

In 1984 Manitoba and Canada signed the first of a new generation of cooperative Mineral Development Agreements (MDAs). Responsibility for program implementation was shared (parallel delivery) between the provincial Department of Energy and Mines, and Energy, Mines and Resources Canada.

In addition to the traditional commitment to geoscientific surveys (Sector A) which was the mainstay of the earlier agreements, the range of activities conducted under the MDA was expanded significantly to include R & D into mining and mineral processing technology (Sector B), marketing and economic studies (Sector C), and communications and public information (Sector D).

In the following years (1984-86) similar multi-year agreements were signed between Canada and eight other Provinces and the Yukon, committing joint expenditures of close to 250 million dollars.**

Federal/Provincial cost-sharing ratios ranged from 50:50 (B.C., Quebec, Saskatchewan and Ontario), 60:40 (Manitoba), 65:35 (New Brunswick, Nova Scotia), 70:30 (Newfoundland), 80:20 (P.E.I.) to 90% Federal in the Yukon. Federal involvement in program delivery varied substantially from 0% in P.E.I. to over 60% in Newfoundland.

INDUSTRY INVOLVEMENT

In this review of Federal minerals-related programming, the Nielsen task force concluded that the MDAs are a potentially powerful and flexible instrument for the coordination of Federal-Provincial activities, provided "activities were directed toward economic potential in the private sector and mechanisms were emplaced to provide for appropriate industry involvement in the setting of priorities and selection of projects".

Within the current generation of MDAs a system of industry advisory forums has evolved in each of the Provinces to assist the selection, priorization, planning and execution of MDA projects by Federal/Provincial Management Committees and Technical Sub-committees.

Furthermore, in order to implement new directions and strong links between CANMET and the minerals and metals sector, the Government of Canada has already strengthened the National Advisory Committee on Mining and Metallurgical research (NAC MMR) to give it a more direct role in the planning and execution of CANMET's R&D programs. The newly named National Advisory Council on CANMET is expected to play a key role in charting the future course of the government's minerals and metals related R & D.

A July 1987 Interim Evaluation of the Manitoba MDA by Price Waterhouse concludes that the Agreement and industry liaison committees, now in their 3rd year, are working well and ensuring timely and appropriate project implementation in response to specific initiatives within that Province.

**see: Summary of Federal Provincial Mineral Development Agreements in Provincial Geologists Journal 1986, p. 121-123.

Where appropriate there is also a trend toward industry cost-sharing some joint projects that would not have been implemented without MDA leverage. In several instances industry representatives have commented on their ability, through the MDA's, to access superior expertise and facilities which might not otherwise have been available to them.

NATIONAL MINERAL POLICY

In its Mineral Policy Paper (May 1987) the Government of Canada outlined six national objectives aimed at promoting the exploration, development and utilization of Canada's mineral and metal wealth.

The sixth objective, directed at Economic and Scientific Information expressly states:

> "the Government of Canada will ensure that its role of providing timely and economic technical and scientific information required by the minerals and metals sector, labor organizations, federal and provincial agencies and the general public is developed to the maximum."

Furthermore, a commitment is made to continue Government support of basic geoscientific mapping,

"as a means of reducing exploration risks and avoiding costly duplication of efforts by the private sector," and for the GSC to work closely with Provincial agencies and to complement their activities in the minerals and metals field "particularly under the MDAs."

At present, these objectives are being met successfully under the MDAs, as well as programs designed to provide the economic information basic to marketing strategies, studies aimed at ameliorating the impact of implementing costly environmental controls, and a broad range of multi-agency projects investigating ways of increasing the effectiveness of mineral extraction and production.

IMPACTS

Cooperation between industry and both levels of government is producing constructive task-oriented results.

New mineral discoveries at Hope Brook (Newfoundland) and Strange Lake (Quebec/Labrador) have been attributed in part to the data bases generated by cooperative Federal/Provincial government geoscientific surveys.

In other regions of Canada the MDAs have done much to strengthen the liaison and close cooperative working relationships between industry and government. MDA outputs are being used extensively by industry and in many instances have led to staking rushes, new ground acquisition and follow-up assessment work.

MDA funding has also been a boon to universities which have benefitted from an attendant increase in the number of contracted applied geoscience research agreements, as well as elevated levels of seasonal student employment and training.

Numerous graduate theses have been supervised/sponsored/cosponsored by government scientific authorities, with many of the topics being tailored to address industry needs in exploration or mining technology research.

Furthermore, a national awareness of MDA momentum and potential has established, in the geoscientific community, a spirit of cooperative research that facilitates interprovincial exchanges of expertise and a joint commitment by researchers in many agencies to resolving problems peculiar to each of the regions.

Government departments themselves have benefitted from an elevated level of information flow, and through socioeconomic and marketing studies have been able to respond constructively with industry-supportive policies and considerations.

