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1990

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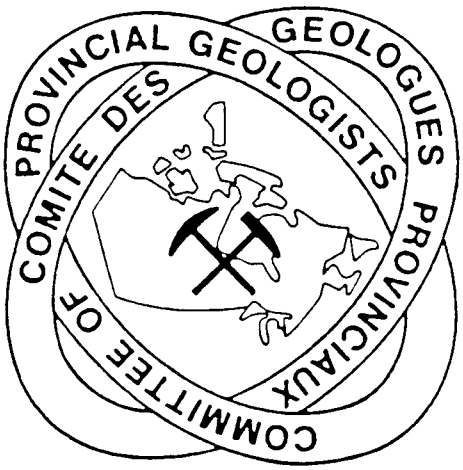
Comité des géologues provinciaux

CONTENTS

1990
PROVINCIAL GEOLOGISTS JOURNAL
JOURNAL DES GÉOLOGUES PROVINCIAUX



VOLUME 8

PUBLICATION ANNEULLE DU
COMITÉ DES GÉOLOGUES PROVINCIAUX

PUBLISHED ANNUALLY BY
COMMITTEE OF PROVINCIAL GEOLOGISTS

FOREWORD

I would like to take this opportunity to thank everyone involved in the compilation of Volume 8 of the Provincial Geologists Journal. This Journal represents a group effort that requires the co-operation, dedication, and support of every provincial and territorial organization in the country.

A special acknowledgment should go to the following individuals who compiled and edited major portions of the document. They include: Ron Smyth and Claudia Logan, British Columbia Ministry of Energy, Mines and Petroleum Resources; Dave McRitchie, Manitoba Department of Mines and Energy; Vic Milne, Mike Grant, Alison Weatherston and Kerstin Lindgreen, Ontario Ministry of Northern Development and Mines; Robert Lamarche and Denis Lefebre, Quebec Ministere de l'Energie et des Ressources; and Peter Gilles and Howard Donohoe, Nova Scotia Department of Mines and Energy.

As in 1989, the Alberta Geological Survey was responsible for final editing and compilation of the Journal. Special thanks should be extended to Mike Prentice and his team of Dale Hite and Karen Parrish-Hite for another job well done.

The Provincial Geologists Journal is available in each province and territory through the offices of the respective geological surveys listed on the back cover of the Journal.

Rand Harrison
Head
Alberta Geological Survey
Alberta Research Council

THE COMMITTEE OF PROVINCIAL GEOLOGISTS
Chairman's Report, 1990

The Committee of Provincial Geologists met twice in the past year: on March 11 in Toronto, at the annual convention of the Prospectors and Developers Association of Canada, and on August 27, during the Mines Ministers Conference in Winnipeg.

The Committee's brief to the Mines Ministers Conference in Sudbury in 1989 stressed the importance of cooperation between provincial and federal geological surveys. Ministers accepted the Committee's recommendation that federal and provincial geologists work toward improved coordination, and directed that a report on progress in this area be presented to Deputy Ministers at the 1990 conference. Major progress has been achieved in the past year on two fronts, as reported at the Winnipeg conference: the development of mechanisms for cooperation between individual provincial surveys and the Geological Survey of Canada, and the initiation of a National Geoscience Mapping Program (NATMAP).

Following the Sudbury meeting, discussions on cooperation in geoscience were held between the Geological Survey of Canada and most provincial and territorial geological surveys. These meetings reviewed activities proposed for 1989-1990 by both surveys for the individual province and territory, and discussed general mechanisms for federal-provincial cooperation. In some cases (Newfoundland, Manitoba, Alberta, British Columbia, Yukon) the meetings led to the development of draft principles for cooperation between the federal and provincial survey. The Alberta Geological Survey and the Geological Survey of Canada have finalized and signed principles of cooperation. Draft principles will be further discussed at the next round of meetings in the other provinces.

Representatives of the Committee of Provincial Geologists participated in the March 8-10, 1990 NATMAP Workshop convened by the Geological Survey of Canada in Toronto. The Committee participated as well in subsequent discussions on this coordinated approach to geological mapping in Canada at the National Geological Survey Committee meeting (March 13, 1990), and at the inaugural meeting of the NATMAP steering committee, held on June 25 at the headquarters of the Ontario Geological Survey. Good progress has been made in formulating the framework under which NATMAP could be implemented, and discussion of pilot projects to be delivered in 1991 is proceeding.

Other activities of the Committee in 1990 included publication of the *Provincial Geologists Journal*, continued liaison with the Prospectors and Developers Association, and cooperation with the Geological Survey of Canada, through the National Geological Surveys Committee, on a number of projects of mutual interest.

Volume seven of the *Provincial Geologists Journal* was published in March. In addition to the usual information on provincial and territorial geoscience organizations, programs, and expenditures, volume seven included a review of the status of geoscience information systems in Canadian geological surveys, and a compilation of geoscience map symbols used in Canada. These two papers report on projects initiated through the National Geological Surveys Committee. The Journal, as well, published an open letter from the Prospectors and Developers Association of Canada, in which the Association outlines its concerns with access to land and the availability of geoscience information.

The Committee again participated in the annual Prospectors and Developers Association Convention in Toronto, organizing, with the assistance of the PDA, the Provincial Activities Session and geological displays in the "provincial room". Seven papers were presented at the Provincial Activities Session:

1. The Golden Fleece and Gold Exploration in British Columbia – Renaissance of an Old Prospecting Tool – P.F. Matysek, British Columbia Geological Survey Branch

2. The New Reality of Exploration and Development of Earth Resources in Alberta: Joint Work for Mutual Benefit and Information Transfer – J. Dixon, Alberta Research Council

3. Saskatchewan Diamonds - A New Reality – M. Gent*, C.T. Harper, P. Guliov, and R. MacDonald, Saskatchewan Energy and Mines

4. Roles du Gouvernement du Quebec dans le processes de renouvellement des Reserves Minerales: Focus sur Chibougamau – R.Y. Lamarche, Ministere de l'Energie et des Ressources, Gouvernement du Quebec

5. Implications of the Southwest Nova Scotia Tin Domain for Tin Metallogeny in the Meguma Terrane, Nova Scotia – D.J. Kontak*, G.A. O'Reilly, and A.K. Chatterjee, Nova Scotia Department of Mines and Energy

6. Volcanological Setting of the Brunswick Massive Sulphide Deposits, Northern New Brunswick – S. McCutcheon, New Brunswick Department of Natural Resources and Energy

7. Mineral Potential of Labrador: An Exploration Frontier for the 1990's – H.S. Swinden*, R.J. Wardle, and P.H. Davenport, Newfoundland and Labrador Department of Mines and Energy

Discussion continued between the Committee and the PDA on a wide variety of subjects, including the requirements of the industry for access to geoscientific data, the public image of the mineral industry, and the availability of land for exploration.

The National Geological Surveys Committee, including representation from the Geological Survey of Canada as well as all of the provincial and territorial geological surveys, maintained subcommittees investigating standardization in various aspects of geoscience, including geoscience information systems, aeromagnetic surveys, and geological map symbols. Reports of these subcommittees are published in the *Provincial Geologists Journal* as they become available. The NGSC will also play a major role in the development of the National Geoscience Mapping Program (NATMAP), coordinating the activities of the NATMAP steering committee.

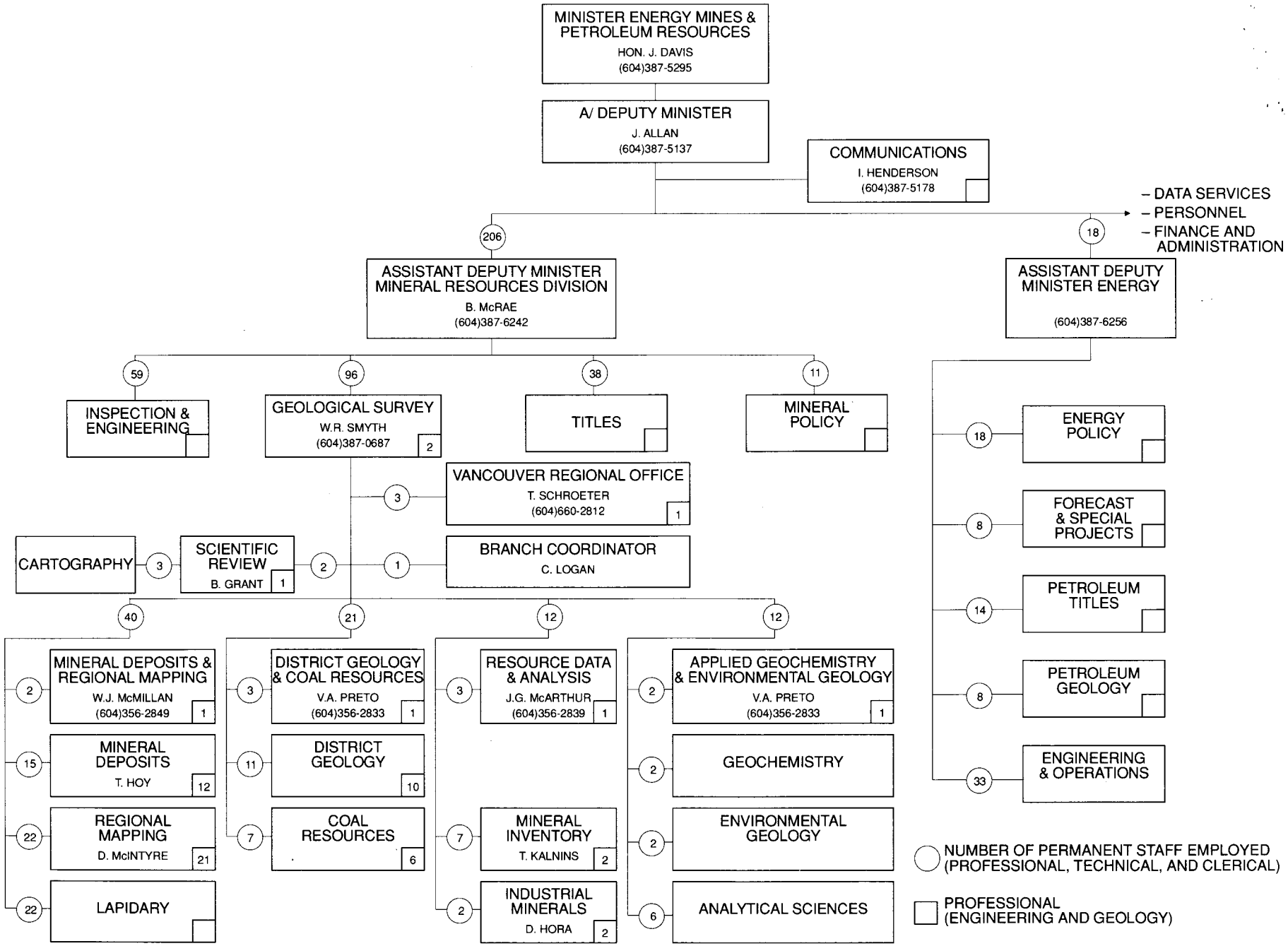
Dr. Jan Boon, who represented the Alberta Geological Survey on the committee since 1985, resigned in 1990. The committee thanks Jan for his active participation and wishes him well in the future. We welcome Dr. R.S. Harrison as the new representative of the Alberta Survey.

*Denotes speaker

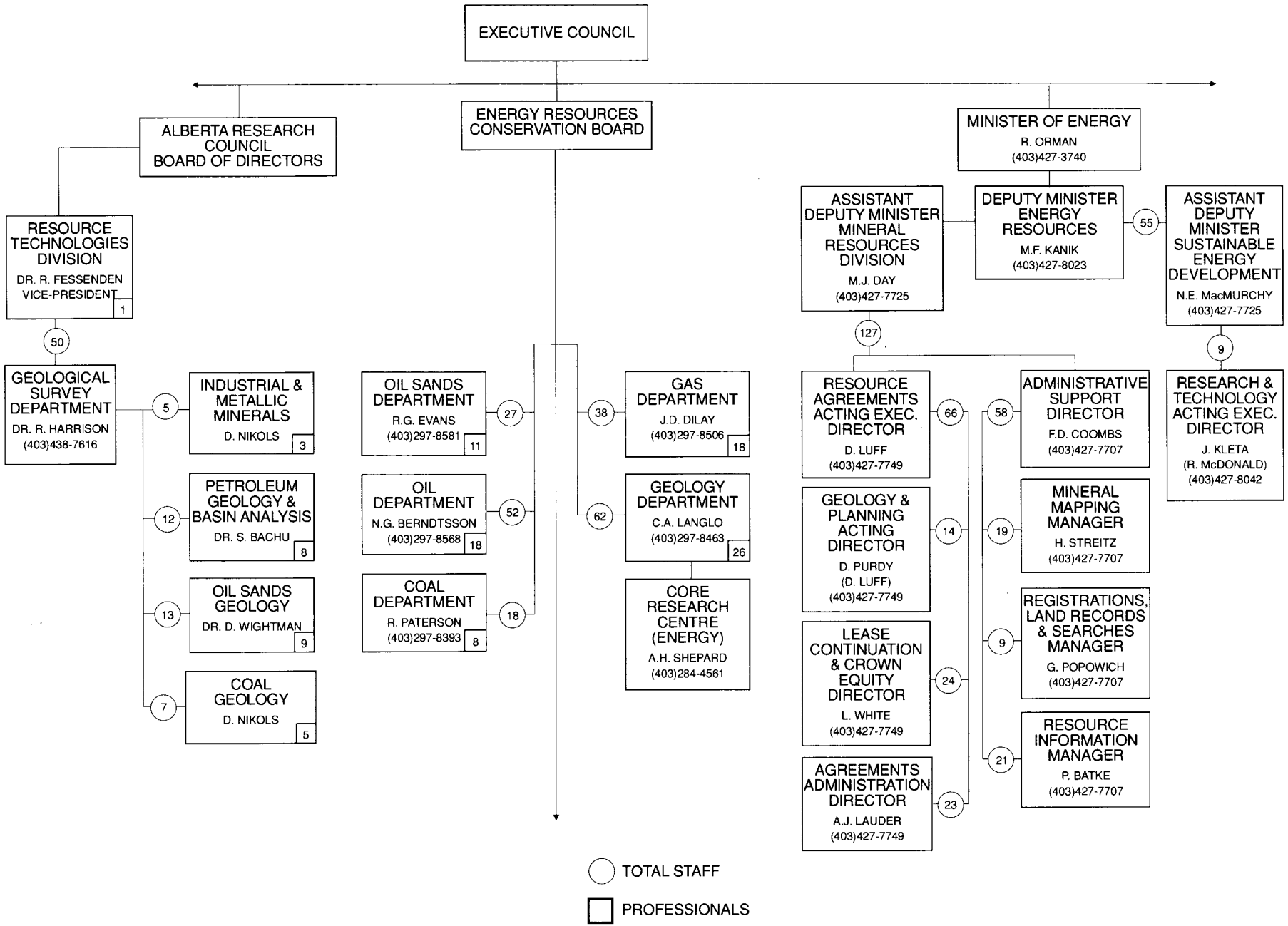
GEOSCIENCE ORGANIZATION CHARTS

Each provincial and territorial government in Canada has developed its own organization structure for conducting geoscientific survey and research work. Some provinces have what is formally called a Geological Survey (e.g. Ontario Geological Survey), but in most jurisdictions the main elements of the geological survey function are embraced in one or more Branches or Divisions of provincial Mines/ Energy/Natural Resources Departments (e.g. the British Columbia Ministry of Energy, Mines and Petroleum Resources is divided into a Mineral Resources Division and a Petroleum Resources Division, with the bulk of geological survey and research work conducted in the Geological Branch of the Mineral Resources Division). The following organization charts are set out in standard format to help alleviate confusion amongst potential users of provincial geoscience services. The charts contain reference to the lines of reporting of the various units in each hierarchy, the manpower associated with each separate jurisdiction, and the names and telephone numbers of key individuals in each system.

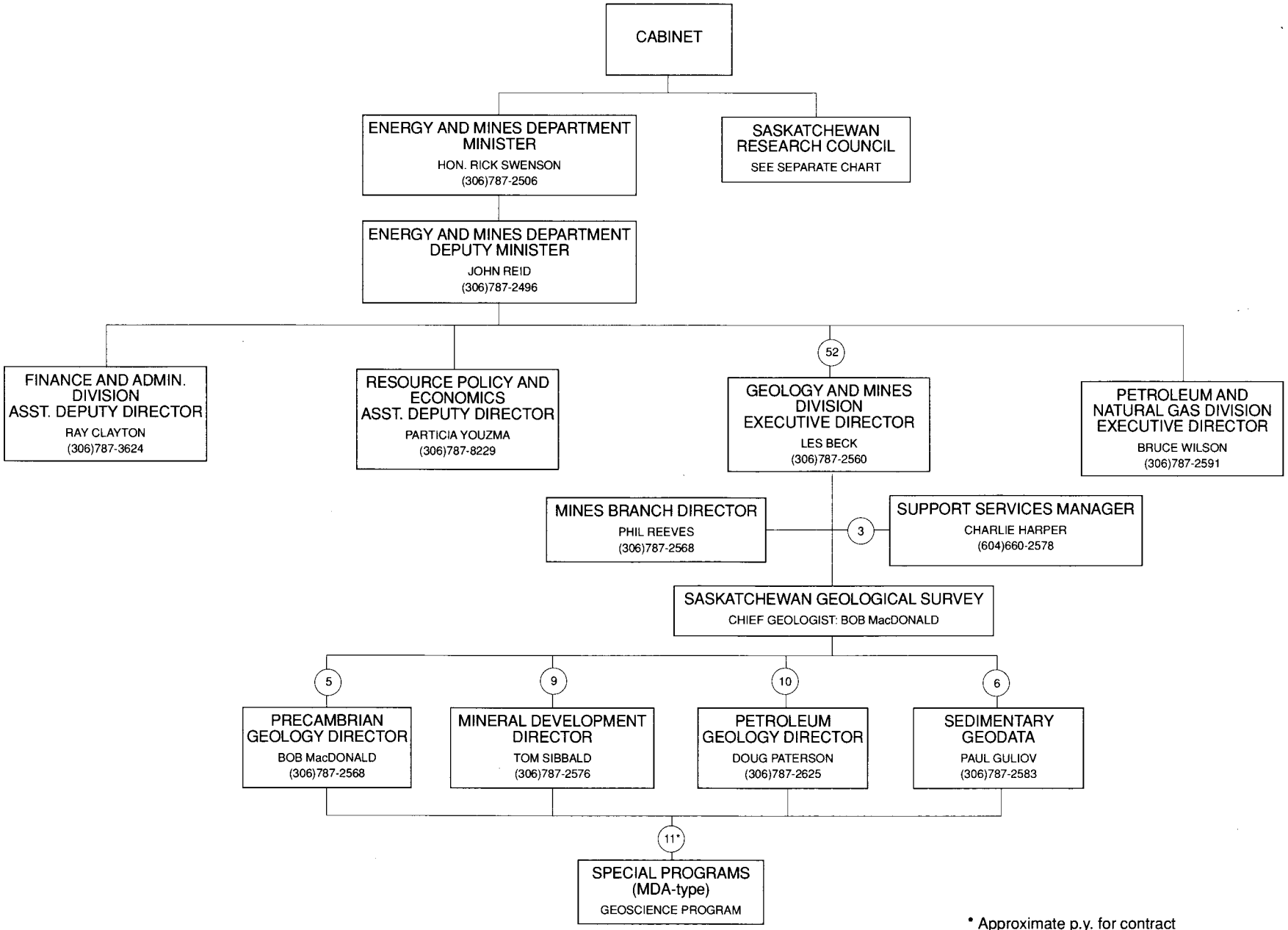
BRITISH COLUMBIA GEOSCIENCE ORGANIZATION CHART



ALBERTA GEOSCIENCE ORGANIZATION CHART

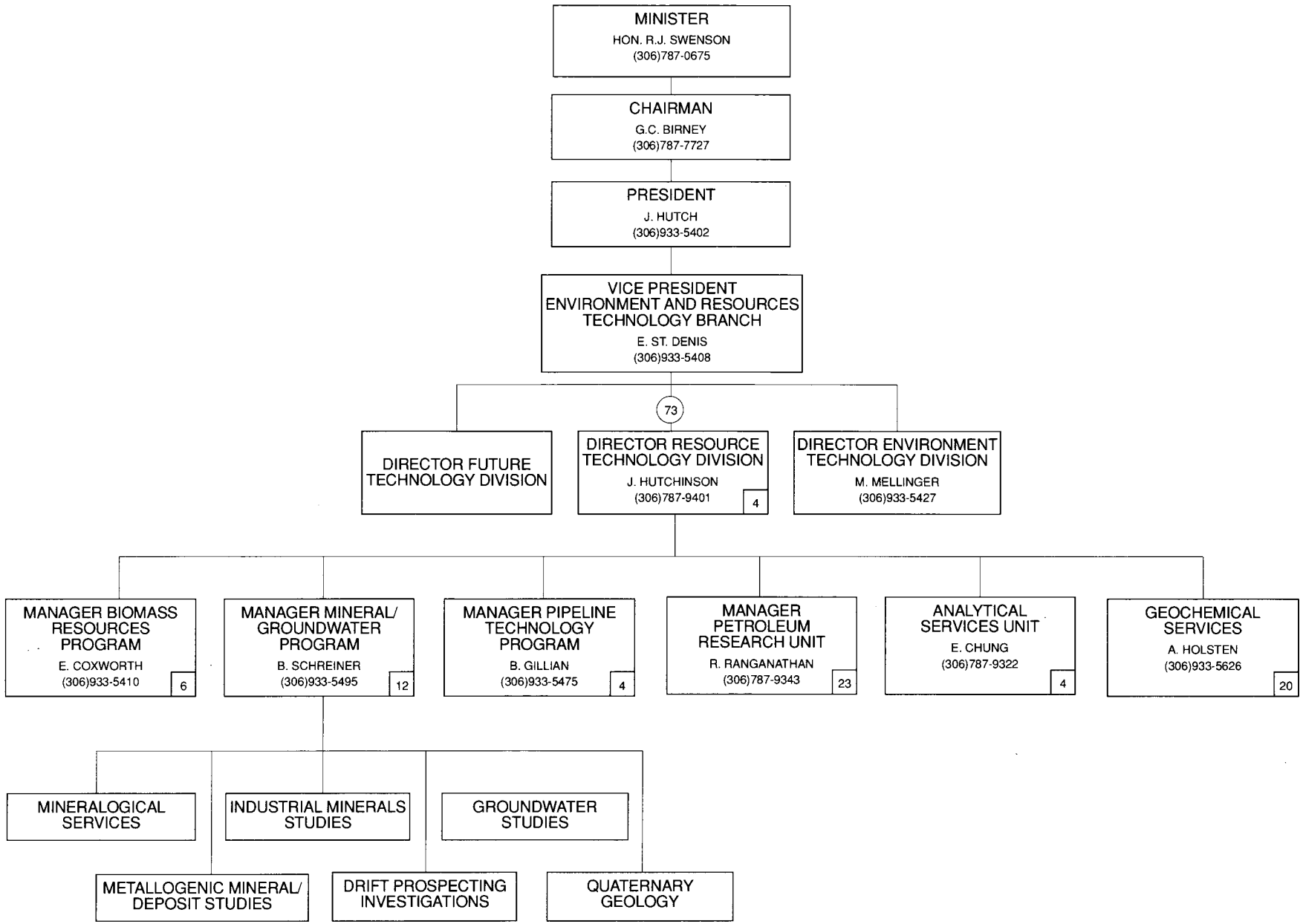


SASKATCHEWAN GEOSCIENCE ORGANIZATION CHART

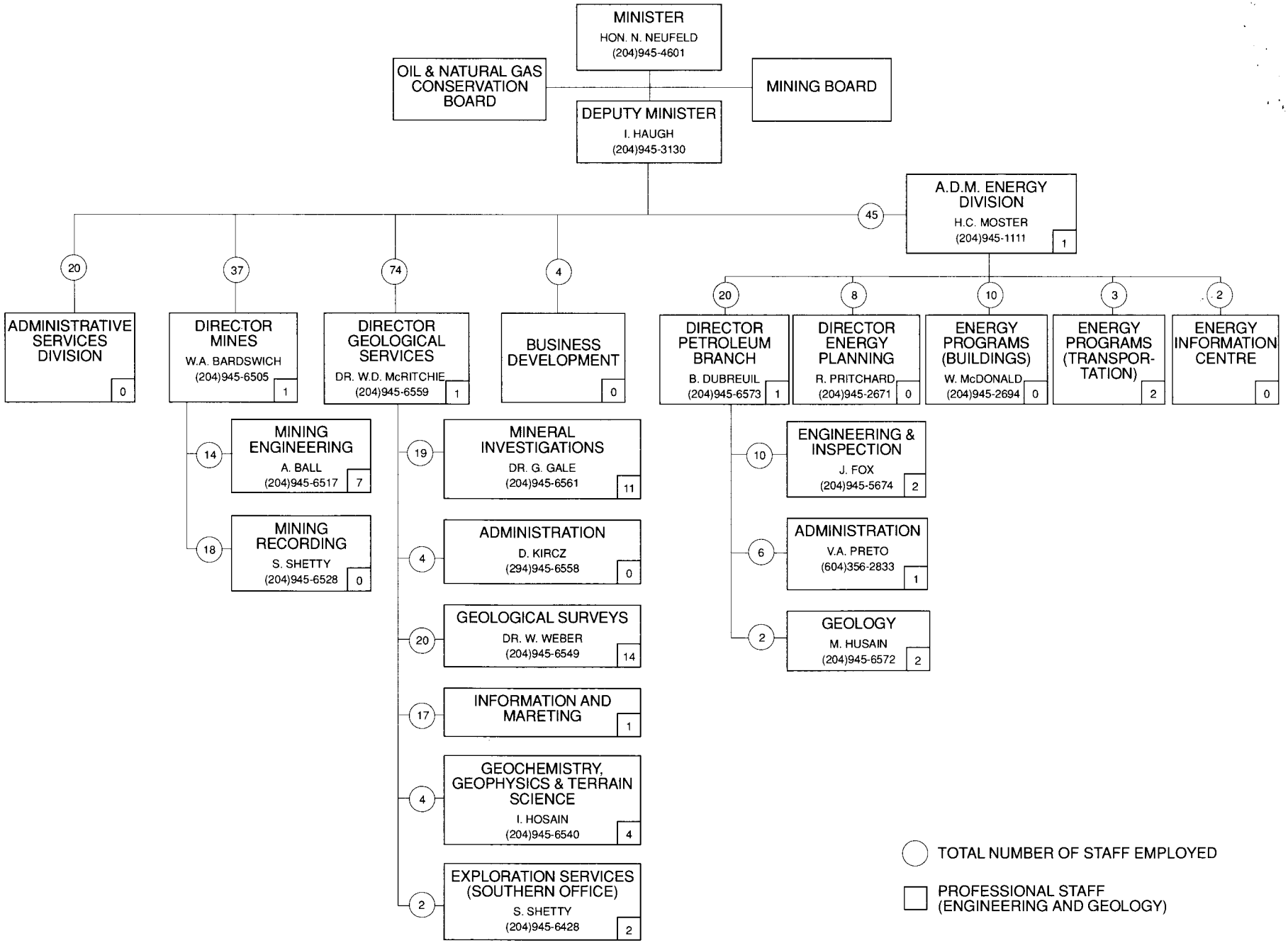


* Approximate p.y. for contract geologists (6) and summer student assistants (5)