Mining technology R & D is helping to increase productivity and safety in operating mines as well as generating a better understanding of new products and new markets for certain commodities.

SUCCESSOR MDAs (Third Generation)

Much as been achieved through the current generation of MDAs, however, much still needs to be done.

In some parts of the country, such as Alberta, the understanding of industrial and metallic mineral deposits is less advanced than in other provinces, and relative to energy resources, these commodities truly constitute a frontier resource. Development of this potential would make a strong contribution to a much-needed diversification of this Province's economy.

The Canadian minerals and metals industry is likely to be faced with strong competitive challenges for the balance of this century.

Accordingly, continued effort must be directed toward finding new mineral deposits, developing new exploration techniques and technologies, and conducting research into new uses for minerals and metals.

The MDAs have proven to be a highly effective mechanism for assembling and catalytically unifying the complementary skills and technologies in industry, universities and both levels of government.

RECOMMENDATIONS

Recognizing that the MDA mechanism has proven successful in delivering government-sponsored industry-supportive minerals programming, the Committee of Provincial Geologists hereby recommends that:

Both levels of Government initiate action to ensure new MDAs are implemented at the conclusion of the current agreements so as "to assist the mining industry locate, mine and produce minerals and metals at the lowest possible cost for expanding world markets and for expanding the related manufacturing sectors across Canada".

The aims and objectives of the successor agreement will be to:

foster continued liaison with and involvement by industry in setting goals and priorities for timely and appropriate MDA projects.

encourage sharing of costs by industry where this is appropriate.

complete basic 1:50,000 mapping in prospective regions.

sustain and intensify detailed 1:20,000 mapping efforts in regions of existing mining activity.

broaden and diversity the focus of field activities to include "greenfields" mapping in more remote as yet undeveloped areas with geologic potential for new discoveries (onshore and offshore).

initiate/expand systematic computerization of minerals oriented data bases to permit integration and analysis.

upgrade mineral inventories to include recent/new developments.

continue and intensify application of proven prospecting and exploration methodologies to upgrade geochemical definition of potential ore zones.

encourage increased participation by university research workers in minerals and economically oriented applied geoscience research.

complete coverage of government funded regional airborne magnetic surveys and continue implementation of electromagnetic surveys in regions with favourable potential for base and precious metal mineralization.

facilitate increased involvement by university graduates or under-graduate students in minerals developments, through institution of co-op education programs with the mineral industry; establishing chairs of Economic Geology; enlarging seasonal employment opportunities.

extending shield-marginal documentation of the Precambrian basement as a means to locating sub-Phanerozoic ore deposits.

increase the level of research and development into cost effective mineral exploration technologies, geophysical instrumentation and drilling techniques.

increase the level of research and development into minerals extraction and processing technologies (institute suitably equipped analytical laboratories in research centres across the country where these do not currently exist).

increase the number of prospectors and improve their skills by holding prospecting schools in mining districts; encouraging native participation and providing prospectors assistance programs.

conduct research and development into preventing and correcting environmental damage caused by acid mine drainage.

conduct research and development into SO2 emission reduction and new smelting techniques to ameliorate the costs of imposing environmental controls.

and as part of a national mineral products strategy;

continue evaluation of industrial mineral potential and potential for new industrial meneral commodities.

evaluate potential for new commodities with high tech applications as well as by-product applications from existing operations.

initiate infrastructure provisions (e.g. Ontario, Quebec)

initiate drill core storage and retrieval programs.

modify the existing parallel delivery approach
i.e. federal contributions to provincial delivery (e.g. Ontario, B.C., Quebec).

improve mineral title systems.

ALBERTA GEOLOGICAL SURVEY WELL DATA BASE

Andre Lytviak, Alberta Geological Survey

INTRODUCTION

The Alberta Geological Survey Well Data Base (AGSWDB) is a computer data base implementing a number of elements of a vast array of data from wells drilled for hydrocarbon exploration or exploitation. It provides the Alberta Geological Survey with easy and quick access to these elements and with an infrastructure useful in computer-based management and manipulation of data not formally included in AGSWDB.

PURPOSE

The many projects and programs within the Alberta Geological Survey use generally available well data, at least during their initial phase. The Energy Resources conservation Board (ERCB), in pursuing its own mandate, maintains a large computer data base of information on wells within Alberta. A subset of these data is publicly available in machine-readable form. AGSWDB was designed and implemented as a common database to reduce duplication of effort in implementing these data for each individual program and project, to facilitate the development of a standard set of data manipulation and display utilities, and to make a subset of ERCB data readily available within the Alberta Geological Survey.

HISTORY

Since the early 70's, first the Groundwater Department and then the Geology Department of the Alberta Research Council have been using computers to manipulate, synthesize and display geographically located data. Though the Groundwater Department did implement a province-wide computer data base of shothole information for bedrock surface mapping, initially most of the data treated were entered from hardcopy into the computer for each project and program separately.

The Alberta Research Council acquired a VAX 11/780 during the late 70's. Shortly thereafter, the Alberta Geological Survey made arrangements with the ERCB to acquire machine-readable Alberta well data on an ad hoc basis. This information was implemented using the Datatrieve* data base managment system. However, because of the volume of data involved, only project-specific subsets resided on disk and the data base as a whole existed only on magnetic tape. It was updated from ERCB data whenever it was felt that some new project warranted current data.

In 1983, as part of a multidisciplinary project to study the deep basin hydrogeology in the Cold Lake area of Alberta, the desing and implementation of an integrated set of data manipulation, synthesis, and display tools was undertaken. As the Datatreive DBMS was judged to be inappropriate for the implementation of a complex data base with one-to-many, many-to-many, variable occurrence and variable length records, a custom data base, General Well Data Base (GWDB) (S. Bachu *et al.*, 1987), was designed and written in FORTRAN and implemented under VMS**. GWDB utilized both magnetic tape and disk to implement a subset of the ERCB well records as well as data entered from hardcopy sources and data derived by the synthesis and interpretation of both.

GWDB and the associated tools were used to support projects in all areas of the Alberta, parts of Saskatchewan as well as in the Beaufort Sea — Mackenzie Delta area. Thus, at one point, in excess of 150 000 wells were being managed within GWDB. The data base and software were developed, supported ans primarily used by the Basin Analysis Group, of the Alberta Geological Survey.

In addition to the suppor of the data base itself, the suport and development of the GWDB software became sufficiently onerous that in 1985, the data base was re-implemented on the commercial INGRES data base management system (RTI, 1985). This implementation was designed to support a common subset of Alberta Geological Survey needs in addition to those specific to the

*Datatreive is a data base management system written and sold by Digital Equipment Corporation (DEC).
**VMS is an operating system written by DEC to run on DEC's VAX computers.

Basin Analysis Group. A set of basic applications was written, using FORTRAN and the INGRES EQUEL high-level language interface to duplicate most of the functions previously provided by GWDB. In addition to the explicitly designed and written applications, AGSWDB users can use a large suite of application-independent tools which are part of the INGRES system.

Currentley work is in progress to add more record types to AGSWDB as well as to provide more tools to manipulate these data.

DESIGN

Data base management systems implement one of three basic data models, commonly called the hierarchical model, the network model, and the relational model. There are a number of hybrids available as well. INGRES directly implements the relational model. In this model, data records (tuples) are stored in a set of files (tables) with no explicit structural links between the contents of one table and those of another (Stevens, 1987). These links are implied by relations between data elements of one thable and those of another. The main advantage of the relational model over the hierarchical and network models is that it is easier to build. The main disadvantages are that it doesn't enforce relationships, and that many-to-many relationships are awkward to implement.

The records and elements in well data tend to have complex many-to-many relationships with one another intuitively best described in network terms (e.g. the case where there are many chemistries from a well battery). A requirements analysis was undertaken to determine the commonly used data elements and access paths. This analysis showed that some basic normalization could simplify the interrelationships. It was then possible to reduce these to a form which could be implemented in a relational model in a relatively straightforward manner.

The fact that the relational model does not enforce relationships between tables is a mixed blessing in an environment such as the Alberta Geological Survey. The onus is on the database implementers to ensure that integrity of relationships is maintained along defined access paths. However, the user is not constrained by any fixed set. Thus, anyone conversant with the retrieval languages, QUEL, SQL, or INGRES-menue is free to explore the data base along other lines and to display or seek additional relationships between AGSWDB data elements or records.

The main link in AGSWDB is a record element called sitid, whick uniquely defines a single well throughout the data base. All well-specific tables include it in their records. In the cases in which multiple occurrences are possible within a well, such as picks, chemistries, cored intervals, etc., sitid is supplemented with an additional identifier. This identifier is specific to each record type. For example, intervals are numbered in the cores cut and core analysis tables. A record which was specific to a well and a cored or analysed interval would contain both the sitid and the interval number. It is through careful management of these links that main relationships are retained within AGSWDB.

IMPLEMENTATION

The data base contains one common MASTER table. The MASTER record type constitutes the primary index and main linking mechanism within AGSWDB. This record type contains three identifier elements. The first, sitid, is unique within AGSWDB and is also contained by any other AGSWDB record specific to this particular well. The sitid element provides the main inter-table link within AGSWDB. The second element, called srcid, is the unique identifier given to the well by the agency from which the record was acquired. This allows AGSWDB to be related to the data base of the source agency for purposes of update, verification and reference. The last element, called wname, is the well name given by the company hardcopy well records. It also serves as a verification mechanism for record correspondences established using other data elements. The MASTER record type also contains an element identifying the source of the well information and the date of its acquisition.