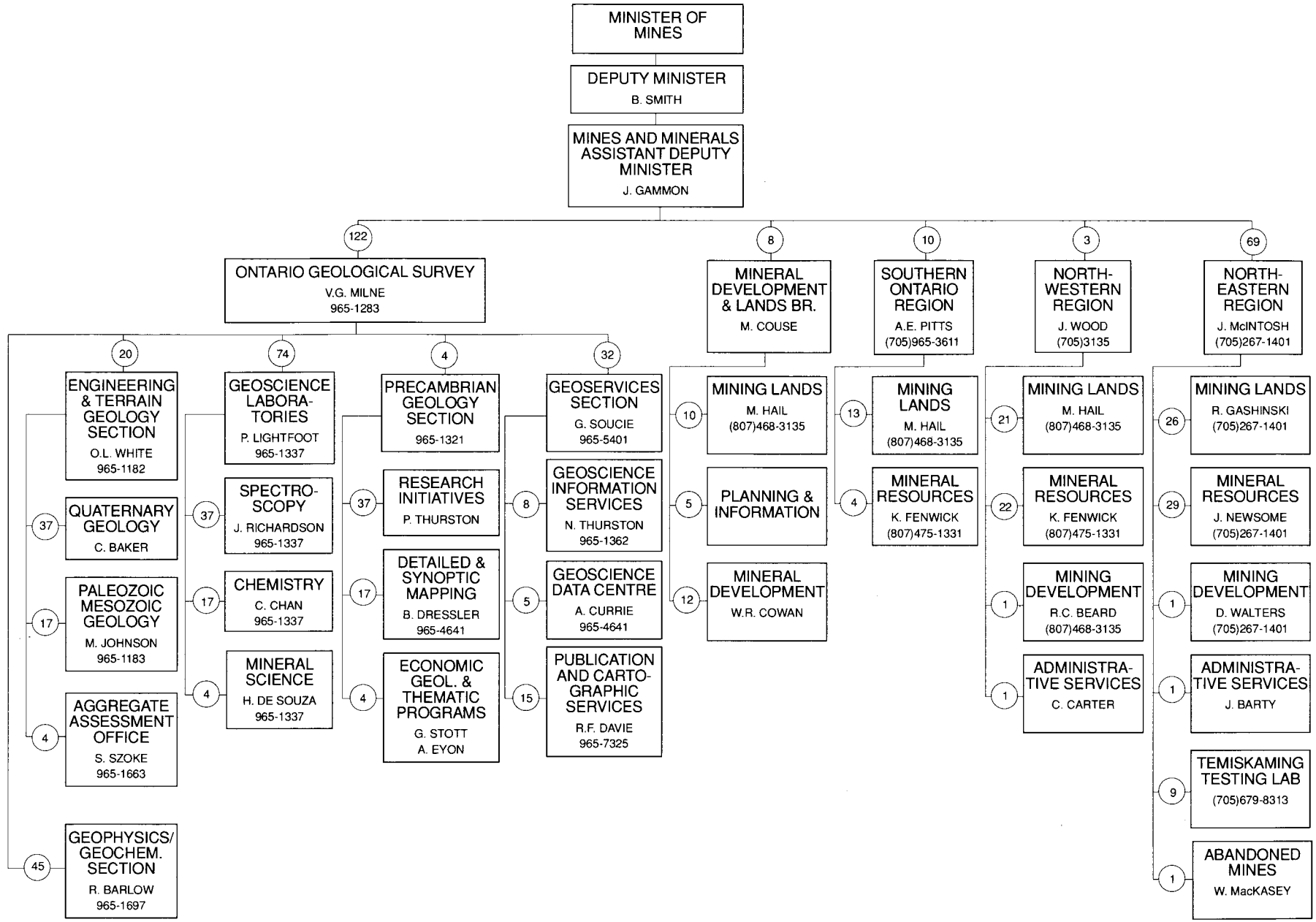
SASKATCHEWAN RESEARCH COUNCIL



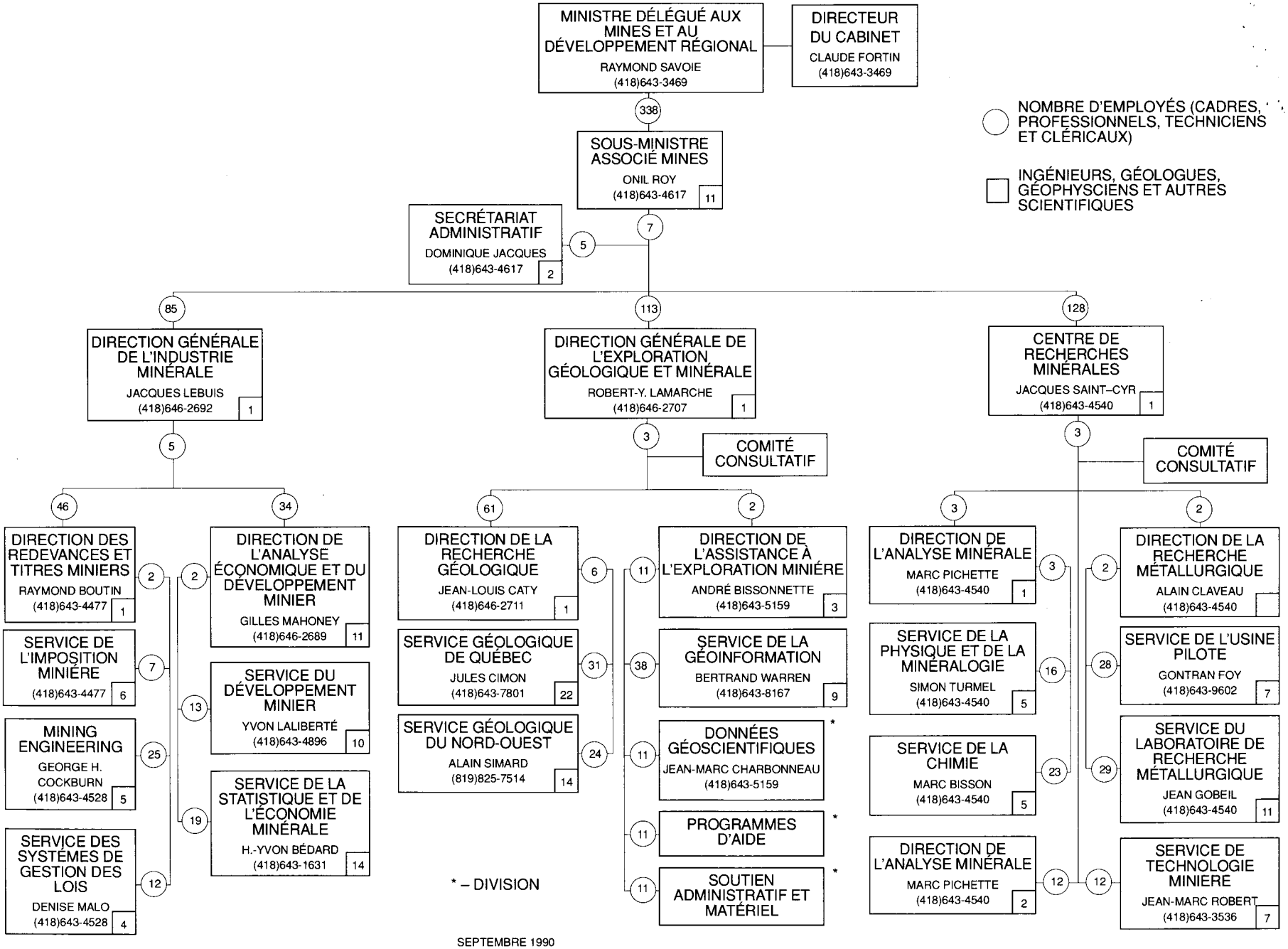
MANITOBA GEOSCIENCE ORGANIZATION CHART



ONTARIO GEOSCIENCE ORGANIZATION CHART

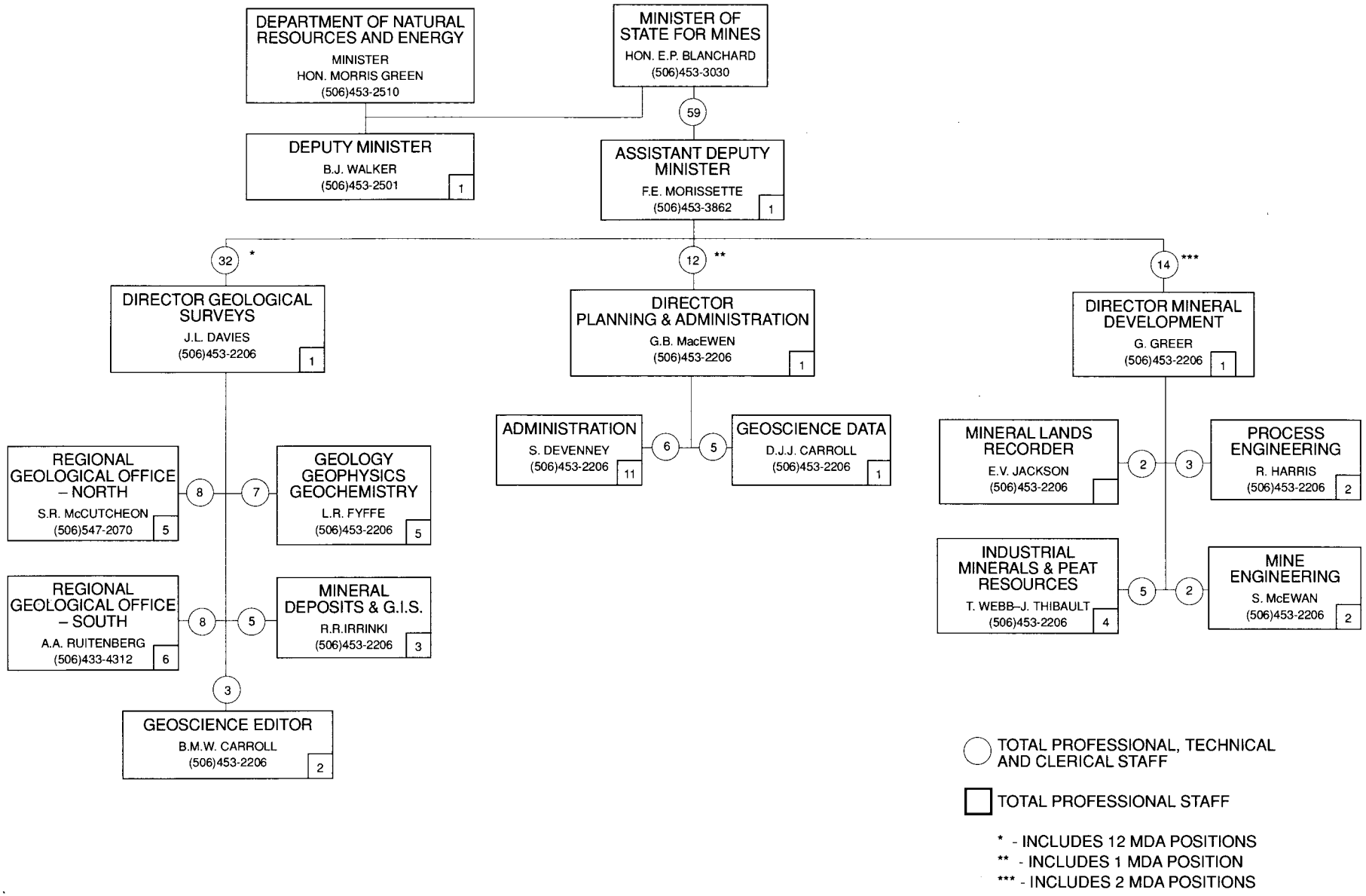


ORGANIGRAMMES DU MINISTÈRE DE L'ÉNERGIE ET DES RESSOURCES (MINES) DU QUÉBEC

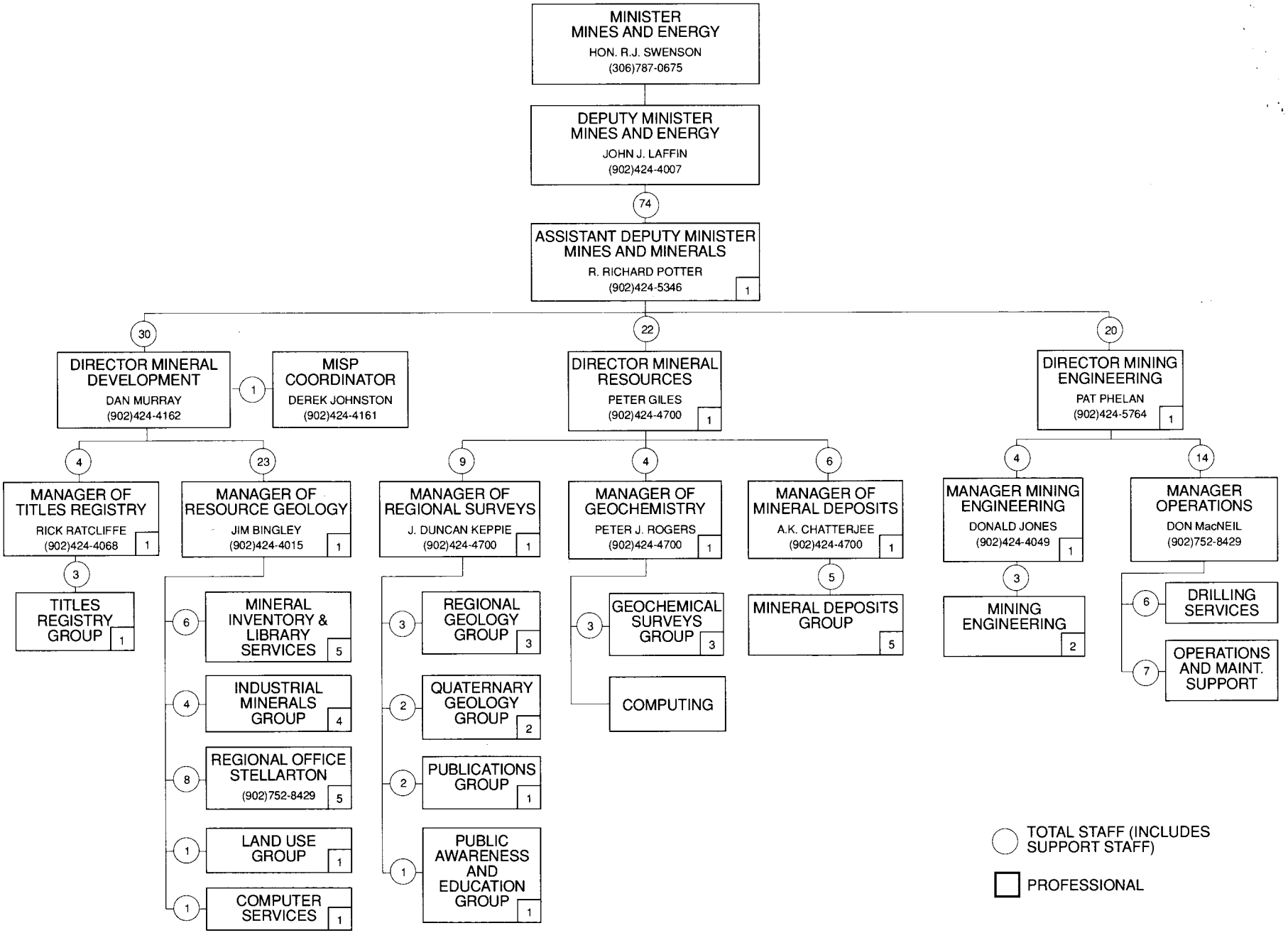


SEPTEMBRE 1990

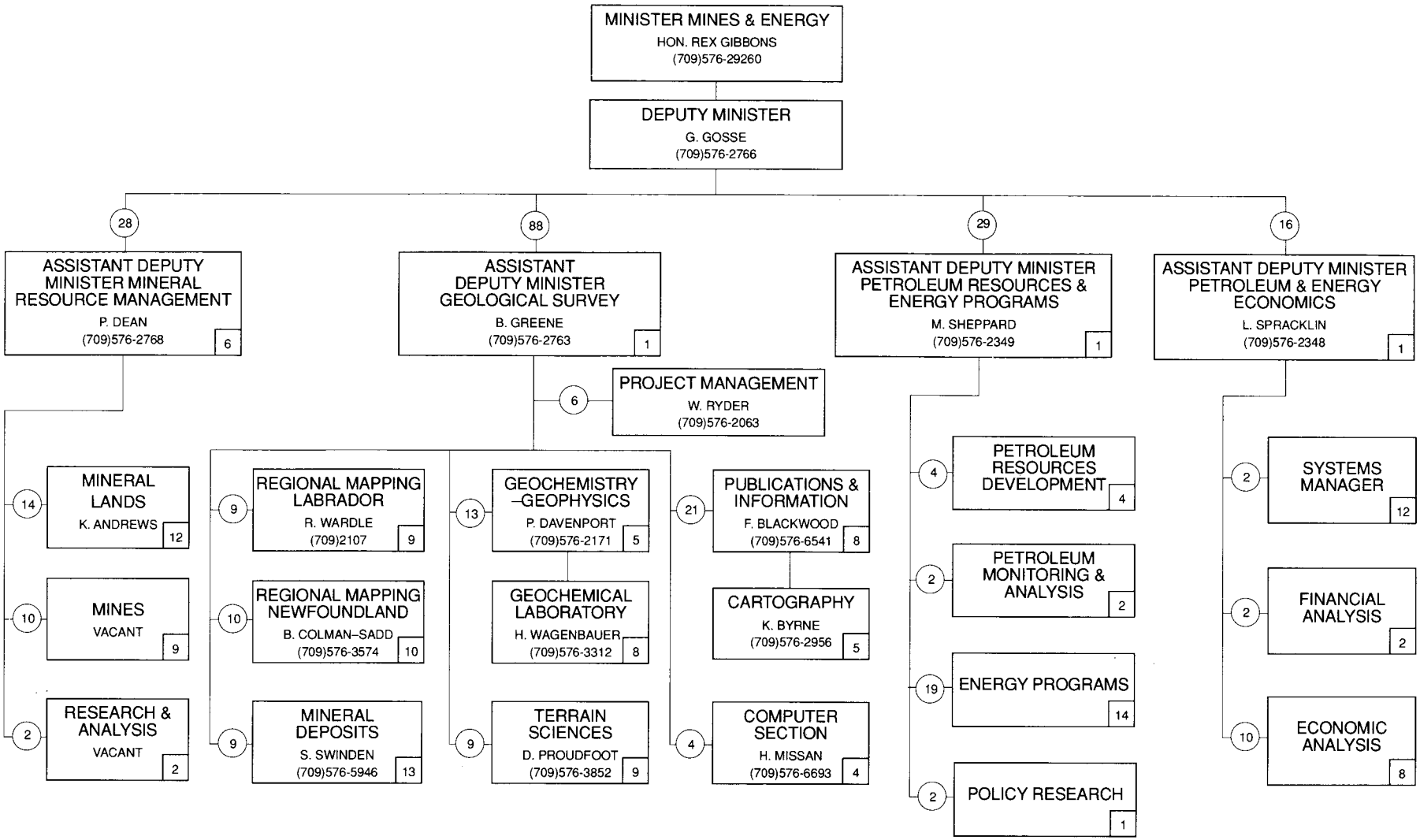
NEW BRUNSWICK GEOSCIENCE ORGANIZATION CHART



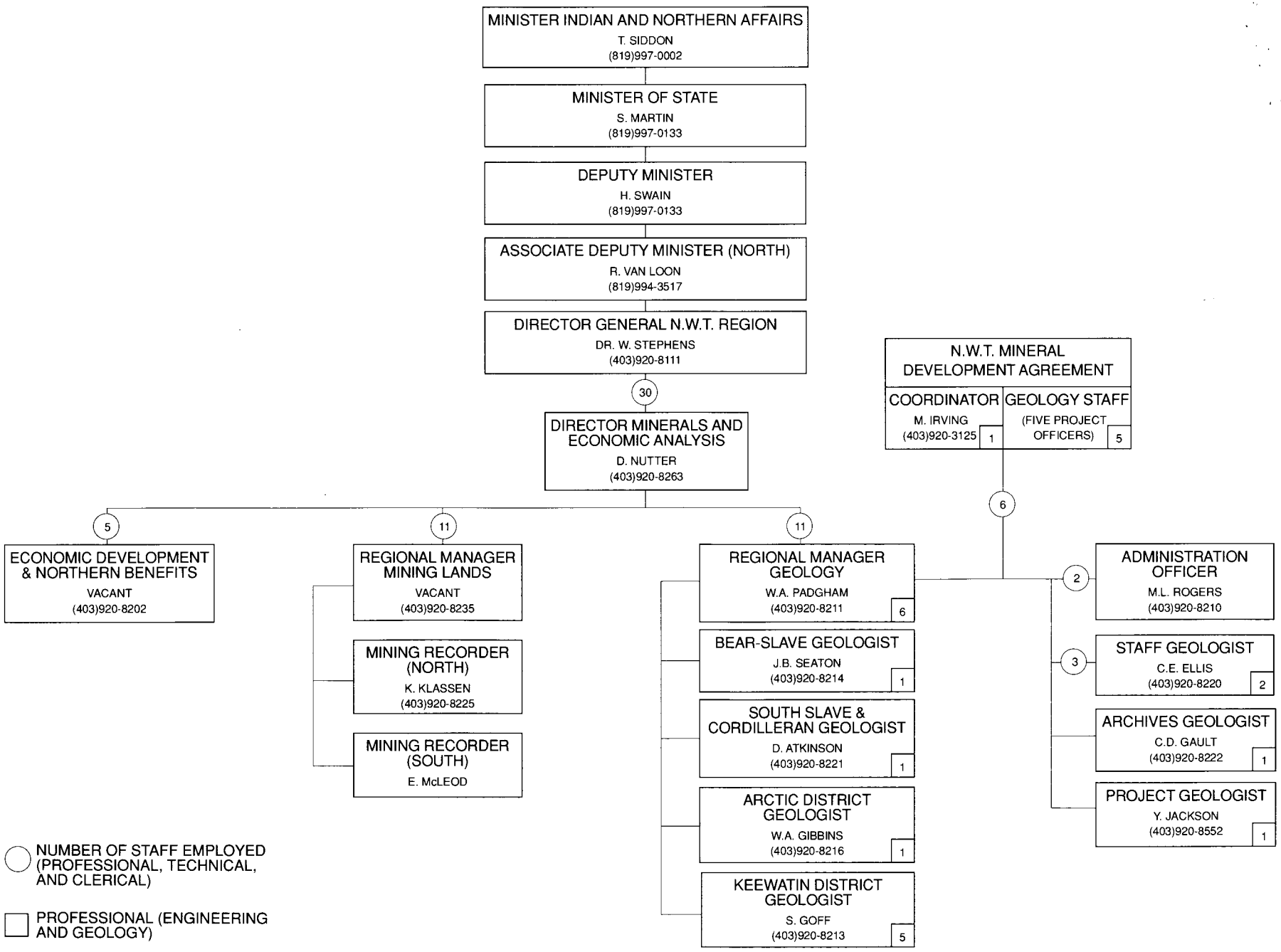
NOVA SCOTIA GEOSCIENCE ORGANIZATION CHART



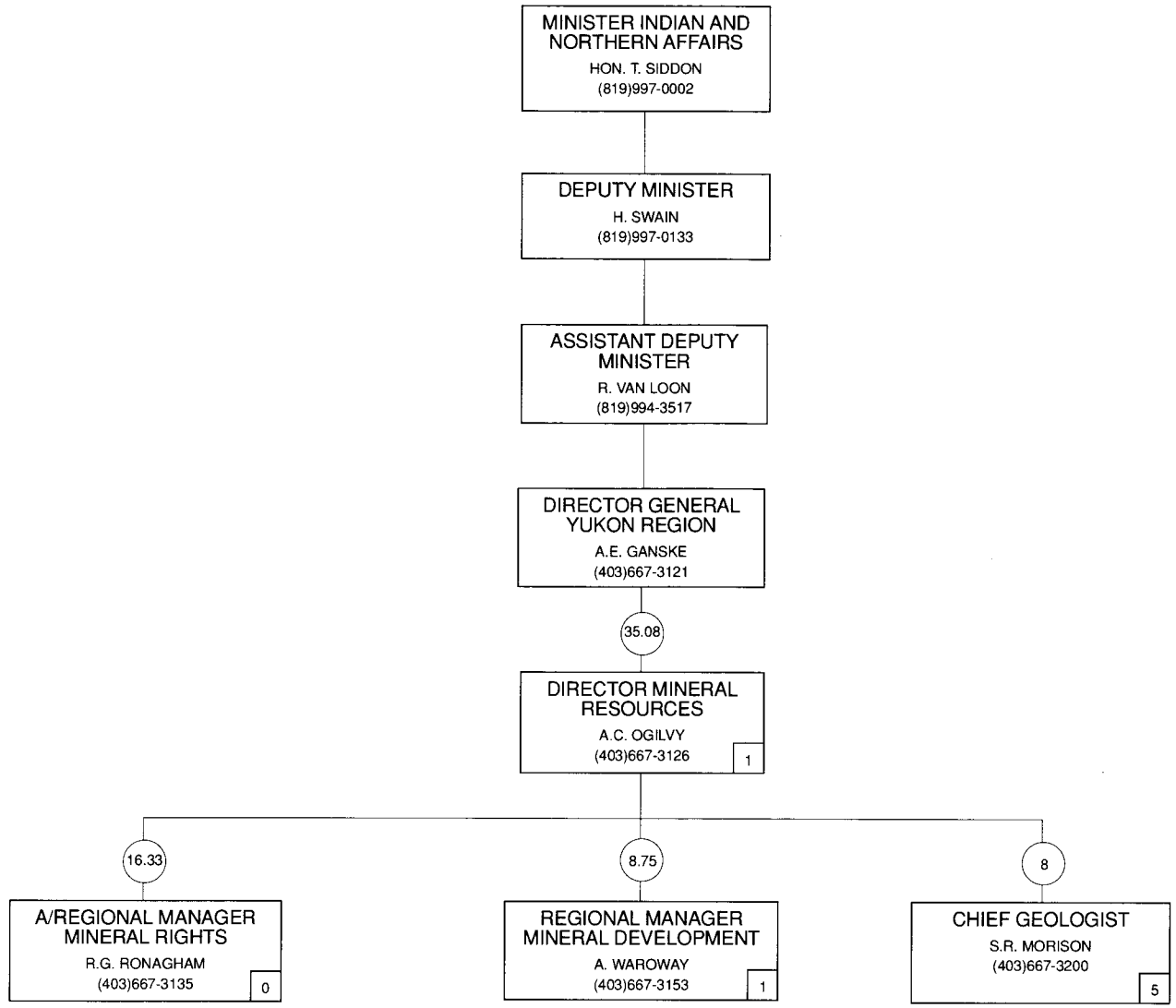
NEWFOUNDLAND GEOSCIENCE ORGANIZATION CHART



NORTHWEST TERRITORIES GEOSCIENCE ORGANIZATION CHART



YUKON GEOSCIENCE ORGANIZATION CHART



◯ NUMBER OF STAFF EMPLOYED (PROFESSIONAL, TECHNICAL, AND CLERICAL)

▪ PROFESSIONAL (ENGINEERING AND GEOLOGY)

PROVINCIAL GEOLOGICAL SURVEY EXPENDITURES, 1989–1990

PROVINCIAL GEOSCIENCES EXPENDITURES
1989 - 1990

Province/ territory	Survey expenditures $ x 10^6	% of total	Total 1989 value of provincial mineral production[1] $ x 10^3	Survey expenditures as % of total value of provincial mineral production	Area of province/ territory km^2 x 10^3	Survey $ spent/km^2	Population (1986) x 10^3	Survey $ spent/ capita
Newfoundland	5.1	6.6	959 213	.53	405	12.6	568	9.0
Nova Scotia	4.2	5.4	235 338	1.78	55	76.3	873	14.8
Prince Edward Island	-	-	2 177	-	6	-	127	-
New Brunswick	2.0	2.6	875 747	.23	73	27.4	709	2.8
Quebec	20.9	27.0	2 812 402	.74	1 541	13.6	6 532	3.2
Ontario	19.9	25.6	7 224 682	.28	1 069	18.6	9 102	2.2
Manitoba	3.5	4.5	1 598 042	.22	650	5.4	1 063	3.3
Saskatchewan	3.8	4.9	1 469 441	.26	652	5.8	1 010	3.8
Alberta	8.4	10.8	1 247 184[2]	.67	661	12.7	2 366	3.6
British Columbia	7.3	9.4	2 333 884	.31	948	7.7	2 883	2.5
Yukon	1.2	1.5	539 880	.22	483	2.5	24	50.0
Northwest Territories	1.3	1.7	965 638	.13	3 380	.4	52	25.0
Totals	**77.6**	**100.0**	**20 263 628**	**-**	**9 923**	**-**	**25 309**	**-**

[1]Source : Canadian Mining Journal, March 1990
[2]Includes fuels

Province: British Columbia
1989-1990

Programs	Survey research agency	Funding agency	No. of projects (or facilities)	Permanent smy	Casual smy	Casual & permanent $	Operating expenditures $	Totals
Chief's Office	GSB (MRD)	EMPR	-	2	-	99 000	158 000	257 000
Vancouver Office	GSB (MRD)	EMPR	4	3	-	78 000	58 000	136 000
Geoscience Grants	GSB (MRD)	EMPR	32	-	-	-	130 000	130 000
Geochemistry	GSB (MRD)	EMPR	3	1	2	197 000	313 000	510 000
	GSB (MRD)	MDA	2	-	1.5	70 000	115 000	185 000
Surficial Geology	GSB (MRD)	EMPR	4	1	1.5	90 000	10 000	100 000
Regional Mapping	GSB (MRD)	EMPR	5	10	18	717 000	453 000	1 170 000
	GSB (MRD)	MDA	4	-	4.5	180 000	293 000	473 000
Mineral Deposits	GSB (MRD)	EMPR	9	8	8	619 000	303 000	922 000
	GSB (MRD)	MDA	2	-	2	80 000	155 000	235 000
Coal Resources	GSB (MRD)	EMPR	10	6	-	286 000	198 000	484 000
Industrial Minerals	GSB (MRD)	EMPR	6	2	.5	89 000	102 000	191 000
	GSB (MRD)	MDA	2	-	2	50 000	45 000	95 000
Prospectors Assistance and Training (FAME)	GSB (MRD)	EMPR	3	-	2	50 000	450 000	500 000
Land Use	GSB (MRD)	EMPR	9	3	1	120 000	72 000	192 000
Mineral Deposits Inventory and Analysis	GSB (MRD)	EMPR	6	7	3	353 000	337 000	690 000
District Geology	GSB (MRD)	EMPR	7	7.5	2	443 000	249 000	692 000
	GSB (MRD)	MDA	-	-	-	-	10 000	10 000
Scientific Review/ Publications	GSB (MRD)	EMPR	-	5	-	159 000	245 000	404 000
	GSB (MRD)	MDA	-	-	-	-	69 000	69 000
Laboratory Analysis	GSB (MRD)	EMPR	-	6	-	249 000	98 000	347 000
Oil and Gas Inventory and Analysis	PGB (ERD)	EMPR	1	5	-	230 000	36 000	266 000
Petroleum Sursurface Investigations	PGB (ERD)	EMPR	1	3	-	140 000	31 500	171 500
TOTALS								
GSB (MRD)	-	-	-	61.5	36	3 499 000	2 726 000	6 225 000
MDA	-	-	-	-	10	380 000	687 000	1 067 000
PGB (ERD)	-	-	-	8	-	370 000	67 500	437 500
FAME	-	-	-	-	2	50 000	450 000	500 000

GSB (MRD) - Geolgocial Survey Branch (Mineral Resources Division)
PGB (ERD) - Petroleum Geolgocial Branch (Energy Resources Division)
EMPR - Minsitry of Energy, Mines and Petroleum Resources
MDA - Canada - B.C. Mineral Development Agreement
FAME - Financial Assistance for Mineral Exploration (Funded by Province of British Columbia)
RGS - Regional Geochemical Survey

Province: Alberta
1989-1990

Programs	Survey research agency	Funding agency	No. of projects (or facilities)	Permanent smy	Casual smy	Salaries Permanent $	Salaries Casual $	Supplies and serivces $
Chief's Office	ARC/ERCB	ARC/ERCB	2	5.00	-	355.3	-	19.3
Core Repositories	ARC/ERCB	AE	2	36.3	.1	1 022.2	2.0	14.7
Geological Survey, Surficial:								
1) Reconnaissance (1:100 000)	ARC	ARC/AFLW	10	0.8	0.8	80.4	25.0	47.9
2) Reclamation/Environmental Impact	ARC	ARC/TRANSALTA STANLEY ENG.	6	3.2	1.2	254.6	47.7	131.0
Hydrogeological	ARC	ARC/AE	5	0.7	-	89.5	-	39.8
Information and Education	ARC	ARC	1	0.4	-	29.9	-	14.7
Laboratory Analysis	ARC	ARC	1	1.2	-	89.6	-	11.0
Mineral Deposit Inventory Analysis	ARC	ARC/AE	12	1.9	0.2	170.8	5.6	58.7
Energy Resources Inventory and Research:								
1) Petroleum and Natural Gas	ARC/ERCB	ARC/ERCB/AE	5	34.0	0.3	1 650.3	12.1	164.7
2) Oil Sands	ARC/ERCB	ARC/AOSTRA AE/ERCB	11	21.6	-	1 408.5	-	264.9
3) Coal Geology	ARC	ARC/AE	12	14.2	0.8	421.4	27.7	206.8
Stratigraphic Research	ARC/ERCB	ARC/ERCB/AE	3	9.6	1.0	609.9	32.4	79.5
Other	ARC/ERCB	ARC/ERCB	8	12.3	0.5	857.0	18.6	167.4
TOTALS	-	-	-	**131.5**	**4.9**	**7 039.4**	**171.1**	**1 220.4**
GRAND TOTAL 8 430.9								

ARC - Alberta Research Council
AOSTRA - Alberta Oil Sands Technical Research Authority
AE - Alberta Department of Energy
AFLW - Alberta Forestry, Lands and Wildlife
ERCB - Energy Resources Conservation Board
TRANSALTA - TransAlta Utilities Ltd.

Province: Saskatchewan
1989-1990

Programs	Survey research agencies	Funding agency	No. of projects (or facilities)	Salaries			Casual/ temporary $	Operating expenditures $	Totals
				Permanent smy	Casual smy	Permanent $			
Administration	SGS	SGS	5	9.0	-	292 300	-	40 000	332 300
	SRC	SRC	(No figures)	-	-	-	-	-	-
Core Repositories									
(Phanerozoic)	SGS	SGS	1	6.0	1.25	92 400	25 000	48 000	165 400
(Precambrian)	SGS	SGS	1	.30	0.25	-	10 000	20 000	30 000
Geochemical Surveys									
(Bedrock)	SGS/UofR	SGS	2	-	-	-	-	16 000	16 000
(Surficial/Drift Prospecting)	SRC	SRC	2	1.0	-	40 000	-	-	40 000
Geological Surveys, Bedrock:									
Detailed (typically 1:20 000)	SGS	SGS	5	3.0	3.0	107 300	94 000	147 500	348 800
Reconnaissance (1:100 000)	SGS	SGS	2	-	2.25	-	68 000	124 000	192 000
Compilation (1:250 000 or less)	SGS	SGS	-	-	1.00	-	53 000	-	53 000
Geological Surveys, Surficial	SRC	SRC	1	0.10	0.33	4 000	-	90 000	94 000
Geophysical Surveys	-	-	-	-	-	-	-	-	0
Hydrogeological Surveys	SRC	SRC	-	1.0	-	40 000	-	75 000	115 000
Information and Education	SGS	SGS	1	0.25	-	12 000	-	10 000	22 000
Laboratory Analyses and Studies:									
Isotope Geochronology	UofR/UofS/ UofK/UofC	SGS/UofS UofK/UofC	3	-	-	-	-	60 000	60 000
P-T-t Studies	UND	SGS	1	-	-	-	-	8 000	8 000
Other	SRC	SRC	-	1.0	-	40 000	-	40 000	80 000
Mineral Deposit Inventory and Analysis	-	-	-	-	-	-	-	-	
including Industrial Minerals	-	-	-	-	-	-	-	-	
and Metallogenic Maps	SGS	SGS	3	5.25	1.25	251 600	29 000	10 000	290 600
	SRC	SRC	8	3.0	-	120 000	-	200 000	320 000
Oil and Gas Inventory and Analysis	SGS	SGS	-	8.0	-	-	12 000	21 000	33 000
Publications/Cartography/ Computerization	SGS/SRC	SGS/SRC	-	6.0	1.0	246 900	-	192 000	438 900
Resident Geologist's Offices	SGS	SGS	1	3.75	-	96 800	9 000	25 000	130 800
Subsurface (Stratigraphic) Studies	SGS	SGS	5	4.0	1.0	204 000	-	45 000	249 000
Water Resource Inventory and Analysis	SRC	SRC	10	4.0	.3	160 000	-	100 000	260 000
Metallogenic/Mineral Deposit Studies	SGS/UofR	SGS	8	1.5	-	75 400	78 000	208 000	361 400
	UoS/SRC	SRC	6	2.0	-	80 000	-	80 000	160 000
TOTALS	**-**	**-**	**66.0**	**59.15**	**11.63**	**1 862 700**	**378 000**	**1 559 500**	**3 800 200**
GRAND TOTAL $3 800 200									

NOTE: Some allocations are approximated, grand total is accurate.
SGS - Saskatchewan Geological Survey, Department of Energy and Mines; SRC - Saskatchewan Research Council
UofR - University of Regina; UofS - University of Saskatchewan; UofC - University of California (Santa Cruz)
UND - University of North Dakota; UofK - University of Kansas. University funding participation is not included in these figures.

Province: Manitoba
1989-1990

Programs	Survey research agency	Funding agency	No. of projects (or facilities)	Permanent smy	Casual/ term smy	Salaries Permanent $	Salaries Casual $	operating Expenditures $	Total
Core Repositories	MM	MAN	1	.26	-	19 300	-	11 000	30 300
Geochemical Surveys									
1) Bedrock	-	-	-	-	-	-	-	-	-
2) Drainage	-	-	-	-	-	-	-	-	-
3) Soil	MGS	MAN	2	1.00	1.13	52 800	32 100	22 600	107 500
4) Peat	-	-	-	-	-	-	-	-	-
Geological Surveys, Bedrock									
1) Reconnaissance (1:100 000)	-	-	-	-	-	-	-	-	
2) Detailed (1:50 000)	MGS	MAN	20	10.00	1.38	500 300	38 100	96 500	634 900
3) Phanerozoic	MGS	MAN	3	.42	1.24	36 300	42 100	25 800	104 200
Geological Surveys, Surficial									
1) Reconnaissance (1:100 000)	-	-	-	-	-	-	-	-	-
2) Detailed (1:50 000)	-	-	-	-	-	-	-	-	-
3) Resource Management	-	-	-	-	-	-	-	-	-
Geophysical Surveys									
1) Airborne Electromagnetic	-	-	-	-	-	-	-	-	-
2) Airborne Magnetic, Gradiometer	-	-	-	-	-	-	-	-	-
3) Ground Magnetic	-	-	-	-	-	-	-	-	-
4) Gravity	-	-	-	-	-	-	-	-	-
5) Seismic	-	-	-	-	-	-	-	-	-
6) Radiometric	-	-	-	-	-	-	-	-	-
7) Remote Sensing	-	-	-	-	-	-	-	-	-
Hydrogeological Surveys	-	-	-	-	-	-	-	-	-
Information, Education, Assessment Services and Compilation	MGS/MM	MAN	14	3.00	3.00	146 200	92 100	58 400	296 700
Laboratory Analysis	MGS	MAN	3	10.18	3.00	365 000	76 100	69 700	510 800
Mineral Deposit Inventory and Analysis	MGS	MAN	20	5.00	6.28	265 700	174 200	94 500	534 400
Industrial Minerals	MGS	MAN	5	1.00	1.39	49 400	41 200	23 700	114 300
Oil, Gas Inventory and Analysis	-	-	-	-	-	-	-	-	-
Publications	MGS	MAN	33	-	-	-	-	55 600	55 600
Resident Geologist's Office	MGS	MAN	2	.26	1.00	19 400	44 900	12 300	76 600
Subsurface Invest, Indust Min Drilling and Management	MGS	MAN	2	.34	.16	29 200	14 200	39 000	82 400
Water Resource Inventory and Analysis	-	-	-	-	-	-	-	-	-
Other:									
1) Administration	MGS	MAN	-	5.00	2.00	179 900	48 500	239 500(1)	467 900
2) Drafting	MGS	MAN	-	10.38	2.21	374 300	53 500	23 400	451 200
3) Uranium/Lead	MGS/UNIV	MAN	1	-	-	-	-	800	800
TOTALS	**-**	**-**	**-**	**48.28**	**24.23**	**2 044 300**	**650 500**	**772 800**	**3 467 600**

MGS - Manitoba Geological Services Branch
MM - Manitoba Mines Branch
UNIV - University of Manitoba
(1) - Includes Field Equipment, Capital and Computerization

Province: Ontario
1989-1990

Programs	Funding agency	No. of projects (or facilities)	Person-years Permanent	Person-years Casual	Salaries Permanent $	Salaries Casual $	Operating Expenditures $	Totals $
Administration (Director's Office OGS)	MNDM	-	7	2	321.5	86.1	150.2	557.8
Libraries	MNDM	7	11	2	333.9	40.3	141.6	515.8
Geophysical Airborne Electromagnetic Surveys	NDF	5	-	2	-	93.4	1 865.46	1 958.8
Other Geophysical Surveys/ Research	MNDM	3	10	1	398.3	37.5	401.9	837.7
Geochemical Surveys/ Research	MNDM	2						
Geological Surveys:								
Precambrian	MNDM	30	31	23	1 366.1	750.7	906.6	3 023.4
Phanerozoic	MNDM	2						
Quaternary	MNDM	6	18	5	717.7	264.3	533.1	1 515.1
Aggregate	MNDM	2						
Geoservices (OGS)								
Publications	MNDM	-	15	10	481.9	270.9	1 303.7	2 056.5
Laboratory Analysis	MNDM	-	23	2	812.9	49.9	737.2	1 600.0
Equipment, Vehicles	MNDM	-	4	1	183.7	21.0	279.9	484.6
Information, Education, Library, Assessment Files	MNDM	-	13	6	415.8	69.1	435.8	920.7
Resident Geologist's Office	MNDM	15	52	10	1 836.4	233.0	769.2	2 838.6
Geoscience Research Grants Programs	MNDM	22	-	-	-	-	662.0	662.0
Other Geological Research Grants	MNDM	14	-	-	-	-	398.0	398.0
COMDA	CAN/ONT	36	-	45	-	1 501.7	1 001.1	2 502.8
TOTALS	**-**	**-**	**184**	**109**	**6 868.2**	**3 417.9**	**9 585.7**	**19 871.8**

MNDM - Ministry of Northern Development and Mines
COMDA - Canada-Ontario 1985 Mineral Development Subsidiary Agreement - provincial delivered geoscience projects only
NDF - Ontario Northern Development Fund
OGS - Ontario Geological Survey

Note: $ Values in 1,000's

Province: Québec
1989-1990

Programs	Matre d'oeuvre	Financement	Nombre de projets ou d'installations	Employés permanents pers.-année (c-p-a-)**	Employés occasionnels pers.-année	Budget alloué
Levés géologiques	DGEGM	MER/EMR*	-	-	-	-
1) Côte-Nord et Nouveau-Québec	DGEGM	MER/EMR*	20	5P-1A	2	1 650 500
2) Montréal-Laurentides	DGEGM	MER/EMR*	5	3P-1A	2	411 500
3) Gaspésie-Les Iles	DGEGM	MER/EMR*	8	2P-1A	2	743 200
4) Estrie-Laurentides	DGEGM	MER/EMR*	13	4P-2A	1	757 000
5) Minéraux Industriels du Québec	DGEGM	MER/EMR*	11	3P-1A	3	515 300
6) Rouyn-Noranda	DGEGM	MER/EMR*	5	3P-3A	1	534 800
7) Val-d'Or	DGEGM	MER/EMR*	7	3P-3A	5	838 000
8) Chibougamau	DGEGM	MER/EMR*	5	3P-2A	2	883 200
9) Gites minéraux du Nord-Ouest	DGEGM	MER/EMR*	16	3P	-	943 500
10) Levés géochimiques	DGEGM	MER/EMR*	30	3P-2A	3	1 187 800
11) Levés géophysiques	DGEGM	MER/EMR*	15	2P	-	1 319 600
12) Opérations (équipement de terrain, informatique, etc.)	DGEGM	MER	-	3P-4A	11	1 378 300
13) Assistance financière	DGEGM	MER/EMR*	27	1C	4	3 707 200
14) Géoinformation	DGEGM	MER/EMR*	-	2C-9P-24A	8	4 101 500
15) Promotion	DGEGM	MER	-	1A	-	189 000
16) Administration	-	MER	-	7C-4P-7A	9	1 734 400
TOTAUX	**-**	**-**	**-**	**10C-50P-52A**	**53**	**20 894 800**