AGSWDB contains one common LOCATION table. The LOCATION record type provides the ability to locate the well in geographic coordinates. The ability to locate quickly and positively identify the wells in a given area is the single most commonly used function of AGSWDB. In addition to the sitid

element, LOCATION records contain the latitude and longitude of the well surface location, its ground and kelly elevations, its total depth and true vertical depth. Each set of values also has an associated data element which indicates the precision of the given location and depth values.

Horizons are implemented as a single dictionary table, HORDIC, together with a separate table, HORIZON, for each horizon picked. These are implemented to allow the storage and retrieval of pick records such as those available from the ERCB. The HORDIC record type provides the link between horizon names, identifies the source of the horizon picks, as well as the date the horizon was implemented in the data base. The HORIZON record type contains the sitid element as a link to the well, the depth of the pick, a quality code and an element describing the part of the horizon picked. The fact that picks for each horizon are implemented in separate tables makes the manipulations of horizons as entities straightforward at considerable detriment to the ability to deal with the down-hole relationships of horizon sequences.

An inventory of the cored intervals is implemented as a single table, CORES CUT. The CORES CUT records are linked to the other tables via the sitid data element and differentiated by a core no element. The top and bottom of the cored interval as well as the length of core recovered constitute the main elements in this record type. Several other elements such as date of coring and fluid used are also retained.

The results of core analyses are also implemented as a single table, CORE ANAL, and implemented much the same as the CORE CUT record type. The core anal records have, in addition to elements used for linking and differentiating records, a subset of possible determinations. This subset consists of maximum, perpendicular and vertical permeabilities, porosity, grain density, etc.

Drillstem tests (DST) and formation fluid chemistries have been implemented in AGSWDB. These are both complex implementations of one-to-many and many-to-many relationships. They differ from the previous data types in that, though their indices are based on machine-readable files from the ERCB and other agencies, the bulk of the data was entered by hand from hard-copy originals or through interactive interpretations of such base data.

CURRENT STATUS

The Alberta Geological Survey Well Data Base currently contains records on approximately 170 000 wells. About 130,000 of these are in Alberta, 30 000 in Saskatchewan, and the remainder are in B.C. and N.W.T. (Figure 1).

The ERCB releases an updated version of its data base four times a year. To take advantage of ERCB's update flags and, thereby, decreasing the number of records to be processed, the Alberta subset of AGSWDB is also updated four times a year. The Saskatchewan, British Columbia, and North West Territories subsets are updated only when project requirements indicate this to be necessary.

Currently one main users utility, GEOCRT (GEOgraphy CaRTography) (A. Lytviak, 1986), has been written to allow users transparent access to AGSWDB. GEOCRT allows users to define a project with any number of associated study areas. These can be disjoint or subsets of other study areas. Within each study area users can extract, edit, and print the pertinent subset of wells from AGSWDB's total holdings. These subsets constitute a custom database accessible only to the user. Changes to this subset do not affect the common tables and are not available to other users without explicit arrangements being made by the data base administrator. GEOCRT also allows users to extract, edit, and print custom horizon tables. The extraction process allows one to equate any combination of the generally available horizons with user-defined horizons. These, as well, are specific to the user unless explicit arrangements are made with the data base administrator.

Though some custom reports have been predefined and can be run by inexpert users, access to AGSWDB holdings other than well distribution and horizon picks currently requires knowledge of the INGRES retrieval and report languages.