DGEGM - Direction générale de l'exploration géologique et minérale
MER - Ministère de l'Energie et des Ressources du Québec
EMR - Energy, Mines and Resources, Ottawa
* - Entente auxiliaire Canada-Québec sur le développement minéral
** - C = cadre
P = professionnel
A = autre

Province: New Brunswick
1989-1990

Programs	Survey research agency	Funding agency	No. of projects (or facilities)	Staff-years Permanent	Staff-years Continuing auxiliary	Staff-years Summer auxiliary	Salaries Permanent $	Salaries Continuing auxiliary $	Salaries Summer auxiliary $	Operating expenditures $
Director's Office	GSB	DNRE	1	2	-	-	81 900	-	-	18 200
Core Repositories	GSB	-	3	1	-	-	42 700	-	-	19 800
Geochemical Surveys:										
Bedrock	-	-	1	0.3	-	-	-	-	-	-
Soil	-	-	-	-	-	-	-	-	-	10 000
Drainage	GSB	-	2	2.7	-	1.9	96 800	-	-	69 800
Geological Surveys	GSB									
Bedrock										
1:10 000	-	-	-	-	-	-	-	-	-	-
1:20 000	-	-	3	3	-	0.8	137 200	-	23 600	86 400
1:50 000	-	-		1	-	-		-	-	-
Surficial										
1:50 000	-	-	2	1	-	0.6	41 300	-	19 900	27 500
Information Education	PAB	-	3	3	-	-	83 000	-	-	71 000
Regional Geologist Offices	GSB	-	2	9	-	0.8	253 000	-	22 000	104 200
Metallic Mineral Deposits	GSB	-	2	1.5	0.5	0.6	87 000	16 000	21 000	67 600
Industrial Minerals	MRB	-	3	3	-	-	116 000	-	-	25 800
Coal Projects	ERB	-	1	1	-	-	40 000	-	-	20 000
Oil and Gas Projects	ERB	-	1	1	-	-	42 000	-	-	30 000
Publications	GSB/MRB	-	3	3	-	-	100 000	-	-	10 000
Peat Projects	MRB	-	1	0.5	-	0.3	21 000	-	5 000	5 000
Coastal Zone	MRB	-	1	0.5	-	-	21 000	-	-	5 000
Geoscience Information System	GSB	-	1	0.5	0.5	-	40 000	17 000	-	10 400
Grants to Prospectors	GSB	-	-	-	-	-	-	-	-	104 000
TOTALS	**-**	**-**	**-**	**33.0**	**1.0**	**5.0**	**1 202 900**	**33 000**	**86 500**	**684 700**

GSB - Geological Surveys Branch
MRB - Mineral Development
DNRE - Department of Natural Resources and Energy
* Includes mineral ecomonic, and mining sutdies and various research projects supported by GSB

Province: Nova Scotia
1989-1990

Programs	Survey research agency	Funding agency	No. of projects (or facilities)	Permanent staff man-years	Casual staff man-years	Budget allocations $
Core Repositories	NSDME	NSDME/NSDOD	3	4	1	206 000
Geochemical Surveys:	NSDME	NSDME/NSDOD	2	3	-	159 800
1) Bedrock	-	-	-	-	-	-
2) Drainage	-	-	-	-	-	-
3) Soil	-	-	-	-	-	-
Geological Surveys, Bedrock:						
1) Reconnaissance (1:100 000)	-	-	-	-	-	-
2) Detailed (1:50 000)	NSDME	NSDME/NSDOD	2	7	-	353 500
Geological Surveys, Surficial:						
1) Reconnaisance (1:100 000)	-	-	-	-	-	-
2) Detailed (1:50 000)	NSME	NSME/NSDOD	2	3	-	151 000
Geophysical Surveys:						
1) Airborne Radiometrics	-	-	-	-	-	-
2) Airborne Magnetic (includes VLF-EM)	-	-	-	-	-	-
3) Ground Magnetic	-	-	-	-	-	-
4) Gravity	-	-	-	-	-	-
5) Seismic	-	-	-	-	-	-
Hydrogeological Surveys	-	-	-	-	-	-
Information and Education	NSDME	NSDME/NSDOD	3	5	1	260 000
Laboratory Analysis	-	-	-	-	1	-
Mineral Deposit Analysis	NSDME	NSDME/NSDOD	9	11	1	735 700
Coal and Peat	NSDME	NSDME/NSDOD	4	4	-	794 000
Oil and Gas Inventory and Analysis	NSDME	NSDME/NSDOD	2	3	-	564 100
Publications	NSDME	NSDME/NSDOD	N/A	7	-	495 900
Resident Geologist's Office	NSDME	NSDME	N/A	3	-	133 700
Subsurface Investigations	NSDME	NSDME	N/A	4	-	350 400
TOTALS	**-**	**-**	**27**	**54**	**4**	**4 204 100**

NSDME = Nova Scotia Department of Mines and Energy
NSDOD = Nova Scotia Department of Development

Province: Newfoundland
1989-1990

Programs	Survey research agency	Funding agency	No. of projects (or facilities)	Permanent[1] smy	Casual smy	Salaries Permanent $	Salaries Contract[1] $	Operating Casual $	Operating expenditures $
Director's Office	NDME	NDME	3	8	1	229 047	23 367	4 044	93 286
Core Repositories	NDME	NDME	1	2	1	86 188	-	10 433	44 928
Geochemical Surveys:									
1) Bedrock	-	-	-	-	-	-	-	-	-
2) Drainage	NDME	NDME	4	5	-	144 415	61 727	-	157 931
3) Soil	-	-	-	-	-	-	-	-	-
Geological Surveys, Bedrock:									
1) Reconnaisance (1:100 000)	NDME	NDME/DEMR	9	8	5	242 579	104 835	31 260	262 991
2) Detailed (1:50 000)	NDME	NDME/DEMR	12	10	6	251 893	194 285	29 192	194 979
Geological Surveys, Surficial:									
1) Reconnaisance (1:100 000)	-	-	-	-	-	-	-	-	-
2) Detailed (1:50 000)	NDME	NDME	5	7	5	121 353	149 627	29 005	175 996
Geophysical Surveys:									
1) Airborne Electromagnetic	-	-	-	-	-	-	-	-	-
2) Airborne Magnetic	-	-	-	-	-	-	-	-	-
3) Ground Magnetic	NDME	NDME	2	2	-	-	43 391	-	7 487
4) Gravity	-	-	-	-	-	-	-	-	-
5) Seismic	-	-	-	-	-	-	-	-	-
6) Radiometric	-	-	-	-	-	-	-	-	-
Hydrogeological Surveys	-	-	-	-	-	-	-	-	-
Information and Education	NDME	NDME	5	13	-	250 300	135 877	-	174 563
Laboratory Analysis	NDME	NDME/DEMR	4	8	-	266 047	-	-	134 749
Mineral Deposit Inventory and Analysis	NDME	NDME/DEMR	15	15	5	327 494	270 006	27 979	305 106
Publications	NDME	NDME/DEMR	4	14	-	196 734	163 729	-	138 211
Resident Geologist's Office	-	-	-	-	-	-	-	-	-
Subsurface Investigations	-	-	-	-	-	-	-	-	-
Water Resource Inventory and Analysis	-	-	-	-	-	-	-	-	-
Other	-	-	-	-	-	-	-	-	-
TOTALS	**-**	**-**	**64**	**92**	**23**	**2 116 050**	**1 146 844**	**131 913**	**1 690 227**
Grand Total 5 085 034									

[1]Includes long term temporary staff
NDME - Newfoundland Department of Mines and Energy
DEMR - Department of Energy, Mines and Resources, Canada

Province: Northwest Territories
1989-1990

Programs	Survey research agency	Funding agency	No. of projects (or facilities)	Permanent smy	Casual smy	Salaries Permanent $	Salaries Casual/ temporary $	Operating expenditures $
Head Office (Administration, General Support)	NWT GD	DIAND	1	5.5	-	260	-	130
Head Office (Administration, General Support)	MDA	MDA	1	-	0.5	-	20	71
Core Repositories	NWT GD	DIAND	1	0.1	-	10	-	5
Geological Surveys:								
Bedrock (1:50000)	NWT GD	DIAND	4	1.4	2.5	78	127	214
Bedrock (1:50000)	MDA	MDA	5	-	9.5	-	492	95
Surficial (1:50000)	NWT GD	DIAND	2	0.1	0.2	6	15	30
Education	NWT GD	DIAND	-	0.3	-	25	-	5
Education	MDA	MDA	-	-	-	-	-	76
Laboratory Analysis	NWT GD	DIAND	-	0.1	-	3.0	-	19
Mineral Deposit Inventory and Analysis	NWT GD	DIAND	2	-	.6	-	35	26
Mineral Deposit Inventory and Analysis	MDA	MDA	2	-	2.0	-	128	54
Publications	NWT GD	DIAND	12	3.2	0.7	190	50	30
Publications	MDA	MDA	1*	-	0.9	-	32	2
Other:								
Prospectors' Assistance	NWT GD	DIAND	-	0.4	-	28	-	6
Geological Contracts	NWT GD	DIAND	5	0.9	-	28	-	60
MDA Contracts	MDA	MDA	7	-	-	-	-	130
NWT GD Totals	**-**	**-**	**-**	**11.5**	**4.0**	**628**	**227**	**515**
MDA Totals	**-**	**-**	**-**	**-**	**12.9**	**-**	**672**	**423**
GRAND TOTALS (Geoscience)	**-**	**-**	**-**	**11.5**	**16.9**	**628**	**899**	**938**
GSC managed Canada-NWT MDA Projects	**-**	**-**	**18**	**-**	**-**	**-**	**-**	**1 287**

NWT GD - Northwest Territories Geology Division (DIAND)
MDA - Mineral Development Agreement (Canada-NWT Government)
* - MDA preliminary reports were released in the NWT Geology Division open file system

Province: Yukon
1989-1990

Programs	Survey research agency	Funding agency	No. of projects (or facilities)	Permanent py	Casual py	Salaries Permanent $	Salaries Casual $	Operating Expenditures $	
Head Office (Administration, General Support)	INA	INA	1.0	2.5	-	95 000	-	83 000	
								0	
Core Repositories	INA	INA	1.0	0.3	0.25	14 000	7 200	72 000*	
								0	
Geochemical Surveys									
1) Drainage	EMR	EMR/EDP	1.5	-	-	-	-	0	
	INA	INA						285 000	
Geological Surveys Bedrock:									
1) Detailed (1:50 000)	INA	INA/EDP	2.0	0.5	-	29 000	-	42 000	
								156 000**	
Geological Surveys, Surficial	INA	INA	1.0	0.5	0.25	35 000	-	5 000	
								0	
Education	INA	INA	1.0	-	-	-	-	9 000	
								0	
Laboratory Analysis	INA	INA/EDP	2.0	-	-	-	-	17 700	
								94 000	
Mineral Deposit Inventory and Analysis	INA	INA/EDP	5.0	3.0	0.58	85 000	14 000	70 000	
								259 000***	
Publications	INA	INA/EDP	12.0	1.0	0.5	85 000	14 700	43 500	
								21 900	
TOTALS	**-**	**-**	**26.5**	**7.8**	**1.58**	**343 000**	**36 300**	**342 200**	**A-B**
								815 900	EDP
								1 158 100	

INA - Indian and Northern Affairs Canada
EDP - Canada - Yukon Economic Development Agreement
EMR - Energy, Mines and Resources Canada
A-B - A-Base funding (including capital expenditures)

* includes capital expenditures for facility improvement
** EDP hardrock mapping by contract only
*** EDP contract analysis of Regional Geochemical Samples

GEOLOGICAL PROGRAM
HIGHLIGHTS

BRITISH COLUMBIA MINISTRY OF ENERGY, MINES AND PETROLEUM
GEOLOGICAL SURVEY BRANCH

The program of field surveys was reduced in 1990 due to: 1) a reduction of $600 000 in the operation budget of the Branch, which resulted in cancellation or reduction of four mapping programs; and 2) the completion of survey activity, under the 1985-90 Canada-B.C.MDA. It was also a year of review and forward planning for the Branch as we focus on the next decade.

The Ministry invited the Canadian Geoscience Council to conduct an independent review of the Branch. The review was completed over the winter of 1989-90 and the final 100-page report was published in September. One outcome of the review was an internal reorganization of the Branch. The review is treated in greater detail below.

In 1990, responsibility for the Ministry's Mineral Land Use program was transferred from the Geological Survey Branch to Mineral Policy Branch. The Geological Survey Branch will retain a role in providing the basic scientific information and for conducting field evaluations of planning areas on a contractual basis, but will not be involved in day-to-day land-use policy issues.

PROGRAM HIGHLIGHTS 1990-91

Environmental Geology

In 1990, the Geological Survey Branch expanded its mandate by creating an Environmental Geology Section to provide geoscientific input dealing with the deteriorating conditions of the environment and the increasing concern posed by natural geologic hazards. The section comprises a surficial geology unit, an applied geochemistry unit and an analytical sciences unit.

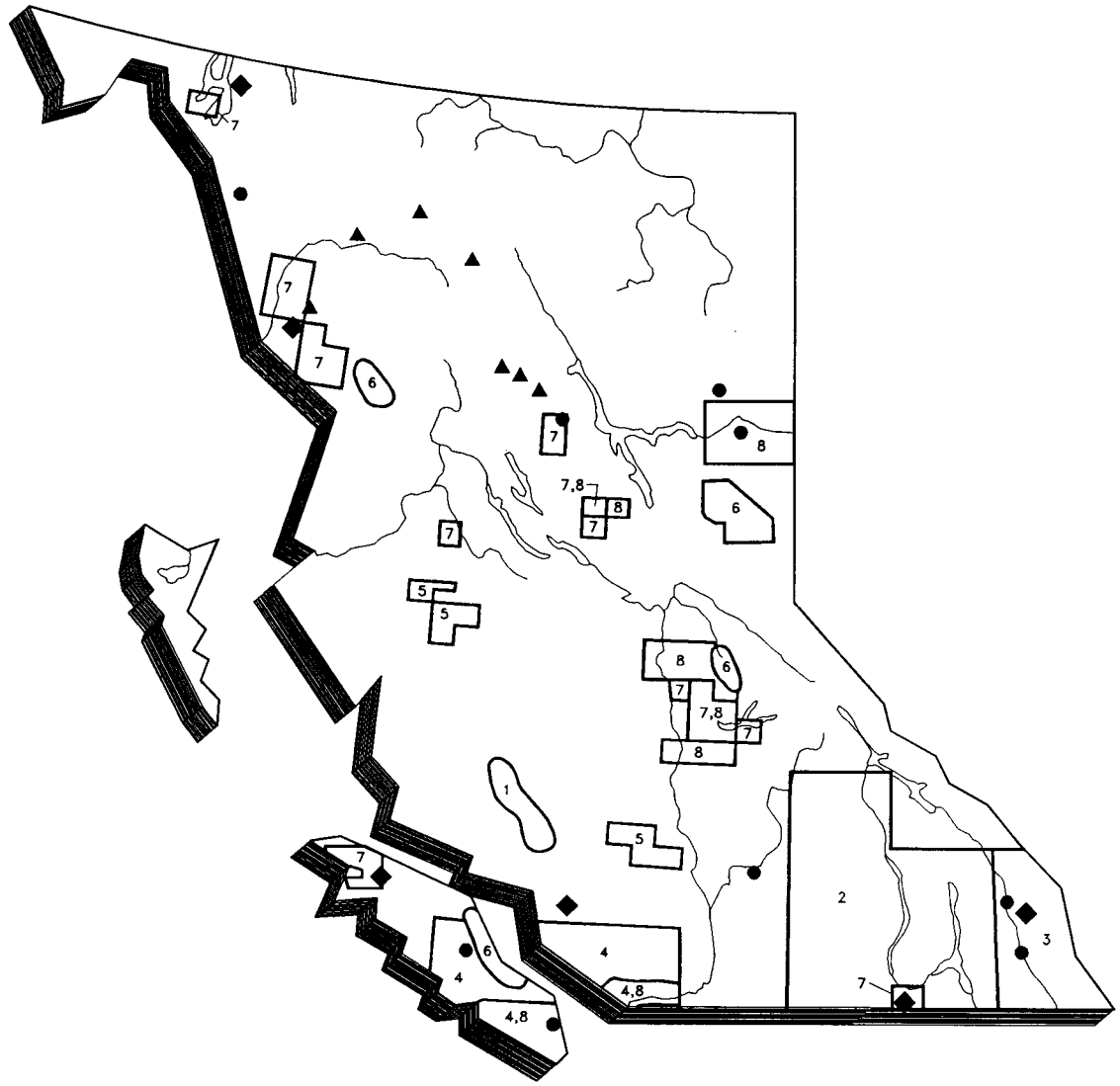
The units work in a complementary and integrated manner to obtain data on the surficial environment. For example, in addition to drift exploration and placer gold programs, the surficial unit is involved in neotectonics and geologic hazards studies. Research on analytical aspects of acid mine drainage is currently being undertaken by laboratory scientist, Mac Chaudhry. Regional Geochemical Surveys (RGSs), under the direction of Paul Matysek and Ray Lett, have been expanded to include analyses of copper, lead, zinc, arsenic, mercury and cadmium in waters. These data will be instrumental in defining background concentrations and natural variability for baseline studies by the exploration industry, public health officials, and fish- and water-quality researchers.

Applied Geochemistry

RGS results for southern Vancouver Island and the adjacent mainland were released in July. The area has considerable mineral potential and some interesting anomalies were located; these were subsequently staked in a mini-staking rush.

The 1990 RGS survey covered the Fernie, Kimberly and Invermere areas of southeastern British Columbia and was undertaken by Paul Matysek and Wayne Jackaman. Water samples were collected in this survey as part of a co-operative project with the Ministry of Environment which was funded by the new Sustainable Environment Fund.

Orientation surveys were conducted by John Gravel and Steve Sibbick in the Mt. Waddington area, along the eastern margin of the Coast Mountains, in advance of the 1991 RGS sampling program. Parts of this area are candidates for wilderness protection and a modern data base is required by explorationists and planners.



BRITISH COLUMBIA
GEOLOGICAL SURVEY BRANCH
LOCATION OF 1990 PROJECTS

SURFICIAL GEOLOGY STUDY AREAS		8
MINERAL DEPOSITS AND REGIONAL MAPPING PROJECTS	◆	7
COAL STUDY AREAS		6
DISTRICT GEOLOGY STUDY AREAS	●	
MDA PROJECTS WRITE UP YEAR	▲	5
REGIONAL GEOCHEMICAL SURVEY AREAS 1989 DATA RELEASE		4
1990 SURVEY		3
ARCHIVE		2
ORIENTATION SURVEY		1

Regional Mapping

The Regional Mapping program bore the brunt of the budget cut. Fortunately, most mappers had accumulated vast amounts of data from the hectic pace of the previous year's work and were productively employed preparing final reports and maps.

Two new regional mapping projects were initiated in 1990. Nick Massey turned his attention to the northern part of Vancouver Island. This area is underlain by a similar Mesozoic package to the southern part of the island mapped by Nick from 1985 through 1989 and hosts the important Island Copper porphyry deposit and numerous copper-gold skarns.

Joanne Nelson and Kim Bellefontaine initiated a multi-year project in the northern Quesnel Trough, which hosts the giant Mt. Milligan copper-gold alkalic porphyry. Although the area is heavily drift covered, the work revealed a number of previously unrecognized plutons, sulphide-rich alteration halos and mineral showings, which may be clues to additional Milligan-type deposits.

Pat Desjardins and Ron Arksey, supervised by Don MacIntyre, completed 1:50 000 scale mapping of the area between the Telkwa Range and Morice Lake, thereby linking areas mapped recently by Larry Diakow, under the MDA program, and by Don MacIntyre.

Limited clean-up mapping was conducted by Derek Brown on the Stikine Project and by Jim Logan on the Iskut Project, in advance of final report writing.

Mineral Deposits

Field work on two mineral deposit projects was completed in 1990. Trygve Hoy and Kathryn Andrew mapped out the Rossland Group – a Lower Jurassic island arc – into a number of formations. The Rossland Camp is the second largest gold producer in B.C. and has traditionally been viewed as a mesothermal vein camp. This work has pointed out the potential for copper-gold skarns and shear-related alkalic porphyries.

Dani Alldrick and Jim Britton completed the most expensive, and probably one of the most ambitious, Branch projects – a regional and metallogenic mapping project of the rugged Golden Triangle in the Iskut River area. The project began in 1986, before the term Golden Triangle was coined for the area, before the discovery of the fascinating Eskay Creek deposits, and before the area was buzzing with helicopters. Work in 1990 concentrated on examining the numerous precious metal deposits in the camp.

Gerry Ray and Ian Webster took their Skarn Project to the Iskut River area, which contains at least two limestone packages with known precious metal skarn and replacement deposits. The McLymont property and 20 other mineralized skarn occurrences were examined, mapped and sampled.

Industrial Minerals

George Simandl joined the Industrial Minerals Unit in June and began a study of the Mt. Brussilof magnesite deposit in southeastern B.C. This is a world-class deposit that produces 200 000 tonnes a year. The aim of the project is to determine the controls of mineralization and to develop an exploration model.

An airphoto study of the dimension stone potential of the southern Coast Range was contracted in 1990. The objective of the study is to locate large intrusions with favorable jointing patterns.

Coal

David Grieve's ongoing Coal Quality project sampled coals from producing mines. Laboratory studies will focus on factors contributing to good coking coal, and on thermal coals and gasification feed stocks.

Alex Matheson sampled coals in the Bowron Basin by shallow drilling. Jim Hunter and Ward Kilby mapped the coal measure geology of the Burnt River map sheet in the Northeast Coalfield. The Burnt River thermal coal deposit is located in the area. In addition there is potential in the area for coalbed methane and for conventional petroleum. Vancouver Island coals have potential for coalbed methane, and industry interest in Candace Kenyon's project in this area has been high.

Prospectors Assistance and Training

The Fame program was renewed for the 1990!91 fiscal year with support for the Prospectors Assistance Program. The $500 000 funding is used to promote prospecting activity by providing training, and financial and technical assistance to prospectors.

The program supported two training courses and contributed to several others. The 14th annual Advanced Prospecting Course was delivered April 24 through May 11, 1989, to a class of 32 students. The course is recognized as one of the best in Canada, and continues to improve each year.

Eighty-six grants, up to maximum of $7500 per prospector, were awarded in 1990–91 to independent prospectors, to help them in their search for the mines of tomorrow.

District Geologists

In 1990, the responsibilities of the five District Geologists continued to be:

- providing timely and informed advice to the Ministry's Mine Development Review Process
- providing timely responses to land use referrals, and input into other aspects of land use reviews, by participating in committees and advising headquarters staff
- maintaining an up-to-date inventory of the geology, exploration trends and developments throughout the province, and reporting thereon
- providing advice and information to industry, prospectors and the public, on the mineral resources of the province
- providing training for prospectors

Although exploration activity decreased somewhat from the record levels of 1989, the District Geologists continued with field studies in "hot" areas such as the Iskut–Stikine gold belt, the Omineca and Quesnel Trough copper-gold porphyry belts, and parts of the Okanagan Valley, Kootenay Mountains and Vancouver Island.