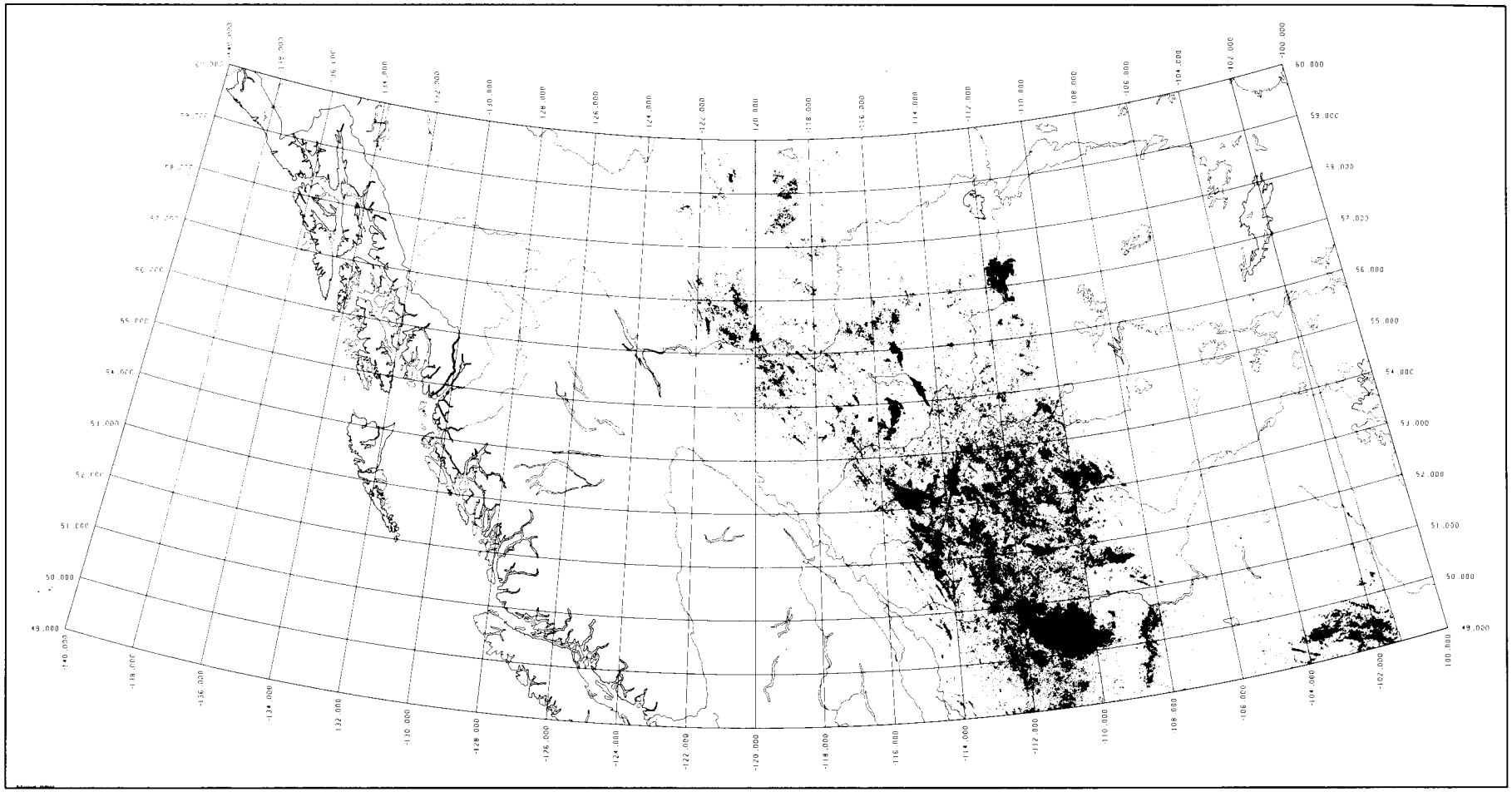

Figure 1. Distribution of wells in Alberta, Saskatchewan, B.C. an N.W.T.

Cartographic representation (plotting) of these data is performed by applying a custom cartographic package, GEOPLTR (A. Lytviak, 1983), to reports generated from AGSWDB, or acquired otherwise. Structure contour maps and other data generalizations are produced by using GEOPLTR in conjunction with the commercial surface manipulation and display package, SURFACE II (R. Sampson, 1975).

FUTURE DIRECTIONS

AGSWDB's emphasis on the horizon relationships will be supplemented by a stronger set of down-hole capabilities. This requires that the multiple tables for horizons be reimplemented as a single, multiple horizon table. This will allow simplification of the currently complex procedure to subset data based on vertical relationships such as "above", "below" and "between".

The logged intervals description data will be implemented in AGSWDB in the near future. The current horizon and area capabilities of GEOCRT will be extended to allow transparent access to the core cut, core analysis data and logged interval data.

The GEOPLTR cartographic package will be rewritten and integrated with the database software to make the plotting and data retrieval system interface more transparent to the user.

The intention is to implement Radian Corporation's CPS-3 subroutine library (K. Graf, 1986), as the basis for surface manipulation and display. This, too, will be integrated with the data base and cartographic packages. The ability to use SURFACE II will be retained, but will not be integrated.

CONCLUSION

At this time it appears that the AGS efforts in adoption and development of a department-wide data base has the following actual and potential consequences.

1) Reduce the duplication of data acquisition and data support effort.
2) Increase the currency, availability, and integrity of many commonly accessed data.
3) Allow the desing and implementation of a common set of data manipulation and display tools for a wider range of projects and programs.
4) Increase the access to data and data manipulation capabilities to the geologist.
5) Increase the amount of departmental resources required for overall computer support, both in terms of computers and computer support personnel.

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INFORMATION ON LEGISLATION SURROUNDING MANDATES OF PROVINCIAL GEOLOGICAL SURVEYS IN CANADA

BRITISH COLOMBIA

LEGISLATION

Ministry of Energy, Mines & Petroleum Resources Act.

Purpose and functions of ministry:

(a) initiate and carry out any investigation, research, study or inventory respecting mineral and petroleum resources, and on energy facilities and future requirements for the Province;

(b) collect and circulate the information acquired;

(c) establish energy services for ministries of the Province, and for that purpose to obtain from them information about their projects, programs and requirements involving energy.

GEOLOGICAL RESPONSIBILITIES

GEOLOGICAL SURVEY BRANCH 87/88 PLAN

MISSION STATEMENT

The mission of the Geological Survey Branch is:

> To aid, stimulate and promote the growth of the mining industry for the social and economic benefit of the people of British Colombia by conducting geoscientific surveys, by inventorying and analysing the geology and mineral depostis of the Province and by disseminating this information in a timely manner.

SUPERORDINATE GOALS

The work of the Geological Survey Branch contributes to five main, inter-related goals that contribute to the over-all mission of the Mineral Resources Division — "stimulate, facilitate and guide mineral exploration development and production for the overall benefit of the Province."

These goals are:

1. To develop and advance the basic geoscientific knowledge of B.C., by undertaking and supporting geoscientific surveys and related research, to enhance the discovery and development of the Province's mineral resources.

2. To analyse and interpret information on the distribution, nature and magnitude of the Province's mineral, coal and industrial mineral resources.

3. To collect, compile and collate all information relating to the geology, mineral resources, and exploration activites in B.C. in order to provide a comprehensive database for government, industry and public use.

4. To develop and communicate the geoscientific information needed by Governments for effective land use and mineral policy decision.

5. To disseminate the information collected in a timely manner through publications, scientific meetings, trade shows, and an annual open house.

ALBERTA

LEGISLATION	GEOLOGICAL RESPONSIBILITIES
ALBERTA RESEARCH COUNCIL ACT	The Alberta Research Council may conduct, on a scientific or engineering basis: (a) research related to the utilization and upgrading of the natural resources of Alberta; (b) research on new and improved technical processes and methods that are of might be used in Alberta industries; (c) research on behalf of or pursuant to agreements with persons, firms or organizations that wish to avail themselves of the expertise and facilities of the Alberta Research Council; (d) basic and applied research in the natural sciences with the objective of improving the welfare and progress of urban and rural life in Alberta; (e) research to ensure the effective application of technology developed by the Alberta Research Council in both the public and private sectors of Alberta. The Alberta Research Council (a) shall, at the request of the Executive Council, advise it on questions of scientific and technological methods affecting the expansion of industries or the utilization of the natural resources of Alberta, and (b) shall supervise matters affecting scientific and industrial research assigned to it by the Lieutenant Governor in Council.
ENERGY RESOURCES CONSERVATION ACT	(a) to provide for the appraisal of the reserves and productive capacity of energy resources and energy in Alberta; (b) to provide for the appraisal of the requirements for energy resources and energy in Alberta and of markets outside Alberta for Alberta energy resources or energy; (c) to effect the conservaton of, and to prevent the waste of, the energy resources of Alberta; (d) to control pollution and ensure environment conservation in the exploration for, processing, development and transportation of energy resources and energy; (e) to secure the observance of safe and efficient practices in the exploration for, processing, development and transportation of the energy resources of Alberta; (f) to provide for the recording and timely and useful dissemination of information regarding the energy resources of Alberta;

(g) to provide agencies from which the Lieutnant Governor in Council may receive information, advice and recommendations regarding energy resources and energy.

OIL SANDS TECHNOLOGY AND RESEARCH AUTHORITY ACT

The compilation, assessment and dissemination of present and future technological information relating to:

(a) exploration for oil sands deposits and the recovery and processing of oil sands products,

(b) the recovery and processing of crude oil and products derived from crude oil,

(c) environmental conservation in connection with those exploration, recovery and processing operations, and

(d) the production and transportation of synthetic crude oil and other oil sands products and of crude oil and products derived from crude oil.

OIL & GAS CONSERVATION ACT

(a) to effect the conservation of, and to prevent the waste of, the oil and gas resources of Alberta;

(b) to secure the observance of safe and efficient practices in the locating, spacing, drilling, equipping, completing, reworking, testing, operating and abandonment of wells and in operations for the production of oil and gas;

(c) to provide for the economic, orderly and efficient development in the public interest of the oil and gas resources of Alberta;

(d) to afford each owner the opportunity of obtaining his share of the production of oil or gas from any pool;

(e) to provide for the recording and the timely and useful dissemination of information regarding the oil and gas resources of Alberta;

(f) to control pollution above, at or below the surface in the drilling of wells and in operations for the production of oil and gas and in other operations over which the board has jurisdiction.

SASKATCHEWAN

LEGISLATION

THE MINERAL RESOURCES ACT 1985.

NOTE: "Section 10 of *The Mineral Resources Act, 1985* empowers the Minister to carry out various geological and mineral-related activities".

POWERS OF MINISTER

10 The minister may do those things that he considers necessary respecting the exploration for and the development, management and conservaton of the mineral resources of Saskatchewan and, without limiting the generality of the foregoing, the minister may;

(a) provide for the carrying out of surveys of any or all minerals or mineral resources in Saskatchewan;

(b) provide for the collection, arrangement and systematization of information respecting minerals and mineral resources and the operation of mines or wells for the production of any minerals in Saskatchewan and the preparation and publication of such reports in connection therewith as he deems necessary;

(c) make and carry out investigations, examinations, experiments, tests and analyses of or pertaining to minerals for the purpose of determining their scientific and economic value.