Geoscience Research

The B.C. Geoscience Research Grant program was continued in 1990–91 with funding totalling $130 000. This enabled the Geological Survey to support geoscience researchers from 15 different institutions in carrying out a total of 22 projects.

Results of these research programs are published in Geological Fieldwork, or other publications of the Geological Survey Branch.

SELECTED 1990 PUBLICATIONS

Exploration in British Columbia 1989

Bulletin 81: A Mineral Resource Assessment of the Chilko Lake Planning Area, by G. McLaren

Paper 1990-1: Geological Fieldwork 1989, A Summary of Field Activities and Current Research

Paper 1989-2: Stratigraphy of the Elk Formation in the Fernie Basin, Southeastern British Columbia, by D.A. Grieve and N.C. Ollerenshaw

Paper 1989-3: Precious Metal Enriched Skarns in British Columbia: An Overview and Geological Study, by A.D. Ettlinger and G.E. Ray

Paper 1989-4: Geology and Coal Resources of the Dominion Coal Block, Southeastern British Columbia, by D.A. Grieve and W. Kilby

Paper 1989-5: Geology and Mineral Evaluation of Kokanee Glacier Provincial Park, Southeastern British Columbia, (82 F/11, 14), by D.A. Brown and J.M. Logan

Open File 1989-22: Gold Production and Reserves in British Columbia, by T.G. Schroeter, C. Lund and G. Carter

Open File 1990-25: Geology of the Greenwood–Grand Forks Area, British Columbia, (82 E/1, 2) (1:50 000 scale), by James T. Fyles

Open File 1990-28: Dispersion and Behaviour of Gold in Stream Sediments, by W.K. Fletcher

Open File 1990-31: Geology of the Central Quesnel Belt British Columbia (NTS 93 A, 93 B, 93 G, 93 H), by D.G. Bailey

Open File 1990-32: Uranium and Thorium Occurrences in British Columbia, by Larry D. Jones

Information Circular 1990-1: B.C. Mineral Exploration Review

Information Circular 1990-8: Canadian Geoscience Council–B.C. Geological Survey Branch Review

CANADIAN GEOSCIENCE COUNCIL REVIEW OF THE BRANCH

The terms of reference for the Canadian Geoscience Council review of the Branch were:

- To review the current mandate of the Branch in terms of the Province's needs through the year 2000
- To analyze its organizational structure
- To report on the adequacy of staff and budget to meet the demands of the next decade

The review was conducted by six distinguished earth scientists; Dr. Chris Barnes (Chairman), Mr. David Barr, Mr. John Hamilton, Dr. David McRitchie, Dr. Ward Neal and Mr. Glen Rushton.

The Committee filed a 108-page report that is divided into four parts:

1. the development of the Branch

2. forecast evolution of the Branch Mandate to the year 2000

3. organizational structure

4. distribution of resources.

The Committee made 63 recommendations. Of particular interest to other Geological Surveys is the section on the "Role of a Provincial Geological Survey in the 1990s". The Committee foresees an impressive array of new challenges, including environmental, geological hazard, outreach and public information, and land use issues, in addition to maintaining the traditional survey role of support of the mineral industry.

Copies of the Report can be obtained free of charge from the Chief Geologist's Office.

ACHIEVEMENTS UNDER THE GEOSCIENCE COMPONENT OF THE CANADA–BRITISH COLUMBIA MINERAL DEVELOPMENT AGREEMENT 1985–1990

The legacy of the Mineral Development Agreement program in geoscience can be summarized in the following points:

1. The program demonstrated that regional 1:50 000 mapping is a viable, and probably the optimum, scale to portray geology and mineral potential in B.C.'s mountainous terrain. The program was initiated with four projects and areas covered by fifteen map sheets were surveyed. Since then, the Province has included nine projects in the base program of the survey.

2. A team of geochemists was formed in the Province to manage and deliver the regional geochemical survey program based on national standards. Acquisition of this expertise has led the Geological Survey of Canada to pass over responsibility for the Regional Geochemical Survey program to the province. B.C. was the first survey to release Regional Geochemical Survey data on floppy diskettes, thereby facilitating use of data by industry.

3. An inventory was compiled on more than 12 industrial mineral commodities with development potential in B.C. This information was used to produce the first provincial-scale map of industrial minerals in B.C.

4. Data were revised for approximately 40% of the Province's mineral occurrences in the B.C. data base, MINFILE. Concurrently, the Province redeveloped the software using a relational data base which runs in both mainframe and PC environments. The data base design and programs are recognized as being amongst the best in the world.

5. The Province's established program of mineral deposit studies was expanded with MDA funding; noteworthy was a study of gold skarns which was centered on the Hedley Camp.

6. Aeromagnetic surveying of the Insular Belt, and parts of the Quesnel Trough, were completed. The Trough is currently the focus of exploration activity for porphyry copper-gold deposits. The mineralized intrusions are often best identified on geophysical maps.

HIGHLIGHTS OF INDUSTRIAL PROJECTS

1:50 000 Mapping Projects:

- Work on the Taseko–Bridge River project defined stratigraphy and refined tectonic interpretations. Integrated studies with university researchers discovered a nearly complete ophiolite succession in the Shulaps Range; mantle tectonites that cap the mountains were emplaced from the east. Two specific mineral discoveries were made:

1. The Pat claims were staked by Esso Minerals in 1987 following the release of assays that returned values of up to 331 g/t Au and 337 g/t Ag from samples collected in 1986 along the margin of the Warner Lake stock

2. MacNeil International Industries Incorporated implemented a $250 000 diamond drilling program after the MDA mapping discovered disseminated molybdenite and auriferous quartz veins on their Cub 200 claim.

- Regionally, the Midway-Cassiar project mapping discovered North American ties within the Sylvester allochthon that argue against major lateral movements for these rocks. Volcanic rocks hosting gold mineralization at Erickson Mine, near Cassiar, are of late Triassic age; the younger gold mineralization is related to listwnite alteration along the sole thrust of the allochthon and may be localized by a buried intrusion. In addition, new rhodonite discoveries are under investigation by industry.

- Although virtually all Sicker Group rocks on Vancouver Island were staked prior to initiation of the MDA project, the mapping clearly defined stratigraphic and structural relationships, enabled lithogeochemical modelling of the volcanic package, and outlined areas that are more favorable for volcanogenic massive sulphide deposits within the Sicker Group. The study also reminded explorationists of the lode gold potential of carbonate-altered fault zones in the area.

- In the Smithers-Whitesail area, MDA mapping, and the jointly funded Regional Geochemical Survey of the area, led to significant staking activity. The mapping is also partly responsible for shifts in the boundaries of Tweedsmuir Park that resulted in major exploration programs on Deerhorn and Chikamin mountains.

- Alaskan ultramafic rocks were mapped to evaluate their potential as sources of platinum group elements. Historically, those at Tulameen, in southern B.C., were sites of placer platinum production. Source regions for platinum discovered in placer deposits elsewhere in the province is unknown. Microprobe studies, in conjunction with work by CANMET scientists, confirmed that the Tulameen placer deposits were derived from chromitites in the dunitic core of this Alpine ultramafic complex.

Industrial Minerals:

- Reports on deposits in B.C. were completed for dimension stone, limestone and dolomite, peat, olivine, nepheline syenite, feldspar, carbonatites, garnet, silica, talc, zeolites, flourospar, magnesite, and phosphate.

Metallogenic Mapping Projects:

- An unanticipated outcome of the Hedley gold skarn project was the discovery of a garnet deposit, and the subsequent proposal by Polestar Exploration Inc. for the Crystal Peak garnet project. This proposed development is currently in the Province's Mine Development Review Process.

- Mineral claim staking followed quickly after each year's release of information from the Chilko Lake project. Prospecting and lithogeochemistry resulted in discoveries of porphyry and vein-type mineralization and confirmed the tenor of known mineralization. Zones of high mineral potential can now be confidently identified; some have been staked.

Geochemistry Projects:

- Research proved that the "golden fleece" (i.e., moss mats), is an effective sampling medium for both base and precious metal exploration targets in B.C.

ALBERTA GEOLOGICAL SURVEY
ALBERTA RESEARCH COUNCIL

The Alberta Geological Survey, a department of the Alberta Research Council, is co-managed with the Alberta Department of Energy. Our mission is to advance the economy of the province through survey and research services that are supportive of environmentally responsible management, exploration and sustainable development of the province's energy and mineral resources.

During 1990 the Alberta Geological Survey worked in four main areas: coal geology, industrial and metallic minerals, oil sands geology, and petroleum geology and basin analysis. Much of the work was jointly funded with government departments and agencies, with a small amount done under direct contract to industry or government departments.

Coal Geology

The highlight of the Coal Geology Section in 1990 has been the start-up of its coal bed methane (CBM) program. The program is focused on more clearly defining the CBM potential of the Alberta basin, by mapping the distribution and thermal maturity of several coal zones in both the plains and foothills. Scheduled for completion in June of 1991, the study is supported by funding from 14 companies, the Alberta Department of Energy and CANMET.

The Coal Section also continued to refine the Coal Geology Database that has been under development for the previous two years. The database contains coal related information collected by the AGS, the Energy Resources Conservation Board and industry. Data from the system is now being offered to clients on a custom search, fee for service basis. The first phase of the Section's coal compilation mapping project was also completed during the period of this report. Through the application of geographic information systems technology the project has produced a series of four regional coal maps of the foothill region of west-central Alberta. These four maps are the first in a collection to include 18 1:50 000 map sheets. Available in electronic or hard copy formats, the maps are extremely flexible. The final product can be customized to suit the needs of individual clients and can include as much or as little of the available data as desired.

Traditional mapping of the coal resources of the Grande Cache area and work related to the regional variability of coal quality data were also conducted by the Coal Geology Section during 1990.

Industrial and Metallic Minerals

1990 saw the Industrial and Metallic Minerals Section make substantial progress on its Mineral Deposits and Occurrences File. The file, which is run on the MacIntosh Hypercard software, includes information on known occurrences of metallic and industrial minerals in Alberta. Data contained in the system includes information on: location, geologic setting, chemical analysis and references to literature sources for more detailed investigation. The database is currently in the prototype stage and should be available for general distribution early in 1991.

The year also marked the end of a study that defined the placer gold potential in Alberta. Through two summers of field work, sampling was conducted on the major river systems in the province. Included in the study was a review of tertiary gravel systems, thought to be an attractive target for the resource. Data accumulated through the study has been incorporated into the Section's electronic Mineral Deposits and Occurrences File and is available on diskette.

The Section also continued its tradition aggregate survey activities in 1990 focusing its efforts on the Athabasca region of the province, located approximately 100 km north of Edmonton. Work also continued on a comprehensive report on economic clay mineral potential in Alberta. This study will continue in 1991 and should be completed in early 1992.

Oil Sands Geology

Oil Sands Geology studies comprise two research programs. The largest, the joint oil sands geology program, is funded on an equal basis by the Alberta Research Council and AOSTRA. Within this program there are two major technical projects: resource characterization, which is currently focused on the Athabasca oil sands area; and reservoir analysis, which deals with the development and application of techniques for reservoir characterization and multidisciplinary reservoir modelling. The latter project has recently focused on an investigation of the Syncrude minesite aimed at the quantitative characterization and scaling up of petrophysical parameters in an oil sands reservoir. Results of this work will be highly valuable to enhanced recovery process simulation modelling.

The second major research program, funded entirely by AOSTRA, is the strategic research program. Geological support for AOSTRA's Underground Test Facility was the main priority in 1990, and the opportunity exists for an unparalleled examination of reservoir characteristics and response to thermal stimulation. Activities range from detailed core work to mapping, calculating reserves, and planning drilling programs for UTF expansion. Documentation of the UTF geological framework is fundamental to developing and refining the new technology used at the UTF site.

Petroleum Geology and Basin Analysis

The objective of the Petroleum Geology and Basin Analysis Section is to establish a systematic and integrated framework of the Alberta subsurface on a regional scale. This framework is intended to then serve as a basis for evaluation of the potential of the Alberta basin for energy and mineral resources. The staff in this section have expertise in stratigraphy, clastic and carbonate sedimentology, hydrogeology, geochemistry, geothermics, geoscience data base design and management, and numerical modelling of basin evolution and flow processes.

The main activity during the period covered by this report involved the large-scale regional description and analysis of the whole or parts of the Western Canada Sedimentary Basin. Work continued on two major projects: the Geological Atlas of the Western Canada Sedimentary Basin and studies of the Peace River Arch area.

The Atlas project began to wind down in 1990 as most of the mapping, data processing and regional compilation work was completed in June for exhibition at the Canadian Society of Petroleum Geologists convention in Calgary. What remains for 1991 is the editing and publishing of this landmark document. Release of the atlas is currently slated for the fall of 1991.

The Peace River Arch investigation, which was concluded in 1990, dealt with many stages of Arch development, focusing on phases represented in the Precambrian, Carboniferous and Cretaceous strata.

One of the most important conclusions arising from this joint program with the Institute of Sedimentary and Petroleum Geology, is that the Peace River Arch is not a single structural entity. It is a composite structure consisting of a Precambrian uplift, an Early Carboniferous extensional basin and reactivated Precambrian basement fault zones. These three features had different origins and have created three distinct structural trends in the region. The investigation has also established that the Arch is a much older structure than previously thought. Previous subsurface work had not been able to establish a definite origin older than the Devonian, but new evidence from the Cordillera has shown it formed in the late Precambrian.

SASKATCHEWAN DEPARTMENT OF ENERGY AND MINES
GEOLOGY AND MINES DIVISION

The geoscience activities of the Geology and Mines Division, in public interface identified as the Saskatchewan Geological Survey, are undertaken by four branches: Precambrian Geology, Mineral Development, Petroleum Geology and Sedimentary Geodata. Advice and evaluation on program content are provided by the Saskatchewan Geological Liaison Committee, comprising representatives from industry, universities, the Geological Survey of Canada and the Saskatchewan Research Council.

Mineral Exploration Activity

During the past year, exploration for metallic minerals in the province, as elsewhere in Canada, has continued to wane. Uranium and gold exploration levels have been much reduced, although production, test mine developments and advanced exploration continued on a number of properties. There is some interest in base metals, highlighted by the discovery at McIlvenna Bay, and the promise of further finds, particularly under the feather-edge of Phanerozoic sediments along the eastern shield edge.

Oil exploration has yet to respond significantly to the higher prices engendered by the Middle East crisis. New exploration continues in the Winnipegosis (Devonian) and other deep targets, with encouraging results. Exploration for natural gas continues in the Cretaceous of the southwest and production has been at relatively high levels. While potash remains the core industrial mineral, such commodities as clays, dimension stone, high-salinity brines, and silica sands are considered to have potential.

The diamond exploration play which commenced in 1988 continues actively, with over 700 000 hectares staked, mainly in the central belt (Prince Albert to Choiceland) and in the Val Marie region of the south. Industry has confirmed the existence of 9 kimberlite bodies, found by testing aeromagnetic anomalies and drilling through thick glacial overburden. Microdiamonds have been encountered in most of these bodies. The Saskatchewan Geological Survey, through its own investigations, has found indications of several other pipes at various places in central and southern Saskatchewan.

New Trends at the Saskatchewan Geological Survey

Although the Saskatchewan Geological Survey mandate has, in the past, been seen primarily as relevant to the development of the mineral industry, calls on regional geoscientific data in environmental studies are growing. These concerns include not only the particular environment of mining operations, but a range of fields including water supply, epidemiology, waste disposal, and land use management in general. Regional geochemical surveys and studies are particularly applicable in providing information for these concerns, which are expected to become more important in future years.

Another shift in program emphasis is towards the enhancement of data base systems and the accompanying need to develop computer systems. These took a quantum leap this year, with a microcomputer now in the hands of every geologist, establishment of a partial microcomputer network (Novell), the acquisition of a publishing system for coloured maps, trials in computerized geological map production, and preliminary planning towards establishing spatial (geographical) information systems (GIS). The Survey also embarked on a pilot study into the processing and enhancement of geophysical, and other regional numeric data, using RTI/CAD software. The computerized Well Information File (oil and gas wells) is now available on a monthly updated CD-ROM disk, through CD Pubco Inc. in Calgary. Several data base files are being released as open files and made available in microcomputer formats. These include the Assessment Work Catalogs, Mineralized Core Collection Inventory, Mineral Deposits Inventory, Saskatchewan Precambrian Bibliography, and the Geochronology File.

Funding and Operations

Operational funds in 1989-90 were provided by the province under the Saskatchewan Mineral Industry Diversification Program (MIDP), in its second year. A Summer Student Employment Program (SSEP)

brought total project operational funding in the year to about $1.2 million. A new 5-year, $10 million, Canada–Saskatchewan Mineral Development Agreement (MDA 2), with 50:50, participation is being negotiated, and is expected to be back-dated to April 1, 1990.

As in previous years, the Saskatchewan Geological Survey geoscience program has involved: permanent and contract staff; contracts and joint studies, mainly with the universities of Saskatchewan and Regina and the Saskatchewan Research Council; and joint projects with other universities.

Northern Geoscience Program

The northern geoscience program this year has focussed on projects related to gold, and particularly base metal, exploration. The main emphasis of this program is to improve the basic geological map of the southeastern part of the Precambrian Shield, which is currently perceived as having the highest mineral potential. The general bedrock mapping scale is 1:20 000, with final compilation and publication as 1:50 000 scale coloured maps with accompanying reports. The region south of Flin Flon and along the Manitoba border is being remapped at 1:12 500 scale. This basic mapping, leading to a better understanding of the geological framework of the north, is supported by (P-T-t), lithogeochemistry, geochronology and isotope geology studies, amongst others. Coloured compilation bedrock geology maps at 1:250 000 scale now cover over 65 percent of the Precambrian Shield area in first edition. A coloured edition of the important Pelican Narrows and Amisk Lake sheets in the southeastern part of the Shield is in preparation.

Mineral deposit investigations in the Precambrian Shield region are largely focussed on gold and base metals, with a lesser emphasis on uranium, polymetallic uranium-gold-platinum group element (PGE) and rare earth metals. These included a joint study with the Saskatchewan Research Council; and an industry consortium on the Wollaston Group, which is designed to provide a better understanding of the basement influence on uranium mineralization. Several, new, 1:250 000 scale metallogenic maps were completed.

Two resident geologists are headquartered in La Ronge, and the Creighton office continued to be operated on a part-time basis. The Mineralized Core Collection in La Ronge acquired core mainly from gold and base metal exploration sites. The Prospectors' School continues to offer a 6-week course. The course is deemed particularly relevant during the present period of intensive gold exploration, as prospecting, even in today's age of technology, still represents one of the most effective gold exploration methods.

Kimberlite Studies

In 1989, a program was commenced to stimulate and assist the diamond exploration play. This program included: a highly productive study of "Phanerozoic anomalies"; a petrographic-isotope study of core from deep basement in the Phanerozoic area; and a joint study, with the Geological Survey of Canada (GSC) on a kimberlite environment. Potential kimberlite sites in the shield were also ground checked.

Southern Geoscience Program

The Petroleum Geology branch continued work on its contribution to the new *Geological Atlas of the Western Canada Sedimentary Basin*. Stratigraphic information from licensed wells was processed and added to the Well Information System. Stratigraphic studies in progress included the geology of the Cretaceous Medicine Hat Sand and the Silurian Interlake Formation. A report on the development of a depositional model for the oil-prone Jurassic section in the Wapella!Moosomin area is being prepared for publication. A significant part of the branch's activity is devoted to log picking and consultations to industry geologists.

Several workshops on introductory geology were arranged for school groups; due to a change in school curricula there has been a dramatically increased demand for sets of typical Saskatchewan rocks and minerals produced in the branch.

The industrial mineral program, apart from kimberlite-oriented studies, was spearheaded by the building stone project, which concentrated on the Amisk Lake area. Investigations of subsurface brine resources have commenced, and a preliminary paper on potash genesis was compiled. The Survey supported a coalfield modelling project in the Willow Bunch–Wood Mountain area. Other projects included: sampling and analyses of industrial minerals, with detailed investigation of two major silica sand deposits; and preliminary sampling of bentonite and dolomite deposits. A report was produced on structural industrial minerals.

Mineral Development Agreement 1984–9: Wrap up Year

The year 1989–90 was the wrap up year for the 1984–89 MDA, and as such included the preparation of final reports. Most bedrock mapping in the MDA program was completed at 1:20 000 scale and released in open file form with monochrome maps. Several final compilation reports on these areas are scheduled to be accompanied by coloured 1:50 000 scale maps; notable amongst these will be complete coverage of the Central Metavolcanic Belt, La Ronge Domain, and the Laonil–Uskik Lakes area, Glennie Domain. Due largely to retooling in connection with computerization, many of these reports still have to see the light of day, and efforts to wind up the backlog will continue with a goal of completion in 1990–91.

SASKATCHEWAN RESEARCH COUNCIL
GEOSCIENCE ACTIVITIES

Mineral Deposit Studies

The program has been orientated toward aspects of uranium exploration and development. A 2-year study is under way to enhance the understanding of the Wollaston Group stratigraphy. The chlorite-dravite trend is being investigated in the Athabasca Formation. A study was undertaken to characterize the background geochemistry and mineralogy of the Reven–Horseshoe deposit.

A project has been completed to characterize the major and minor element lithogeochemistry of the Martin Formation in the Beaverlodge area, in co-operation with the University of Saskatchewan and the Saskatchewan Geological Survey.

In the future, research will be focussed toward investigating host-rock alteration, geological models, and drift prospecting associated with base metal deposits, in order to develop models as exploration tools to enhance mineral exploration.

Geochemical Services

The Geochemical Services Laboratory provides major and minor element analyses of ores, rocks, tills, soils, lake sediments and vegetation for both in-house projects and the mineral exploration industry. Approximately 500 000 element determinations were performed on 50 000 samples during the past year. The heavy mineral concentrating facility is being well-utilized by the exploration industry. A fire-assay service is in operation for gold and platinum group elements. Instruments and techniques for separating and analyzing specific heavy minerals are being developed in response to the exploration activity for diamonds in southern Saskatchewan.

Mineralogical Services

A laboratory is performing mineralogical analyses, particularly, identification of minerals by X-ray diffraction. The results of these analyses permit the detection of hydrothermal alteration associated with uranium mineralization, in deep drilling across the Athabasca Basin. This mineralogical determination is also used for mineral identification in many other materials, such as the clay minerals and alteration products in clay liners, and to augment routine petrographic examinations.

Drift Prospecting Studies

Quaternary geology mapping and sampling in areas of gold and platinum exploration will continue to provide information about the Province's glacial geology, and thus, assist in the design, execution and interpretation of till geochemistry surveys. Several contract studies are being carried out for various exploration companies.

Research is being conducted, concerning mineral exploration in southern Saskatchewan for diamonds, placer gold and various industrial minerals.

The 1:25 000 scale National Topographic Series maps summarizing the surficial geology of the entire province are available, and the production of a 1:1 000 000 scale Quaternary geology map of the province in under way.

Industrial Minerals

An assessment of industrial mineral resources, and their market potential, was begun this year. The purpose of this year's work is to define structural minerals specifically, and to determine the availability and requirements for these types of mineral resources. This work is being done with the support of the

Saskatchewan Geological Survey. An assessment of placer mineral potential was also initiated in southern Saskatchewan.

Groundwater Study

An investigation of groundwater processes continued near Saskatoon, with emphasis on flow in tills, age dating, aquifer hydraulics and chemical processes. Graduate students from the University of Waterloo are assisting with the project. An investigation of computer-assisted methods for producing geology and groundwater maps, cross sections and graphs is continuing.

An evaluation of the groundwater resources of the Regina area was completed, and similar investigations for the area around Yorkton and Estevan were initiated, under contract. Providing information on groundwater conditions, along with monitoring of groundwater levels at 50 sites, was continued. Monitoring of subsurface brine migration at a disposal facility for potash mine waste, continued. This work will be expanded to encompass the investigation of decommissioning options for the potash tailings piles and brine ponds.

Pipeline Technology

The Pipeline Development Centre undertook projects for clients studying the transport of coal in crude oil, water-oil emulsions, tar sands and coal-condensate slurries. Physical modelling of horizontal wells was begun this year, in conjunction with other heavy-oil research work.

Petroleum Research

Research projects focussed on enhanced oil recovery, including: steam injection, horizontal wells, in situ combustion, and carbon dioxide injection. An enhanced light-oil recovery project (carbon dioxide injection) is also under way. Other work includes emulsion treating, upgrading, and alternative fuel products.

Special Information Services

The development of remote sensing, image analysis, computer mapping and GIS capabilities, and methodologies for enhancing and interpreting exploration data, is continuing. These techniques will be applied to assist mineral exploration, through contracts with the mineral industry. Mapping and analyzing lineaments is one of the projects designed for mineral exploration.

Rock Mechanics

The triaxial testing of large potash cores, to determine material properties, has been completed successfully. A 2-year project to test 30 potash cores from Saskatchewan mines is under way. Rock mechanics instrumentation, designed and fabricated for potash mines includes: stress cells, closure meters, gauge panels, water-pressure monitoring devices, and data acquisition systems.

MANITOBA ENERGY AND MINES
GEOLOGICAL SERVICES BRANCH

General

1990 proved to be a year in which budgetary constraints and reorganization limited the range and level of activities undertaken by the Manitoba Geological Survey. Continued delays in signing a new Mineral Development Agreement (MDA) resulted in postponement of many provincial projects, and federal program contributions in Manitoba dropped to less than $150 000.

Workplans were revised in mid-season, as a result of additional budgetary limitations. Several projects were cancelled, others were severely trimmed, and the remainder suffered significant cutbacks. By late summer, most projects were operating at a maintenance level.

Nevertheless the year proved fruitful, with publication of many new reports stemming from the previous MDA, and good progress being made in completing the main body of work conducted during the previous 6-year period.

In the spring, the Minerals Division was reorganized. Promotional and informational services, previously provided by the Exploration Services Section of the Mines Branch, were transferred to the Geological Services Branch (GSB). A Geophysics, Geochemistry and Terrain Sciences Unit was established in the Geological Services Branch, and the Analytical Laboratory was placed within the Minerals Investigation Section.

Regional offices at The Pas and Flin Flon continued to be active in providing support to local prospectors, and in retrieving drill core from various industry drilling operations.

The final meeting of the 1984–1990 MDA Management Committee was held in Ottawa, March 14, at which time Manitoba tabled its most recent draft proposal for future minerals programming. Discussions aimed at development of a joint MDA–II workplan continued throughout the summer, together with liaison relating to ongoing Exploration Science and Technology (EXTECH) projects and proposals for future initiatives under NATMAP and Lithoprobe.

In response to a request from the Mines Ministers (Sudbury 1989), "that federal and provincial geologists explore ways of improving the coordination of geological programming in Canada", managers from both Survey organizations met on several occasions to discuss new mechanisms for enhancing co-operation and integration of their efforts. Reports on this topic, with contributions from all provinces, were presented to the Mines Ministers by both the Committee of Provincial Geologists and the National Geological Surveys Committee, at the 47th Annual Mines Ministers' Meeting in Winnipeg (August 27–28). A memorandum of understanding between the Geological Survey of Canada (GSC) and the GSB, to entrench a co-ordinated and complementary approach to geoscience program delivery in Manitoba, will be signed in the immediate future.

The federal cabinet announced its priorities for regional economic programming in western Canada in late August, and authorized initiation of negotiations with Manitoba for a second MDA for the period 1990–95. Continued input was provided throughout the year to the evaluation of the 1984–89 MDA, the results of which are now available.

In the spring, and in the absence of a new MDA, the provincial field program was mounted at an extremely modest level with expenditures significantly lower than those in 1989, the wind-up year of the last Agreement. Twenty-five students were employed to facilitate the summer's program, but for want of funds, several were retained in Winnipeg to expedite data analysis and sundry computer functions.

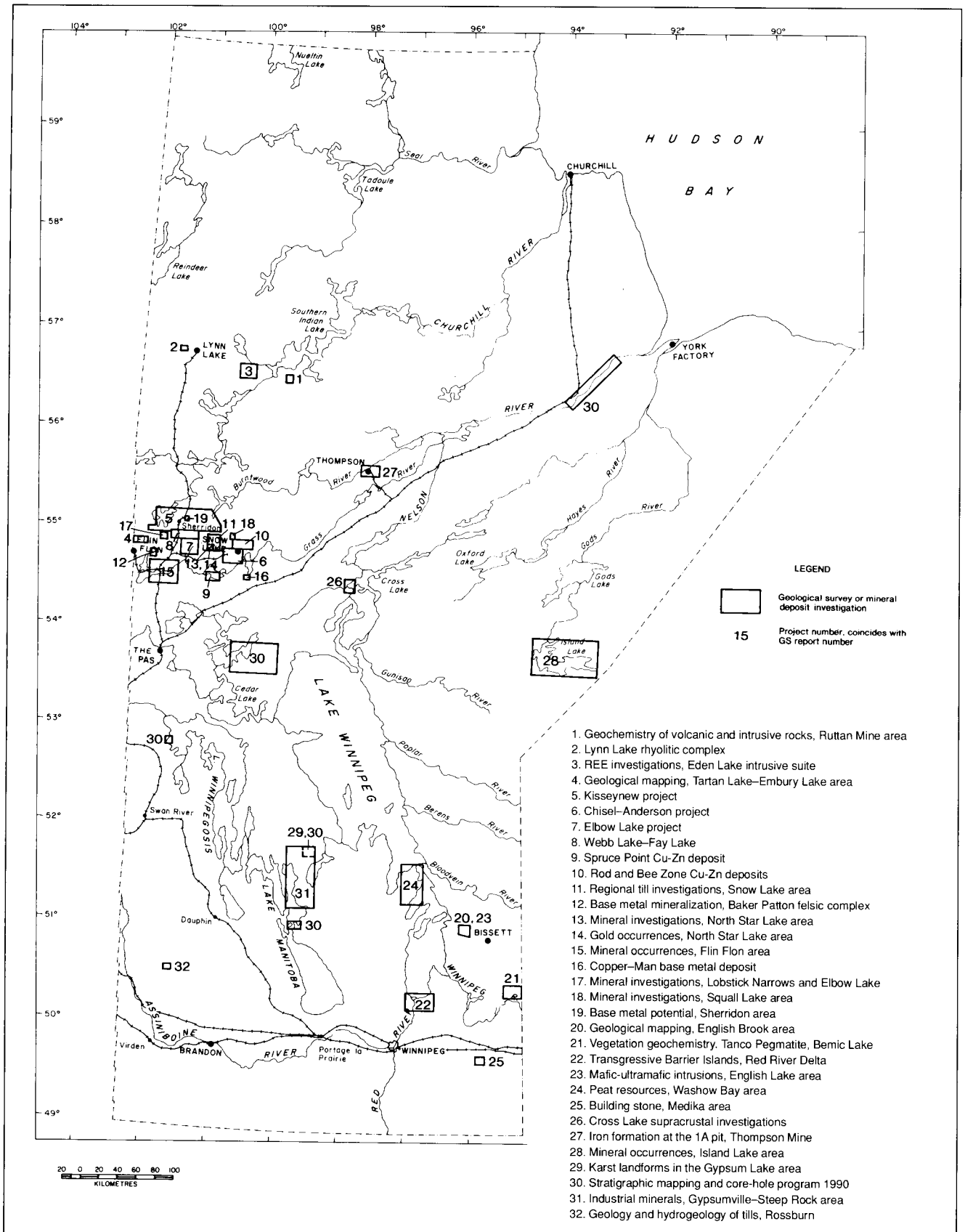


Figure 1. Manitoba Geological Survey projects, 1990.

The main focus of the summer's activities was directed to an evaluation of the mapping potential of areas affected by the 1989 forest fires, more specifically the fire in the Elbow Lake–North Star Lake region, that southwest of Wekusko Lake, and the new burn in the English Lake area of southeastern Manitoba. Feedback from these orientation surveys will be compiled into a major workplan to be implemented over the next 2- to 3-year period under the acronym of STOMP (Short Term Outcrop Mapping Program).

During the summer, Branch staff led and/or assisted in several field workshops designed to familiarize industry, university and government geologists with key exploration and research areas, and new concepts arising from previous work. Most notable of these were: 1) a 3-day field trip in the Flin Flon–Hanson Lake area, convened by the "Friends of the Reindeer Zone"; 2) a 2-day tour of the Assean–Split lakes area as part of a workshop organized by the "Friends of the Nickel Belt" (20 delegates); and 3) a 6-day tour of the Flin Flon–Snow Lake–Thompson region (35 delegates), led jointly by GSC and GSB geologists as Field Trip No. 10 of the International Association on the Genesis of Ore Deposits (IAGOD) conference.

In the spring of 1990, Lithoprobe Phase III was approved for 5 years, with a 3-year funding level (1990–91 through 1992–93) of 4.5 million dollars per year. The trans-Hudson Orogen Transect (THOT), in Manitoba and Saskatchewan, is one of the projects to be started in 1991; it will commence with reflection seismic surveys. The Manitoba Survey expects to play an active role in providing logistical support for several of the projects to be conducted under the THOT. Projects already started include U-Pb geochronology of the Lynn Lake area, the Thompson Belt–Reindeer Zone, and Molson Dyke Swarm paleomagnetism.

Throughout the summer, in co-operation with the Manitoba Energy Authority, and Industry Trade and Tourism officials, Branch geologists gave several presentations on commodity prospects to industry representatives, most notably to the Metal Mining Agency of Japan, Fact Finding Mission on Rare Metals.

Technical presentations on various aspects of the province's development potential, and geological attributes, were given in Vancouver, Dallas, Hibbings, and Calgary. Work also continued on the *Geological Atlas of the Western Canada Sedimentary Basin*, which is being co-ordinated by the Alberta Research Council. Contributions by the GSB included cross sections of the lower Paleozoic sequence, corrections to Manitoba's Oil and Gas Well data base, and stratigraphic core hole information in areas with no deep holes.

Budgetary limitations again impeded the Branch's ability to conduct co-operative research with universities, and interaction with the Department of Geological Sciences, University of Manitoba, was constrained to several minor projects entailing an exchange of analytical services.

Several new reports in the Mineral Deposit Series were issued during the year, as were two new additions to the provincial 1:250 00 scale atlas. Compilation work on the sub-Phanerozoic Precambrian basement continued for several areas south of Snow Lake, with maps scheduled for release in November 1990, at the annual Meeting with Industry. A review of geophysical assessment reports that encompass the Bissett district is also well advanced; publication of an open file is scheduled for early 1991. Final drafts of the Fox River report are now complete, and this publication should also be released in 1991.

Geographic information systems (GIS) activities continued at a low level, with continued experimental work on the Division's PAMAP system. Marked progress has been made in developing new systems for standardizing and processing field data, and a new user manual is being widely utilized throughout the Branch. AutoCAD capabilities are now being used by some geologists, and cartographic staff. Output from AutoCAD has been especially beneficial in assisting figure production for the Mineral Deposit reports; and also for area-quantification in support of an analysis of "prospectivity" in Manitoba, currently being conducted by B. Mackenzie, Centre of Resource Studies, Queen's University.

DISTRICT SUMMARIES

Lynn Lake–Ruttan Region

In the Lynn Lake area, investigations were conducted into the geological setting of part of the Lynn Lake rhyolite complex, which hosts massive sulphide-type deposits. Geochemical studies on selected volcanic rocks from the Ruttan Mine region confirmed the island-arc affinity of the volcanism.

In June and July, the GSC mounted airborne gamma-ray spectrometer surveys in the Ruttan–Eden lakes and Snow Lake areas, as part of its new EXTECH initiative. Advance copies of maps from the Ruttan area were used by the provincial survey to target areas for follow-up ground truthing centred on the Eden Lake monzogranite complex. Detailed ground scintillometer and spectrometer surveys were mounted over positive uranium anomalies, west of Highway 391, and west of "Spur" Lake, in the hope that rare earth element (REE) concentrations, similar to those at Eden Lake, would be encountered. Although zones of elevated radioactivity were found, no REE mineralization was detected, and the host monzogranites contain neither the ubiquitous aegirine-augite seen at Eden Lake, nor the widespread fluorine-bearing pegmatites, common south of Kwaskwaypichikun Bay.

Flin Flon–Snow Lake

Mapping, at 1:20 000 scale, was completed in the Tartan Lake area. This year, two major, and similar, fractionated gabbro sills were found to face inward toward the axial zone of the northwest-trending Ruby and Bartley lakes syncline. The relations between the Mikanagan and Batters lakes sills and the Tartan Lake gabbro complex is uncertain. However, some evidence indicates the sills are contemporaneous with an early phase of the complex. Volcanic units mapped in the Flin Flon–White Lake area, to the south, were traced north into the core of the Ruby and Bartley lakes syncline, which appears to comprise the upper part of the Bear Lake Block section. The best copper and zinc values obtained were at the contacts of major gabbro intrusions; however, significant copper values were also found in veins of quartz and felsite. Eight gold showings were found, most within 3 km of the Tartan Lake Mine.

A detailed mapping program was initiated in the Baker–Patton felsic complex, to determine the geological setting of the Don Jon and North Star massive sulphide deposits.

In 1989, a large forest fire between Elbow Lake and Sherridon resulted in greatly improved bedrock exposure in areas previously covered by old-growth, mature forest. Several reconnaissance projects were conducted to determine which of the newly exposed areas warranted mapping, and to develop a framework for programming in the region over the next few years.

Supracrustal rocks at Elbow Lake were found to comprise Amisk Group metavolcanic and related intrusive rocks, together with a wide variety of relatively high level intrusions of unknown affinity. The supracrustal rocks form an enclave centred on the lake, and are transected by the 2 km wide Elbow Lake shear zone. Supracrustal rocks east of the shear zone comprise a very strongly deformed package of pillowed mafic lavas and diabase, intruded by tonalite and gabbro. To the west, primary volcanic structures are preserved, and two possible intravolcanic unconformities were defined within the volcanic sequence.

At Fay Lake, 1:20 000 scale mapping delineated extensive areas of high strain, and also located new exposures of Missi Group basal conglomerate, unconformably overlying Amisk metavolcanic rocks. At Webb Lake,1:10 000 scale mapping outlined a moderately well preserved, steeply dipping section of intercalated mafic and intermediate volcanic, volcaniclastic and sedimentary rocks; and extensive areas of rhyolitic and rhyodacitic rocks that are either flows or high-level intrusions. This complex of supracrustal rocks and intrusions appears to be a large roof pendant enveloped within a younger, variably quartz-phyric, granodiorite intrusion.

A 1:5000 scale geological map was prepared for a small portion of the new outcrops in the North Star Lake area burn. The area is underlain by mafic and felsic volcanic rocks. Although rusty weathering zones were delineated, it was not possible to relate these zones to massive sulphide-type alteration.

Quartz-vein-hosted gold occurrences in the North Star Lake area were documented, and accurately located with the assistance of newly acquired 1:5000 aerial photographs.

Three detailed mapping projects were initiated in the vicinity of the Rod, Bee Zone and Spruce Point copper-zinc deposits. The Spruce Point study will be supplemented by a geochemical assessment of alteration related to the mineralization.

Detailed mapping at Anderson Lake attempted to clarify the stratigraphic relations between the copper-zinc massive sulphide deposits in this area, and zinc-copper deposits at Chisel Lake, 8 km to the southwest. This study also examined areally extensive footwall alteration zones associated with the base metal mineralization. The intent is to relate the base metal mineralization to the alteration processes, and to synvolcanic intrusions. The study suggests that the Anderson Lake copper-zinc base metal deposits occur lower in the stratigraphic section than the Chisel area zinc-copper deposits. Furthermore the study indicates that the deposits in the two areas may be related to two discrete hydrothermal-geothermal systems generated by two unrelated, synvolcanic tonalite plutons.

At the Copper-Man deposit near Wekusko Lake, outcrops and geology were mapped at 1:2000 scale to provide a geological framework for future geochemical studies.

Regional till sampling was initiated in the Snow Lake area as part of EXTECH, in co-operation with the GSC. The till sampling will establish the geochemical character of surficial deposits in this region, and may detect dispersion trains related to underlying base metal mineralization.

In the Kisseynew gneiss terrain, investigations centred on 1) evaluating the mapping potential of recently burned areas, and 2) detailed studies of the geological settings of massive sulphide and gold deposits. In the Sherridon area, structure zones of hydrothermal alteration were investigated and sampled in a newly burnt area. Stratabound gold mineralization was mapped at Lobstick Narrows, and a differentiated intrusion that hosts gold-arsenopyrite occurrences was mapped in the vicinity of Squall Lake. The host rocks to this mineralization are similar to those at the Moon-Gertie and Margaret zones immediately south of Squall Lake.

Thompson Belt

New exposures at the Thompson Mine open pit were mapped and sampled in order to determine the internal stratigraphy and composition of a stratabound "iron formation" that is spatially associated with the nickel sulphide ores.

Further south, 1:20 000 scale geological mapping was initiated to map soon-to-be-flooded shoreline exposures at the west end of Cross Lake. A major synclinal structure was found in rocks whose metamorphic grade is generally higher than that to the east. Consequently, primary structures and stratigraphic sequences are not as well preserved.

Information and assistance was provided to several companies exploring the southwest extension of the nickel belt, and all available drill core was retrieved for future studies.

Island Lake

As part of the initial mineral deposit documentation of the northern Superior Province, 195 mineral occurrences that lie within the eastern segment of the Island Lake greenstone belt, were sampled and mapped in detail.

Southeast Manitoba

Detailed mapping of a mafic igneous complex, southeast of English Lake, located massive to layered, gabbroic to pyroxenitic phases intruded by tonalite. The complex contains widespread megabreccias and pegmatitic phases, which together with the common occurrence of pyrite, make this an attractive target for platinum group element exploration.

A reconnaissance survey east of Manigotagan, in an area of recently burned, focussed on the northern boundary of the Rice Lake greenstone belt. The boundary represents a major tectonic break, separating greenschist facies supracrustal rocks from a mid to lower crustal section to the south, represented by upper amphibolite grade, intermediate to ultramafic breccias of the English Lake magmatic complex to the north.

Industrial mineral activities focussed on a granite dimension stone evaluation in the Medika area.

A pilot study was conducted in the vicinity of the Bernic Lake tantalum mine, to investigate the possibility of using vegetation geochemical surveys to detect tantalum-bearing pegmatites buried at depth. Limited data indicate that trunkwood, through routine element procurement, may reflect tantalum occurrences in the substrate and may, therefore, prove a useful medium to facilitate exploration for this type of rare-element-enriched pegmatite.

Interlake and Manitoba in General

Stratigraphic mapping along the lower Nelson River was carried out to examine Ordovician units from the Hudson Bay Basin. Recent drilling at the proposed Conawapa generating site suggests that all outcrops along the river are Ordovician; this contradicts earlier studies that showed a Silurian outlier within the Ordovician outcrop belt. Palynological analysis will be conducted to confirm or refute the current interpretation. The examination of these outcrops supplements core holes logged from Manitoba Hydro's other dam site investigations, including Limestone, Conawapa DX and Gillam Island.

In the Grand Rapids area, reconnaissance mapping of Paleozoic bedrock between William and South Moose lakes was augmented by 3 stratigraphic core holes, drilled to provide subsurface control and depths to basement. One hole intersected an unusual fracture zone, in the Red River Formation, that may indicate post-Paleozoic tectonism.

Further studies on the Devonian Winnipegosis reef structures were carried out at the Bluff on Dawson Bay, and at the Narrows on Lake Manitoba. Three holes were drilled at the Bluff, and 5 at the Narrows. Follow-up research is being conducted at these localities, by the universities of Regina and Manitoba, respectively.

Four core holes were drilled in the Gypsumville area, to help determine the areal extent of the Jurassic gypsum deposits and red bed sequences, as well as to extract further information from the Lake St. Martin Series and the Lake St. Martin Structure.

The ongoing evaluation of karst features in the Interlake was also centred this year on the Gypsumville area. A provisional terrain morphology classification was developed for those areas exhibiting karst landforms, and several of the caves discovered in 1989 were mapped in co-operation with members of the Speleological Society of Manitoba.

Industrial minerals activities included: an evaluation of high-calcium limestone in the Elm Point Formation at Steep Rock, Kinosota, and the Winnipegosis area; a preliminary inventory of gypsum and anhydrite in the Gypsumville area; and an initial assessment of dolomite in the Ashern Formation and the Interlake Group. A field trip was given for several organizations interested in development of the Wekusko dolomite. Nine sphagnum bogs in the Washow Bay area were assessed for potential as sphagnum peat producers; 5584 ha, containing an estimated 96.63 million m^3 of sphagnum peat were delineated. The 1841 ha Daves Lake bog contains high quality sphagnum to a depth of 4 m, and has estimated reserves of 64.4 million m^3 of peat.

An increasing commitment to sustainable development initiatives has prompted the Branch to engage in co-operative work with several agencies, most particularly the Department of Natural Resources. The fundamental linkage between the surface and subsurface environments, and past and ongoing geological processes, places the Geological Services Branch in an ideal position to make substantive contributions to an enhanced and informed environmental awareness.

This summer, the newly formed Terrain Sciences Unit embarked upon an investigation of the Holocene history of the Red River Delta, and the modern-day geological processes operating at the south end of Lake Winnipeg. To investigate the provenance of the barrier islands, 124 sediment samples were collected; 15 samples of peat and organic-rich silt and clay were collected for radiocarbon dating, to determine the rate of shoreline recession and crustal warping.

A joint project with the Water Resources Branch was initiated, at a small site in the Rossburn area, to investigate the composition of tills and their effect on groundwater chemistry. Cores from 10 wells, and data from 48 piezometers, were provided by the Manitoba Hazardous Waste Corporation. Till and bedrock samples (550) will be analysed, principally for elements of concern in drinking water quality.

ONTARIO MINISTRY OF NORTHERN DEVELOPMENT AND MINES
MINES AND MINERALS DIVISION
ONTARIO GEOLOGICAL SURVEY

Introduction

During 1989–90, the Ontario Geological Survey (OGS) carried out detailed, regional and province-wide geoscience studies. Locations of field projects carried out during 1990 are shown on Figure 1. Many projects were undertaken in co-operation with Mines and Minerals Division geologists, universities and private companies. The Ministry supported applied research projects at Ontario universities through the Geoscience Research Grant Program and other grants.

A major effort of the OGS continues to be the *Geology of Ontario* project. This project consists of geological and geophysical compilation maps and an accompanying volume, to mark the centennial of the OGS in 1991.

In 1989–90, a number of regional economic stimulation projects continued to be funded through the Ministry's Northern Development Fund, and by the Canada–Ontario Mineral Development Agreement (COMDA).

Precambrian Geology Section

The broad range of expertise within the Precambrian Geology Section allows for a team approach in carrying out projects that integrate bedrock mapping with mineral deposit studies. An outgrowth of this capability is specialized research on all aspects of the geology of the shield.

In 1989–90, work on the *Geology of Ontario* project continued. The production of 1:1 000 000 scale bedrock maps is now in the publication stage; the tectonic maps and "space-time" diagrams are being edited and reviewed. The development of these maps has given us a much better understanding of the tectonic and magmatic evolution of the Precambrian Shield in Ontario. This understanding gives us a base to undertake further studies in a complex geological environment.

Studies of the evolution of the Archean crust in the Abitibi belt in Ontario are continuing. Work in the Abitibi belt includes studies of granitic magmatism and structural and stratigraphic relations. The results of these studies will be used to model the development of analogous greenstone belts across the shield.

Documentation of the geology of Archean lode gold deposits within the Superior Province continues with work in the Hemlo, Missanabie–Renabie and Swayze areas, and in the Abitibi greenstone belt.