"This is from the *departmental* "Mandate, Aims and Objectives". The document does not contain a specific mandate or mission statement for the Geological Survey but states major aimns of the Geology and Mines Division (1-7 below) of which the Survey is a part." (Dr. Les Beck 11/6/87).

GEOLOGICAL RESPONSIBILITIES

Geology and Mines Division

(1) Perform geological and mineralogical studies in order to assess the mineral potential of the province and to provide a framework for mineral exploration programs by industry.

(2) Maintain an up-to-date and relevant geoscientific library (maps, reports, data files, inventories and core collections).

(3) Promote resources and exploration opportunities in the province through publication, technical meetings, open house displays and individual consultations.

(4) Assess the results of petroleum and mineral exploration submitted by industry for technical validity and conformity to the regulations.

(5) Monitor mining operations to ascertain that good conservation practices are in place and that mine development correlates with royalty returns.

(6) Regulate and administer the disposition of crown lands relating to potash, uranium, hard rock minerals, sodium sulphate, coal and quarriable commodities such as limestone and aggregate.

(7) Maintain up-to-date and accurate records of mining and exploration activites, mineral production and the value of mineral sales in the province.

MANITOBA

LEGISLATION

An act to create a Department of Mines and Natural Resources.

Appointment of staff

A deputy minister, an assistant deputy minister, a Director of Mines, a provincial geologist, a provincial assayer, a chief inspector, inspectors, and such other officers and employees as may be required to carry on the business of the department, may be appointed as provided in The Civil Service Act.

Duties of Director of Mines

The Director of Mines, under the direction and control of the minister, shall carry out the provisions of The Mines Act and the regulations or ordors.

Administration

The minister shall administer The Mines Act and the regulations, and the Director of Mines, the provincial geologist, the chief inspector and inspectors appointed under this Act are, and have the powers of, inspectors under that Act and the regulations.

ONTARIO

LEGISLATION

"In 1891, an Act of Legislature created the Ontario Bureau of Mines, its purpose being "to aid in promoting the mineral interests of the Province". It is here that the present Ontario Geological Survey originated and staff were appointed.

The need for geological mapping to encourage exploration for minerals was recognised. Over the years, the role of the Survey was modified from time to time, until the formulation of the current goal statement, of which a copy is attached. This statement, and the eight objectives, were approved in 1978 by the Deputy Minister of Natural Resources. We are now in a new Ministry and the Survey's role is under review" (from Dr. Milne, June, 1987).

GEOLOGICAL RESPONSIBILITIES

PROPOSED GOAL AND ABJECTIVE STATEMENTS

GEOLOGICAL PROGRAM

Goal: To stimulate exploration for, and facilitate sound planning in all matters related to, mineral and all other earth resources by providing an inventory and analysis of the geology and mineral deposits of Ontario.

Objectives:

1. To interpret the geology and mineral deposits of Ontario by undertaking geological, geochemical and geophysical surveys of the bedrock and surficial deposits.

2. To locate areas of high mineral resource potential by analyzing and evaluationg geoscience data in order to determine the characteristics of geological environments favourable for mineralization.

3. To provide expertise and information for the identification and evaluation of earth resources to facilitate integrated planning in the context of MNR's corporate program objectives, putting particular emphasis on the program interaction relative to urban, engineering, recreational and environmental concerns by locating terrain most suitable for construction and development, identifying potential natural hazards and assisting in the siting and potential utility corridors.

4. To evaluate the mineral development capabilities of the province by undertaking inventories of the reserves and potential resources of Ontario's mineral deposits.

5. To achieve wide effective circulation of technically current geological and geotechnical information on the Ontario land mass and its mineral resources, and to develop and maintain a readily accessible modern data storage and retrieval system on the geology and mineral deposits of the province.

6. To stimulate exploration by the private sector and aid regional development by providing financial incentives and assistance programs to the exploration industry.

7. To stimulate and encourage new technology and new concepts in mineral exploration by funding applied geoscience research on the nature and origin of mineral deposits, geological processes, engineering and environmental geology, exploration technology, and data processing.

8. To provide analytical and mineralogical expertise in aid of Ministry Mineral Resource Inventory and Management Activities.

QUEBEC

LEGISLATION

Political Statement relating to Geological Exploration and assistance to exploration of Mineral Deposits.

GEOLOGICAL

OBJECTIVES OF THE DEPARTMENT OF ENERGY & MINES FOR GEOLOGICAL RESEARCH

— To augment all exploration efforts in Quebec.
— To ameliorate its efficacy.
— To diversify mineral production in its territory.

The means for realizing these objectives are based on four activity levels:

Activity 1: Geological mapping over the entire Quebec territory. This is at a reconnaissance level using aeromagnetic and/or gravimetric mapping at a small scale (i.e. of large areas), combined with geological mapping also at a small scale (1:250 000).

Activity 2: Geological mapping of metallogenic provinces (in Quebec) at 1:50 000 scale. Regional geochemical and spectromagnetic survey is based roughly on 1 sample /15 km^2 depending on type of terrain.

Activity 3: Detailed geological mapping in potential or existing mineral districts at 1:20 000 and 1:10 000 scale. Aerial geophysical study, detailed geochemical and geological work help identify complexes, units or structures most favorable for mineral exploration.

Activity 4: Specific studies of mineral districts, helps to finalize the local geological modelling, characterize and locate deposits in the model in order to predict and locate other deposits. This may include various studies such as structural, stratigraphic, sedimentologic, geophysical, geochemical, petrologic, volcanologic, geochronologic, etc.

NEW BRUNSWICK

LEGISLATION

There is no specific Act governing the survey, but there are guidelines setting out the geological responsibilities of the Geology Branch.

GEOLOGICAL RESPONSIBILITIES

GEOLOGICAL SURVEYS BRANCH

The Geological Surveys Branch is responsible for the collection and dissemination of information pertaining to the geology and mineral deposits of New Brunswick. Closely associated activites include the encouragement of mineral exploration, the promotion of the mining industry, and helping those who formulate resource and land use policies. The principal objective of the Branch is to provide a complete and up-to-date inventory of geological data to stimulate and guide mineral exploration, and to allow sound resource planning.

A large part of the Branch's activities in 1985 were carried out under Canada-New Brunswick Mineral Development Agreement (MDA). This accord entails an expenditure of $22.3 million over a five year period on geoscience, mineral technology, and public awareness programs.

NOVA SCOTIA

LEGISLATION

The Department traces its history back to the 1840s when the Inspector of Mines made regular reports. In 1862 an act was passed to establish a Gold Commissioner with power to survey gold mining districts and appoint assistant commissioners and bailiffs in each district as needed.

Not until 1939 did the Department gain a separate identity. In that year the Public Service Act was passed which separated Mines from Public Works and established a department with a deputy minister. The Mines Act, passed during the same period of time, provided for the regulatory functions of the Department.

An amendment to the Public Service Act in 1978 changed the name of the Department from Mines to Mines and Energy. It added responsibility for promoting mineral and energy use and allowed for the regulation of these sectors.

The geological investigations that our Department undertakes are not spelled out in legislation but are encouraged by the various acts through reference to "promotion of our mineral resources," etc.

NEWFOUNDLAND

LEGISLATION

DEPARTMENT OF MINES & ENERGY ACT.

POWERS, FUNCTIONS AND DUTIES OF MINISTER.

7. The powers, functions and duties of the Minister extend to and include

   (a) the supervision, control and direction of all matters relating
   (i) to mines, minerals, coal, oil, natural gas, salt, quarries, quarry materials and beaches.

   (b) the collection, compilation, analyzing and recording of such statistical and other information relating to any of the matters referred to in paragraph (a) as may be useful.

   (c) the preparation and publication of statistics, reports, records, bulletins, pamphlets, circulars and other means of disseminating information in relation to any of the matters referred to in paragraph (a) as may be useful.

GEOLOGICAL RESPONSIBILITIES

OBJECTIVES AND GOALS OF MINERAL DEVELOPMENT DIVISION

The Mineral Development Division is responsible for obtaining and disseminating information on the geology and mineral resources of Newfoundland. The division functions as a geological survey with two major objectives:

1. to promote exploration and development of the province's mineral resources by providing basic geoscientific data indicating areas where mineral deposits may be found, and

2. to provide the geoscientific data necessary for proper management of the province's mineral resources.

In fulfilling its role, the division carries out field and office programs in a number of disciplines related to mineral resource development. These include geological, geophysical and geochemical surveys, evaluation of mineral deposits and resource development potential, and development and maintenance of mineral resource information systems for government, the mineral exploration industry and the general public.

FUNDING

Mineral Development Division's budget for the 1984-85 fiscal year was $4.1 million (net), allocated as outlined below.

Major increases in funding over 1983 levels were due entirely to the initiation of new projects under the Canada-Newfoundland Subsidiary Agreement on Mineral Development, wich was signed in May, 1984. This agreement is for a five-year term (1984-89) and will

involve the expenditure of $22 million. This amount is subdivided as follows:

	Total*	1984-1985
1. Federally funded and delivered projects	$12.1	$2.0
2. Provincially funded and delivered projects	3.4	0.5
3. Provincially delivered, cost-shared (50 percent federal, 50 percent provincial) projects	6.5	1.3
TOTAL	$22.0	$3.8

* Totals in millions

MINERAL DEVELOPMENT DIVISION
ORGANIZATION AND RESPONSIBILITIES