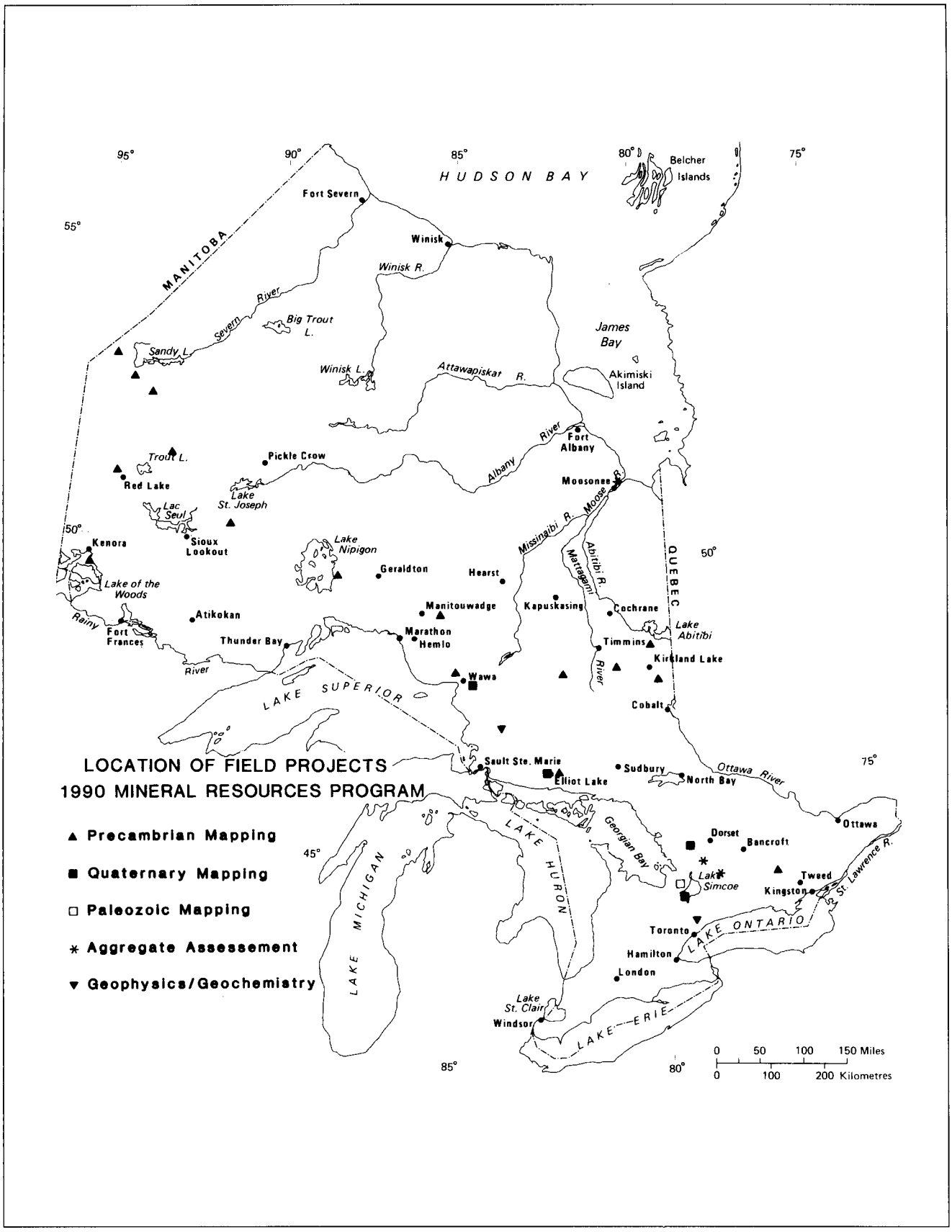


Figure 1. Distribution and types of programs in Ontario.

Amalgamation of the results of the gold studies will provide a more thorough understanding of gold mineralization.

A diverse program of bedrock mapping, from 1:10 000 to 1:50 000 scale, was carried out across the province. Included in this program were reconnaissance studies in the poorly described Berens River Subprovince and detailed mapping in the Uchi, Wabigoon, Abitibi, Southern and Grenville subprovinces. These mapping projects provide basic geoscience information for the mineral exploration industry, and upon which the Section's future activities are planned.

Work continued on the development of the field-based, portable computer mapping software, OGS FIELDLOG. This technology is applicable to all varieties of mapping and data collection.

Joint research activities, which combine special techniques and the expertise of outside institutions with the geological expertise of the Section, are used to address specific problems in shield geology. An ongoing relationship with the Jack Satterly Geochronology Laboratory of the Royal Ontario Museum continues to provide high quality geochronological data with which to better constrain models of the evolution of the shield. $^{40}Ar/^{39}Ar$ techniques, used by the Department of Physics, University of Toronto, and the geologic knowledge of the Section have been joined to facilitate the interpretation of the Precambrian crust's thermal evolution, and to better understand the timing of the deformation of greenstone belts. Applications of remote sensing to geology, carried out in collaboration with the Ontario Centre for Remote Sensing, include the construction of an integrated geoscience data base for part of the Michipicoten greenstone belt near Wawa. The response of different terranes to different satellite and airborne imagery is also being examined. Similar applications are to be applied to the Sudbury area. Staff of the Section continue to be closely involved with the Canadian Lithoprobe program and with the Canadian Continental Drilling program proposal.

ENGINEERING AND TERRAIN GEOLOGY SECTION

Field investigations by staff of the Engineering and Terrain Geology Section were undertaken in 6 areas during the 1990 field season. Earlier in the year, a number of winter drilling projects were completed.

Staff from all units of the Section made significant contributions to the first joint meeting of the Canadian Quaternary Association and the American Quaternary Association at the University of Waterloo in June 1990, through posters, papers and field trip guidebooks and leadership. Section staff also contributed in the preparation of new maps and text for the *Geology of Ontario* project.

Paleozoic/Mesozoic Geology

Staff have initiated a new, multi-year mapping project of the Ordovician rocks in the Lake Simcoe area. This work will produce a major, bedrock data base on the quality of the strata for aggregate purposes. This project has been undertaken in conjunction with the Ontario Ministry of Transportation.

The investigation of neotectonic (stress-relief) features in southern Ontario is continuing with the preparation of a report covering the activities of the past 3 years in Prince Edward County.

Significant data from past projects were released during the year, including: a report on the gypsum deposits in the James Bay Lowland, and a review of the oil-shale resources of the Marcellus Formation in southern Ontario.

Quaternary Geology

The Quaternary Geology Subsection continued its program of surficial mapping of the province at a scale of 1:50 000. Compilation of the Quaternary geology of Ontario, at a scale of 1:1 000 000, has been completed for publication as part of the *Geology of Ontario* project.

The multi-year project in the Barrie–Elmvale area continued; overburden drilling and sampling were undertaken to complement the previously completed mapping of the surficial sediments. These investigations are establishing the distribution, stratigraphy and glacial history of surficial materials and will assist planning studies attempting to reach a balance between urban-industrial growth and environmental concerns.

In northern Ontario, a mapping and drift sampling project was initiated in the Wawa area. Interpretation of results from overburden drilling and sampling projects in the Fort Francis–Rainy River and the Matheson areas continued. Data resulting from the Matheson area Quaternary sampling program are now available on diskette. Data from the completed overburden sampling project in the Kirkland Lake area (KLIP) are also now available on diskette. All of these projects will provide a geological inventory of the respective areas, and will aid in the development of effective drift exploration strategies by documenting the glacial stratigraphy and the generation of geochemical data bases.

In the Huntsville–Bracebridge area, a new mapping project, jointly funded by the Ministry of Northern Development and Mines, the Ministry of Natural Resources and the District Municipality of Muskoka, will seek to identify elements of Muskoka heritage, in particular, unusual examples of geological history, landscapes and areas of outstanding scenic value. The mapping will also contribute basic data on the distribution and character of Quaternary deposits.

Aggregate Assessment

The staff of the Aggregate Assessment Office continued their work in southern Ontario with investigations concentrated in Victoria, Peterborough and Haliburton counties. In northern Ontario, a new project was initiated in the Moosonee area, where information concerning aggregate resources is lacking and good quality aggregate supplies are not readily available. This project was jointly funded by: the Ministry of Northern Development and Mines, the Ministry of Natural Resources, the Ministry of Transportation, local organizations – the Moose Band Development Corporation and the Moosonee Area Development Board, private sector companies – James Bay Travel Ltd. and M.J. Labelle Co. Ltd., and the Ontario Northland Railway.

GEOPHYSICS–GEOCHEMISTRY SECTION

Geophysics Program

A project has been undertaken to compile all of the aeromagnetic data for Ontario into a continuous grid of total magnetic field, sampled at 200 m intervals. A new method, which utilized the existing Geological Survey of Canada (GSC) compilation sampled at 812.8 m, was applied to level the various survey blocks together. The products of this project include colour and/or shaded relief maps of the total field, at 1:1 000 000 scale, and daughter products, such as first vertical derivative maps. All of these products will be included in the *Geology of Ontario* volume, but the total-field shaded relief and first vertical derivative maps will be available before the publication of *Geology of Ontario*.

An interpretation of gravity data, recently acquired over the Kirkland Lake–Matheson–Iroquois Falls area of the Abitibi greenstone belt, has begun. Approximately 5000 gravity stations were established over 3 field seasons. This study, to map and define the deeper geological, lithologic and structural characteristics of the belt, based on the gravitational field, will improve our understanding of the evolution of the belt and its associated mineral deposits.

A research program to investigate improved methods of overburden sounding continued in 1990. Improved methods for objectively identifying layering and overburden materials are considered timely. This is due to increasing environmental and land use planning pressure with respect to groundwater resource conservation, waste management, subsurface excavation, and site investigation in populated areas of the province. The objective of the current project is aimed at improving practical methodology for shallow seismic reflection surveying, and data presentation, for conditions typical of southern Ontario

subsurface environments. Recent advances in shallow electromagnetic sounding methods are being tested for areas which exhibit complex layering in the subsurface.

Five airborne electromagnetic-magnetic surveys, covering areas of high mineral potential, were initiated in 1990. Approximately 82 000 line-kilometres will be surveyed in the Birch Lake–Uchi Lake, Shebandowan, Partridge River, Benny, and Fort Hope areas. The results of the 5 electromagnetic-magnetic surveys conducted during 1989–90, namely the Batachawana, North Swayze–Montcalm, Shining Tree, Rainy River, and Sturgeon–Savant Lake areas, were released during 1990.

Geochemistry Program

During September 1989, lake sediment and water sampling was completed in the Hanes Lake area, a portion of the Batchawana greenstone belt. This represents the third phase of a 3-year project, carried out under the Canada–Ontario Mineral Development Agreement, to provide regional geochemical coverage of the entire Batchawana belt using a standardized methodology.

In December 1989, a full-sized, coloured, regional geochemistry map of the Trout Lake area of the Batchawana belt was released. In March 1990, a map covering the Herman Lake area near Wawa was released. Three maps, covering the Hanes Lake, Pancake Lake and Montreal River areas of the Batchawana belt, are in preparation. With the release of these maps, the entire geochemical data base for each map area is available, on request, on diskette. These data bases are structured so that they can be input directly into a spatial (geographical) information system.

The planning and design of a mobile laboratory unit (MLU) was started in April 1990. The MLU will be designed to carry out methods research in the winter months and for routine analysis, at a rate of 100 samples per day, in the field during the summer. Designed to have a life of at least 10 years, the MLU will benefit the geochemical mapping program by having a quick turnaround of samples, higher quality of analyses for more elements of interest in mineral exploration, and a continuity of data during the life of the laboratory.

GEOSCIENCE LABORATORIES SECTION

The highlight of the year was Geoanalysis 90, An International Symposium on the Analysis of Geological Materials, organized by the Geoscience Laboratories Section and the GSC. During the 3-day meeting, papers were presented by scientists and technical experts from more than 16 countries, on topics including quality control and quality assurance, geostandards, methods development, and geoanalysis in the third world.

Methodologies used by the Geoscience Laboratories were published in 1990 as OGS Miscellaneous Paper 149. Also published was *An Introductory Guide to Sampling for Geoanalysis*.

A laboratory information management system (LIMS) was acquired in 1989. The customized LIMS software enables the Section to track samples more effectively, capture data directly from analytical instruments, and process results more efficiently.

Work has continued on the development of quantitative X-ray diffraction (XRD) techniques for the modal analysis of rock samples, powders and thin sections, and the determination of clay mineral identities and proportions. The Geoscience Laboratories Section's XRD system is equipped with a Peltier-cooled detector, which provides a significantly better peak-resolution compared to the conventional XRD equipped with a gas proportional counter.

The Section has continued to develop analytical methods involving robotic digestion of samples, automated colorimetric determination of chlorine in geological materials, and flow-injection determination of bismuth in geological materials.

Analysis for rare earth elements and yttrium, and high quality, sensitive determinations of hafnium, tantalum, rubidium, strontium, zinc, niobium and cesium, at levels of 200 ppb or lower, are in heavy demand by the client group. Continued refinement of the internal calibration scheme for the accurate and precise determination of thorium and uranium, at equally low levels, is ongoing.

Progress continues in the determination of the platinum group elements (PGE) by a nickel sulphide fire-assay method and ICP-MS techniques.

A number of co-operative projects were undertaken to develop applied mineral sciences capability, these include: 1) assistance in the formulation of geochemical analysis programs and preliminary interpretation of the data in support of the work in the Wawa area; 2) petrogenetic studies of the Keweenawan basalt sequence with emphasis on understanding the origin of mineralization associated with different alteration styles; 3) studies of the PGE potential of the Nipissing Diabase in relation to parental magma composition; and 4) determination and standardization of PGE abundances in the OGS standard reference materials using nickel sulphide buttons prepared in-house and analyzed at the University of Toronto, using ISOTRACE.

GEOSERVICES SECTION

The Geoservices Section consists of the Geoscience Information Services Subsection, the Publication and Cartographic Services Unit, and the Geoscience Data Centre.

Geoscience Information Services

The Geoscience Information Services Subsection provides an information and referencing service on the geology and mineral resources of Ontario. Clients have access to a comprehensive library of government reports and maps, geoscientific and technical texts and journals, and property reports submitted by the exploration industry.

A geoscience information officer is available to answer general geoscience inquiries from all sources, and to prepare general interest publications and displays on geoscience topics.

Publication and Cartographic Services

The Ontario Geological Survey has revised the format of some of its publications, implementing new, computerized publishing tools and streamlining its editorial processes. These changes are designed to meet the demand for faster release of geoscience information while offsetting the increasing costs of publication. As a result, the appearance of OGS reports, studies and maps has changed.

During the first year of operation, the new "fast-track" report and map publication format, which produces a typeset report and coloured map within 6 months of commencement of the editorial process, produced 10 reports totalling 1297 typeset pages and including 8 full-colour maps. A further 10 reports are scheduled for release by the end of 1990.

This work was carried out in parallel with the production of the three annual summary volumes (totalling 897 typeset pages), 16 open file reports, 20 preliminary maps, and 60 data files, and the beginning of work on the *Geology of Ontario* volume.

Geoscience Data Centre

The Geoscience Data Centre continued research and development work on the application of spatial (geographic) information system (GIS) technology to geological data, under the GEOSIS program. The first operational project resulting from this research and development work, the "Geoscience Exploration Data" project (GED), commenced in 1990.

The GED project, when completed, will provide a province-wide, index level, integrated, map-based information system for mineral exploration and mineral deposit files. Information from the GED project

will be accessible through any of the 15 Resident Geologists' offices in the province, in addition to the OGS.

GEOSCIENCE RESEARCH GRANT PROGRAM

In 1990, the Ontario Geoscience Research Grant (OGRG) program awarded 20 grants, totalling $500 000, to 8 Ontario universities. The grant program finances mission-oriented geoscience research in Ontario, research which complements but does not duplicate the activities of the OGS. Summaries of research for the 1988-89 grants were published as OGS Miscellaneous Paper 143, in December 1989. In addition, oral and poster presentations by OGRG recipients were presented during the annual Ontario Mines and Minerals Symposium, held December 11-13, 1989, at the Metro Convention Centre.

In 1989-90, 15 other geoscience research grants were funded, by the Ministry of Northern Development and Mines, through the OGS. Included in these grants is the Ministry's continuing support of the Jack Satterly Geochronology Laboratory at the Royal Ontario Museum.

MINISTÈRE DE L'ÉNERGIE ET DES RESSOURCES
GOUVERNEMENT DU QUÉBEC
SECTEUR "MINES"

Pour l'année financière 1990-91 l'objectif de base du ministre, en ce qui concerne le secteur Mines, est de promouvoir le développement de l'industrie minérale du Québec par un ensemble de mesures visant à appuyer l'initiative et le leadership du secteur privé, tout en s'assurant que l'exploitation des ressources minérales se fait selon les meilleurs intérêts des québécois. Plus particulièrement, il s'agit de:

1. stimuler les investissements privés pour le développement de nouveaux gisements, l'expansion des capacités de production existantes et la modernisation des usines de première transformation;

2. localiser la recherche et le développement sur des projets spécifiques répondant aux besoins de l'industrie et pouvant aider à consolider notre position concurrentielle et susciter le développement industriel à court et moyen termes;

3. contribuer au renouvellement des réserves domestiques pour les minerais de cuivre et de zinc et favoriser la diversification de la production minérale dans les régions du Québec par la stimulation de l'exploration minière;

4. assurer la promotion et la défense de l'amiante et, au niveau mondial, promouvoir l'adoption de législations visant un usage sécuritaire de ce produit.

Chacune des trois directions générales du Secteur "mines" répond plus spécifiquement à l'un ou l'autre des grands objectifs cites.

Depuis janvier 1990, la direction du Secteur mines et deux de ses directions générales (DGIM et DGEGM) occupent de nouveaux locaux, situés au 5700, 4e Avenue Ouest, à Charlesbourg, en banlieue de Québec.

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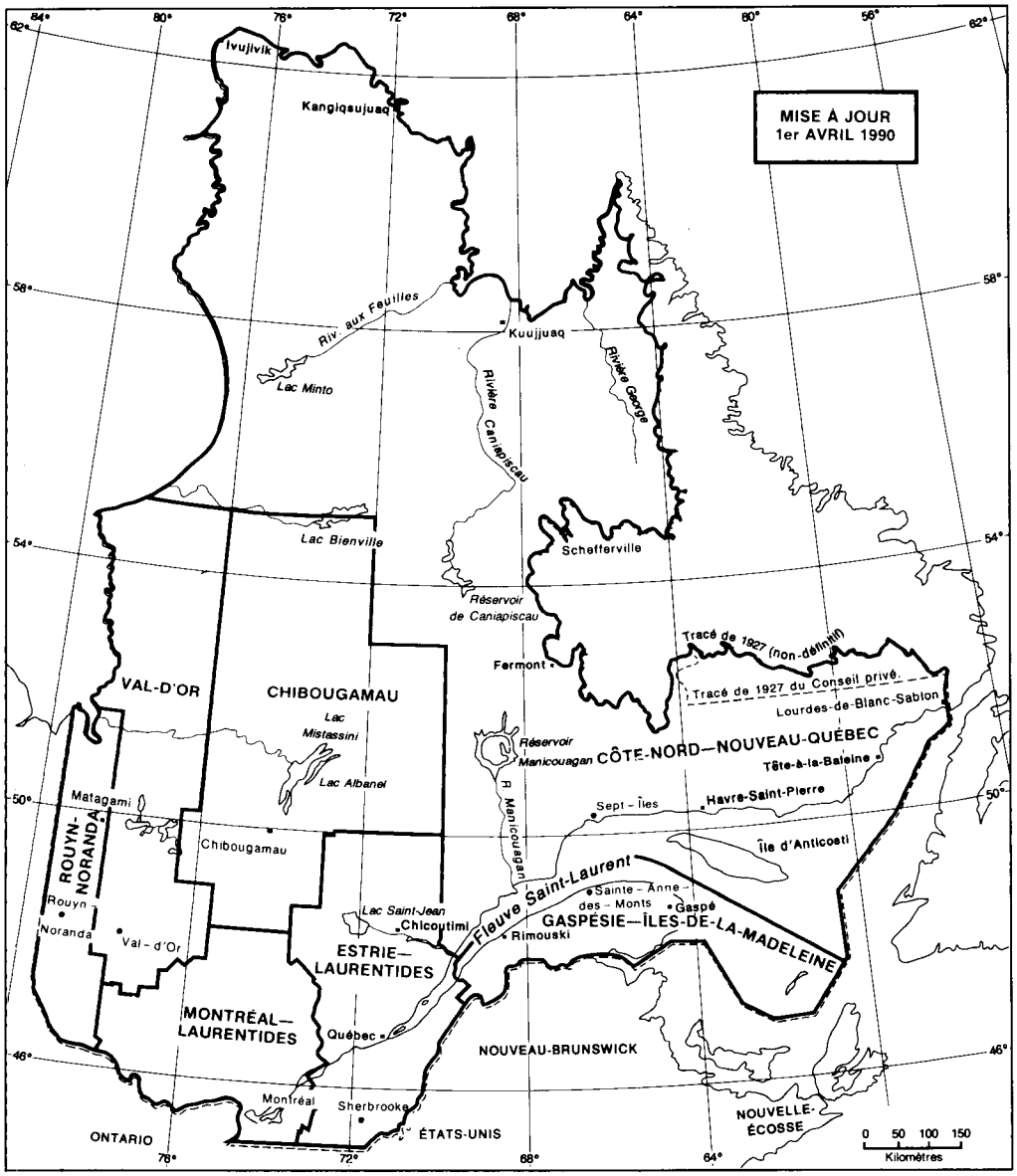

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LA DIRECTION GÉNÉRALE DE L'INDUSTRIE MINÉRALE (DGIM)

Le mandat de la DGIM est d'administrer les lois minieres, de tenir a jour les connaissances relatives au contexte fiscal, economique et reglementaire dans lequel evolue le secteur mineral et de favoriser la mise en valeur, l'exploitation, la transformation primaire et la mise en marche des ressources minerales du Quebec.

Le Service de la statistique et de l'économie minérale (SSEM)

Le SSEM a comme principaux objectifs de:

- fournir aux gestionnaires du MER-Mines et aux intervenants du secteur minéral des données statistiques fiables et récentes afin qu'ils puissent élaborer et appliquer des politiques économiques aptes à contribuer au développement de l'industrie minérale du Québec;

- analyser la situation et l'évolution de chacun des secteurs de l'industrie minérale du Québec en fonction de l'évolution des marchés mondiaux et de la concurrence internationale, de façon à en dégager les perspectives d'avenir, à éclairer l'élaboration des politiques sectorielles gouvemementales et à informer l'ensemble des agents économiques;

- étudier divers facteurs économiques et réglementaires qui ont une incidence directe sur l'environnement québécois dans lequel opère l'industrie minière et, de là, proposer des orientations et des programmes susceptibles de contribuer au développement de l'industrie.

En 1990-1991, le S.S.E.M. prevoit produire, outre les publications periodiques (La ressource minérale (en anglais et en français), L'industrie minérale du Québec, Bulletin d'économie minérale, série statistiques), diverses études portant, notamment sur le marché potentiel d'utilisation de l'amiante au Québec, le potentiel de marché de la wollastonite, l'impact de la TPS sur le secteur minéral, l'impact économique de l'industrie minérale ainsi que l'impact des législations et réglementations environnementales sur le développement de l'industrie minérale.

Actions accréditives

Le Gouvernement du Québec, dans le discours du budget du 6 avril 1990, a poursuivi sa politiaue fiscale d'encouragement à l'exploration par actions accréditives en prolongeant d'un an, soit jusqu'au ler janvier 1992, les allocations additionnelles relatives aux frais d'exploration engagés au Québec par des entreprises d'exploration n'ayant pas de bénéfices d'exploitation de ressources. Rappelons que les frais d'exploration définis comme "frais de surface" engagés au Québec par un particulier sont devenus admissibles, à compter de l'année d'imposition 1989, à une déduction de 166 2/3%; les frais souterrains de puits, rampes ou galeries d'exploration ou de forage sous terre demeurent valables pour une déduction de 133 1/3%. De plus, à compter de l'année d'imposition 1989, les frais d'exploration qui sont admissibles aux allocations additionnelles de 331/3% ou de 66 2/3%, selon le cas, n'entrent plus au calcul des pertes nettes cumulatives sur placements (PNCP) à l'impôt du Québec.

Loi sur les mines

L'Assemblée nationale du Québec a adopté, le 23 juin 1987, la Loi sur les mines (projet 161, 1987, chapitre 64) dont la mise en vigueur a été proclamée le 24 octobre 1988. Les mesures transitoires contenues dans cette loi prennent fin le 24 octobre 1990. Le projet de loi 77 modifiant la Loi sur les mines a été adopté le 16 octobre 1990.

Le permis de prospection est valide pour cinq ans; la période de validité du claim est portee à deux ans et il est renouvelable. La période de validité du bail minier est fixée à vingt ans et le délai pour commencer l'exploitation minière est de quatre ans.

Dans certains territoires du sud du Québec, l'acquisition des claims se fait par désignation sur carte; au nord du 52° de latitude, le titulaire d'un permis d'exploration peut enregistrer un claim sur tout le territoire (ou une partie du territoire) visé par son permis d'exploration.

Enfin, la loi assujettit certaines décisions du ministre à la possibilité d'un appel à la Cour provinciale ainsi que d'un appel, sur permission, à la Cour d'appel.

Droit sur les mines

Sommairement, la Loi concernant les droits sur les mines comporte les modalitàs suivantes (certaines mesures sont en vigueur depuis le 24 avril 1985):

- la réduction à 100% des frais d'exploration et de mise en valeur;
- une allocation pour déprédation de 30% du coût des actifs dépréciables;
- une allocation additionnelle de 331/3% de certaines dépenses prescrites;
- une allocation pour traitement égale à 8% ou à 15%, selon le stade de transformation, du coût des actifs dépreciables;
- le profit minier est assujetti à un taux fixe de taxation de 18%;
- les droits payables sont réduits d'un crédit annuel de 90 000 $. La partie inutilisée de ce crédit est reportable sur les trois exercices financiers ultérieurs;
- un crédit remboursable de 18% est applicable s'il y a perte. Ce credit est égal au moindre de 18% de la perte d'une année et de 18% des dépenses d'exploration, de mise en valeur et de la dépréciation déduites au cours de cette année;
- la partie d'une perte non admissible au crédit remboursable est reportable sur les trois exercices finanders antérieurs et les sept suivants.

LE CENTRE DE RECHERCHES MINÉRALES (CRM)

Le Centre de recherches minérales (CRM) fait partie intégrante du Secteur mines du ministère de l'Énergie et des Ressources. Sa raison d'être est de contribuer au développement des entreprises québécoises qui oeuvrent dans les domaines de l'exploration, de l'exploitation, du traitement et de l'utilisation des substances minérales. Sa mission est de développer et d'optimiser les procédés d'exploitation et de traitement des substances minérales, tout en offrant des services d'analyse minérale.

Au cours de l'année 1989-90, le CRM a poursuivi ses activités en répondant aux besoins de l'industrie minérale en matière d'application et de développement technologique. 11 a analysé plus de 41 000 échantillons qui ont nécessité environ 830 000 déterminations, dont le coût total s'est élevé à quelque 1,6 million de dollars. L'industrie minérale a aussi commandité des projets afin de solutionner des problèmes reliés à l'analyse. En minéralogie appliquée, la majeure partie des travaux consistait en des études de caractérisation des éléments et minéraux dans des substances minérales ainsi que des études pétrographiques. Le CRM a poursuivi ses efforts en vue de robotiser la préparation des échantillons destinés à l'irradiation avec l'aide du Centre specialisé de robotique Lévis-Lauzon.

En traitement des minerais, l'année 1989-1990 représente un sommet pour le CRM en ce qui concerne la valeur des projets qui nous ont été confiés par des entreprises. En effet, des travaux d'une valeur de plus de 3,6 millions $ ont été réalisés dans le cadre de plus de 130 projets commandités par les clients du secteur minéral. Ced représente une augmentation de plus de 30% par rapport au sommet précédent établi en 1986-1987.

Les projets reliés au traitement des minéraux industriels et à la récupération secondaire de rejets d'usine ont répresenté plus de 75% des activités de la dernière année, soit une valeur de 2,7 millions $. Cette situation reflète une modification importante dans la nature des demandes de notre clientèle, par rapport aux années precédéntes.

Dans le domaine des minéraux industriels, la croissance des activités s'est poursuivie pour une troisième année, la valeur des projets en commandite aneignant près de 1,5 million de $. Encore une fois cene année, la grande majorité des projets concernaient la mise en valeur de gisements de graphite et le traitement des rejets d'amiante. Des travaux exhaustifs ont été effectués sur deux gisements de graphite en paillenes de la région de Fermont et de la région de Mont Laurier. D'autre part, le projet Magnola, qui vise à produire du magnésium métallique a partir des rejets d'amiante de la région d' East-Broughton, s'est poursuivi par l'essai en usine-pilote du procédé de purification du chlorure de magnésium provenant de la lixiviation des rejets d'amiante.

En récupération secondaire et environnement, de nombreux projets ont été effectués au cours de la dernière année. Citons, entre autres, l'essai à l'échelle pilote d'un procédé de récupération de l'argent de résidus provenant de la production du zinc. Le procédé, conçu au Centre de technologie de Noranda, a été éprouvé et modifié pour l'adapter aux exigences industrielles. Dans un autre domaine, un procédé a été mis au point en laboratoire pour séparer le carbone de rejets provenant de la production d'aluminium.

Un autre domaine où les projets en commandite ont progressé en 1989-1990 est le contrôle des procedes de traitement et de transformation des minerais. L'application des techniques modernes, reliées à l'informatique, est un moyen rempli de potentiel pour améliorer la productivité des usines et les industries québécoises du secteur minéral y recourent de plus en plus. Au cours de la dernière année, des études ont été réalisées dans les domaines suivants: le broyage et la classification des minerais d'or, le sciage du granit, la cuisson des boulettes de minerais de fer et la réduction directe des minerais de fer.

La demande provenant de notre clientèle québécoise, des secteurs du traitement des minerais de fer et des métaux précieux, a été moins élevée qu'au cours des anneés antérieures. Par contre, plusieurs projets ont été réalisés pour des clients en dehors du Québec.

En technologie minière, en 1989-1990, le CRM a réalisé 31 projets commandités pour une valeur de 382 000 $. Avec la participation financière de partenaires québécois, il a commandé la rédaction d'un guide des techniques d'évaluation des gisements d'or. 11 a organisé en novembre 1989, la semaine de la technologie minière au Cégep de l'Abitibi-Témiscamingue à Rouyn-Noranda.

Le CRM collabore au programme canadien (12,5 M$) de neutralisation des eaux de drainage dans l'environnement minier (NEDEM). 11 allouera chaque année un montant de 400 000 $ à ce programme, jusqu'en 1994. Trois projets de recherche présentes par le CRM ont été acceptés et concernent trois sites differénts dont le parc à résidus Waite-Amulet et celui de Solbec-Cupra.

En 1989-1990, le CRM a amorcé une période de réflexion qui débouchera à l'automne 1990-1991 sur la déposition d'un plan quinquennal de réalisation contenant des orientations stratégiques renouvelées.

DIRECTION GÉNÉRALE DE L'EXPLORATION GÉOLOGIQUE ET MINÉRALE (DGEGM)

L'année financière 1990-91 est, comme l'année précédente, marquée par un haut niveau d'activités en acquisition de connaissances géoscientifiques et par la consolidation du programme d'assistance financière à l'exploration minière. En 1990-91, seul le programme d'assistance financière bénéficie du prolongement d'un an de l'entente auxiliaire Canada-Québec sur le développement mineral.

La DGEGM consacre plus de 9,9 millions de dollars sur le volet "acquisition de connaissances" et un montant de 7,3 millions de dollars est consacré à des programmes d'assistance financière à l'exploration ainsi qu'à la préparation et à la diffusion de la geoinformation.

Direction de la recherche géologique (DRG)

La direction de la recherche géologique (DRG) a pour mandat d'étendre et de raffiner la connaissance géologique de base du territoire afin d'en arriver a l'identification de zones à potentiel minéral elévé.

Pour la mise en oeuvre de ses programmes, la DRG a recours à deux services géologiques (Nord-Ouest et Québec).

Service géologique de Québec (SGQ)

Le Service géologique de Québec dessert les deux tiers du territoire québécois dont les Appalaches, les Basses Terres du Saint-Laurent, la majeure partie du Grenville et l'ensemble du territoire du Nouveau-Québec reposant au nord du 55^{e} parallèle. 11 gère quatre bureaux régionaux, animé chacun par un géologue résident, alors que métallogénistes, géologues régionaux, géophysiciens et géochimistes, ainsi que le personnel de la Division des minéraux industriels sont regroupés au bureau de Charlesbourg.

Au cours de 1 'année 1990-1991, le Service géologique de Québec disposait d'un budget de 3,9 millions de dollars pour la réalisation de 30 projets de terrain et l'achèvement de 17 autres projets entrepris l'année précédente. Le budget global est réparti entre quatre divisions régionales, correspondant aux districts régionaux, et une division thématique.

La Divlsion Côte-Nord/Nouveau-Québec dispose d'un budget de 1,5 million de dollars, dont 116,4 K$ ont été consacrés à la Fosse de l'Ungava, 564,1 K$ à la Fosse du Labrador (incluant son avant-pays et son arrière-pays) et 805,4 K$ à la Côte-Nord. Aucun travail de terrain n'a été poursuivi dans la région de la Fosse de l'Ungava, mais les efforts ont porté sur l'achèvement des études destinées à mieux définir le potentiel économique du territoire couvert entre 1983 et 1988, à optimiser les données recueillies et à continuer la préparation d'un mémoire. Pour la Fosse du Labrador et les territoires adjacents à l'est et à l'ouest, les travaux ont consisté en recherches métallogéniques destinées à la préparation d'un mémoire qui doit etre réalisé au cours de l'automne 1991. Pour la seconde année consécutive, le budget alloué à la Côte-Nord, incluant la région de Fermont, a considérablement augmenté, passant de 516,7 à 805,4 K $, et porte sur la continuation des levés au 1:50 000 aux environs de Forestville et de Fermont ainsi que sur la réalisation d'un léve géophysique aéroporté dans la région de Fermont.

La **Division Montréal-Laurentides** compte sensiblement sur le meme budget que l'année dernière (384,7 K $). Les projets de cartographie déjà entrepris dans la région de Thurso se sont poursuivis et un projet de télédétection par images radars et landsat, portant sur les grands corridors de déformation, a été entrepris. Une étude des indices de métaux et de minéraux est aussi en cours.

Pour tenir compte des revendications de la clientele, émises lors du Sommet Beauce-Appalaches, les travaux préconisés sur le territoire de la **Division Estrie-Laurentides** ont été l'objet d'une réorientation majeure par rapport aux années passées et son budget a été augmenté sensi blement, passant de 757 K $ à 975 K $, dont la majeure partie sera dépensée sur le territoire de l'Estrie et de la Beauce. Environ 150 K $ serviront à définir le potentiel minéral et à cartographier le segment du Grenville compris entre les rivières Saint-Maurice et Saguenay, en incluant la région au nord du lac Saint-Jean. Le rythme des travaux de cartographie au 1:20 000 maintenu depuis quelques années a été ralenti et la réalisation de levés géophysiques héliportés sera entreprise incessamment. Ces travaux constituent la première phase d'une programmation quinquennale visant à mettre l'accent sur la réalisation de levés géophysiques aéroportés et à compléter la couverture géologique au 1:50 000, particulièrement dans les régions dont le potentiel économique semble vouloir se confirmer, tant dans le Grenville qu'en Estrie-Beauce.

Depuis près de quatre ans, l'ensemble des travaux géoscientfiques réalisés en Gaspésie par la **Division Gaspesie/Les Îles** sont répertoriés, compilés, analysés et réinterprétés dans le but d'optimiser l'information déjà disponible et de réaliser une nouvelle couverture cartographique au 1:50 000 et au 1:250 000. Les premiers feuillets de cette nouvelle série devraient être disponibles sous peu. Les travaux de terrain entrepris sont à caractère gîtologique et visent à mieux définir le potentiel mineral des principales structures le long desquelles se retrouvent la plupart des indices minéralisés mis à jour sur ce territoire. Quelque 442 K $ y seront consacrés.

La Division des mlnéraux Industrlels, de la tourbe et des matérlaux de constructlon dispose d'un budget de 357,9 K $ pour la réalisation d'inventaires des sources de granulat, de tourbe, de silice, de calcaire, de dolomie, de granit architectural et de wollastonite. De plus, dans le but de faire connaître le potentiel québécois pour diverses substances spécifiques, le personnel de cette division a continué à rédiger une série de mémoires sur l'apatite, les silicates d'alumine, les argiles, les schistes argileux et le marbre.

Service géologique du Nord-Ouest

Le Service géologique du Nord-Ouest (SGNO) dessert le Nord-Ouest québécois. Les divisions de Rouyn-Noranda, de Val-d'Or et de Chibousamau, chacune animée par un géologue résident, sont logées dans les bureaux régionaux des mines. Le personnel de la Division des gîtes minéraux et celui de la direction du service sont regroupés dans le bureau de Val-d'Or. Soulignons qu'au cours de l'année, un géophysicien et un géochimiste se sont joints au service.

Au cours de l'exercice 1990-1991, le SGNO a consacré un budget de 3,5 millions de dollars à la réalisation de 26 nouveaux projets et à la finalisation de 12 projets entrepris l'année précédente. Les nouveaux projets comprennent sept études gîtologiques, six études thématiques, trois synthèses géologiques régionales ainsi que deux levés géologiques detáillés. On retrouve également, parmi les nouvelles initiatives, trois projets pilotes de compilation géologique supportés par la géomatique.

Soulignons également la poursuite du projet-pilote multidisciplinaire d'évaluation du potentiel minéral de la région de Rouyn-Noranda mené par la Division des gîtes minéraux et supportes également par la géomatique. Trois projets de géophysique et un de géochimie figurent également au programme. Deux nouveaux projets synthèses ont été amorcés au cours de l'année. L'un de ceux-ci consiste en un projet de synthèse structurale portant principalement sur l'étude des corridors de déformation déformation: il est réalisé en étroite collaboration avec l'Université du Québec à Chicoutimi. L'autre consiste en une synthèse métallogénique (processus globaux) réalisée avec le concours de l'Institut de recherche en exploration minérale (IREM).

À la **Dlvlslon de Rouyn-Noranda**, une somme de 1,3 million de dollars a été consacrée aux activités géoscientifiques du district. Douze projets ont été réalisés parmi lesquels il faut compter un important levé géologique couvrant une partie de la zone tectonique de Porcupine-Destor. Le SGNO a été particulierément actif dans le secteur de Témiscamingue y réalisant de nombreuses datations (U-Pb) et un important levé géochimique (sédiments de ruisseau). Ajoutons enfin que 100 K$ ont éte consacrés à la poursuite des activités de Lithoprobe dans le Groupe de Blake River et dans le Groupe de Pontiac.

Quant à la **Division de Val-d'Or**, une somme de 1,1 million de dollars a été requise pour la réalisation de cinq projets. Parmi les principaux, on compte deux importants levés géologiques (1:20 000) dans les secteurs de Senneterre et de Vezza-Bruneau-Grevet au sud de Matagami. Soulignons également qu'une étude métallogénique du secteur de Louvicourt, où se trouve l'important gisement de métaux usuels découvert par Aur-Louvem, a été amorcée par la Division des gites minéraux.

Pour ce qui est de la **Division de Chibougamau**, une somme de 973 K$ a été consacreé à la réalisation de sept projets. Parmi ceux-ci, mentionnons le levé électromagnétique héliporté de la demi-sud du feuillet 32 G/16 qui permet de compléter la couverture du complexe du lac Doré contenant plusieurs gisements. Soulignons également la réalisation de la phase finale du levé géologique de la

bande Caopatina-Desmaraisville contenant les gisements du lac Shortt et Joe Mann et qui fut amorcé il y a six ans.

Directlon de l'assistance à l'exploration minière (DAEM)

Le mandat de la DAEM est de fournir une assistance à l'industrie de l'exploration minière grâce au traitement, à la gestion et à la diffusion de l'information géoscientifique et grâce à la gestion de certains programmes d'assistance a la prospection et a l'exploration minière.

Service de la géoinforamtion

Le ministere a complete l'analyse preliminaire de son système d'information géominière (SIGÉOM). La realisation de cette analyse constitue l'aboutissement d'un long processus entrepris il y a trois ans. Trois projets pilotes relies à la saisie et la gestion des informations recueillies sur le terrain, à la préparation de cartes des gîtes mineraux et à la mise à jour des cartes de compilation géoscientifique ont été realises. Les resultats obtenus de ces projets confirment les solutions proposées par l'analyse preliminaire. Fort du savoir-faire acquis avec les projets pilotes et muni des avis et des recommandations de l'analyse preliminaire, le ministère est prêt à entreprendre, dans l'année en cours, l'implantation de SIGEOM. Au cours de l'exercice 1989-1990, le Service de la geoinformation a édité et mis à la disposition du public 112 nouveaux documents geoscientifiques produits par le ministère, ces documents comprennent 46 cartes et sont diffuses par la Division des donnees géoscientifiques.

Division des données géoscientifiques

La nouvelle Division des données géoscientifiques (DDG) regroupe les activités du Centre de diffusion, de même que les activités ayant trait aux données sur les gîtes, aux cartes de localisation des travaux géoscientifiques ainsi qu'à l'information de nature promotionnelle et éducationnelle. Au cours de l'exercice 1989-90, la division a recu 676 nouveaux dossiers d'exploration minière soumis au Ministère en vertu de la Loi sur les mines. Plus de 2 500 dossiers ont été rendus publics. À cela s'ajoutent 136 nouvelles publications géoscientifiques découlant des travaux géoscientifiques du ministère.

Le Centre de diffusion a traité quelque 3 200 commandes et ainsi diffusé plus de 66 000 produits géoscientifiques pour une valeur de plus de 175 000 $. Plus de 80% des documents ont été diffusés au Québec, quelque 15% en Ontario et moins de 5% dans les autres provinces canadiennes et à l'extérieur du Canada. La division a privilégié la diffusion d'informations géoscientifiques sur support informatique (disquettes, cassettes et bobines). Une nouvelle version des croquis accompagnant les fiches de gîtes a été complétée. Ces fiches sont diffusées sur papier ou sur microfiches et sont disponibles dans la salle de consultation du Ministère à Charlesbourg ainsi que dans les 7 bureaux régionaux du Secteur mines. Une banque de données informatisees sur les gîtes a également été complétée et diffusée sur cassette. À cene banque sont incorporées les données sur les nouveaux gîtes et indices minéralisés de la province répertoriés dans la littérature géoscientifique. Cette banque permet également de produire rapidement des cartes de localisation des gites de la province. Les travaux de plus de 4 400 dossiers d'exploration minière ont été localisés sous forme manuscrite et la localisation des sondages et des périmetrès de plus de 1 100 de ces dossiers a été dessinée sur fonds polyester.

La division a coordonné la participation de la direction générale à une dizaine d'événements promotionnels tels des festivals, semaines des Sciences. etc. Plus de 35 000 personnes se sont documentées à son kiosque dont le thème est "La ressource minérale essentielle à notre qualité de vie". Trois affiches de la série "Géologie pour tous" (série GT) ont été réalisées. Ce sont: "Les tourbières du Québec", "La formation des tourbières" et "Le Mont Saint-Hilaire. Une quatrième affiche portant sur les Basses-Terres du Saint-Laurent a été planifiée.

Une entente a été conclue avec le gouvernement fédéral concernant l'échange de données bibliographiques (banque GEOSCAN vs EXAMINE). Une politique révisée de tarification a été élaborée; son entrée en vigueur est prévue pour le 1 er janvier 1991.

Division des programmes d'aide à l'exploration

La Division des programmes d'aide à l'exploration a gere trois programmes d'assistance financière en 1990-1991. Ces programmes, qui font partie d'ententes fédérales-provinciales, sont:

1. Le programme d'assistance financière à la prospection dans la région du Bas-Saint-Laurent et de la Gaspesie.

2. Le programme d'assistance financière à la prospection minière en Estrie-Beauce.

3. L'assistance financière pour le soutien de l'exploration minière dans les communautés minières en difficuté.

Dans le cadre du programme de la Gaspésie, 100 prospecteurs ont bénéficié d'assistance financière et une dizaine de propriétés ont été amenées à des stades ou elles sont maintenant prêtes pour des campagnes d'exploration avancées.

Dans la région de l'Estrie-Beauce, sept subventions ont été accordees pour appuyer des projets d'autant de compagnies et vingt prospecteurs ont bénéficié d'une assistance financière pour effectuer des travaux sur leurs propriétés minières. Un programme de sensibilisation du milieu à l'exploraton qui cherche à favoriser l'implication de la population a été implanté avec l'aide de l'Assemblée de concertation et de développement économique de l'Estrie.

Dans le cadre de soutien aux communautés en difficulté, une subvention fut accordée à Explorations Noranda pour effectuer des travaux d'exploration en Gaspésie. Cette subvention vise à encourager la diversification et la découverte de nouvelles réserves qui assureront la survie de l'industrie minière en Gaspésie.

Un total de 3,1 M$ fut consacré à l'assistance financière à l'exploration en 1990-1991.

NEW BRUNSWICK DEPARTMENT OF NATURAL RESOURCES AND ENERGY MINERAL RESOURCES DIVISION GEOSCIENCE PROGRAM

Introduction

The present New Brunswick geoscience program comprises 27 projects; the Geological Surveys Branch conducts and funds 22 of these. The Canada–New Brunswick Cooperation Agreement on Mineral Development (MDA II: 1990–95), which was signed on September 12, 1990, after more than two years of negotiations, provided much of the funding.

Mineral Development Agreements

The final carry-over year of the Canada–New Brunswick Mineral Development Agreement (MDA I: 1984-90) involved financing of contract employee salaries comprises eight projects at a total cost of $1.5 million to the provincial treasury. Most of these projects began in 1989 and continued in 1990 with MDA II funding.

Highlights

L.R. Fyffe completed 1:20 000 geological mapping in the Moores Mills area of southwestern New Brunswick (A, Figure 1). The mapping resulted in a revision of the stratigraphic order of the Cookson Group. A new fossil locality indicated that the Digdeguash Formation, previously considered to be Silurian in age, is now assigned to the Ordovician Cookson Group.

A.G. Pronk and M. Parkhill continued surficial geology mapping and till geochemistry surveys in northern New Brunswick. Data on the tills from the Nepisiguit Lakes area (NTS 21 O/7) (B, Figure 1) are being prepared for publication. M. Parkhill is also mapping the surficial geology of the Bathurst (NTS 21 P/12) and Pointe Verte (NTS 21 P/13) areas (C, Figure 1) as part of the MDA Antinouri project.

A.G. Pronk carried out stream-sediment surveys in NTS areas 21 G/11, G/12, and G/14 (D, Figure 1). A.G. Pronk has also initiated a joint project with the Geological Survey of Canada in the 21 O/10 area (E, Figure 1). The project entails detailed sampling of stream silts, tills and vegetation to assess sampling and storage procedures and to evaluate the usefulness of such surveys in mineral exploration.

A.A. Seaman is conducting two projects; one comprises till mapping and sampling in the Canterbury (NTS 21 G/14) area (F, Figure 1); the other entails Quaternary mapping and till sampling in the Forest City (NTS 21 G/12) area (G, Figure 1). In the southwestern part of the Province, fourteen ice-flow events are recognized; however, many are of local extent. Striations and till fabric analyses suggest a clockwise rotation of ice flow over time from northeast through eastward to westward. Hence, tracing a till geochemical anomaly back to its bedrock source is a difficult problem.

M. Foisy and A. Seaman confirmed that the Central Plateau area of the Caledonian Highlands (H, Figure 1) was not a nunatak area during the Late Wisconsinan.

R. R. Irrinki and L. McNeill carried out a pilot project to develop a Geoscience Information System using locally developed Computer Aided Resources Information System (CARIS) software. The hardware for the system was purchased with funds provided by the New Brunswick Department of Commerce and Technology. The pilot project involved the digitization of geoscience data from the California Lake area (21 0/8) (I, Figure 1). The project successfully demonstrated that CARIS is an important resource management tool.

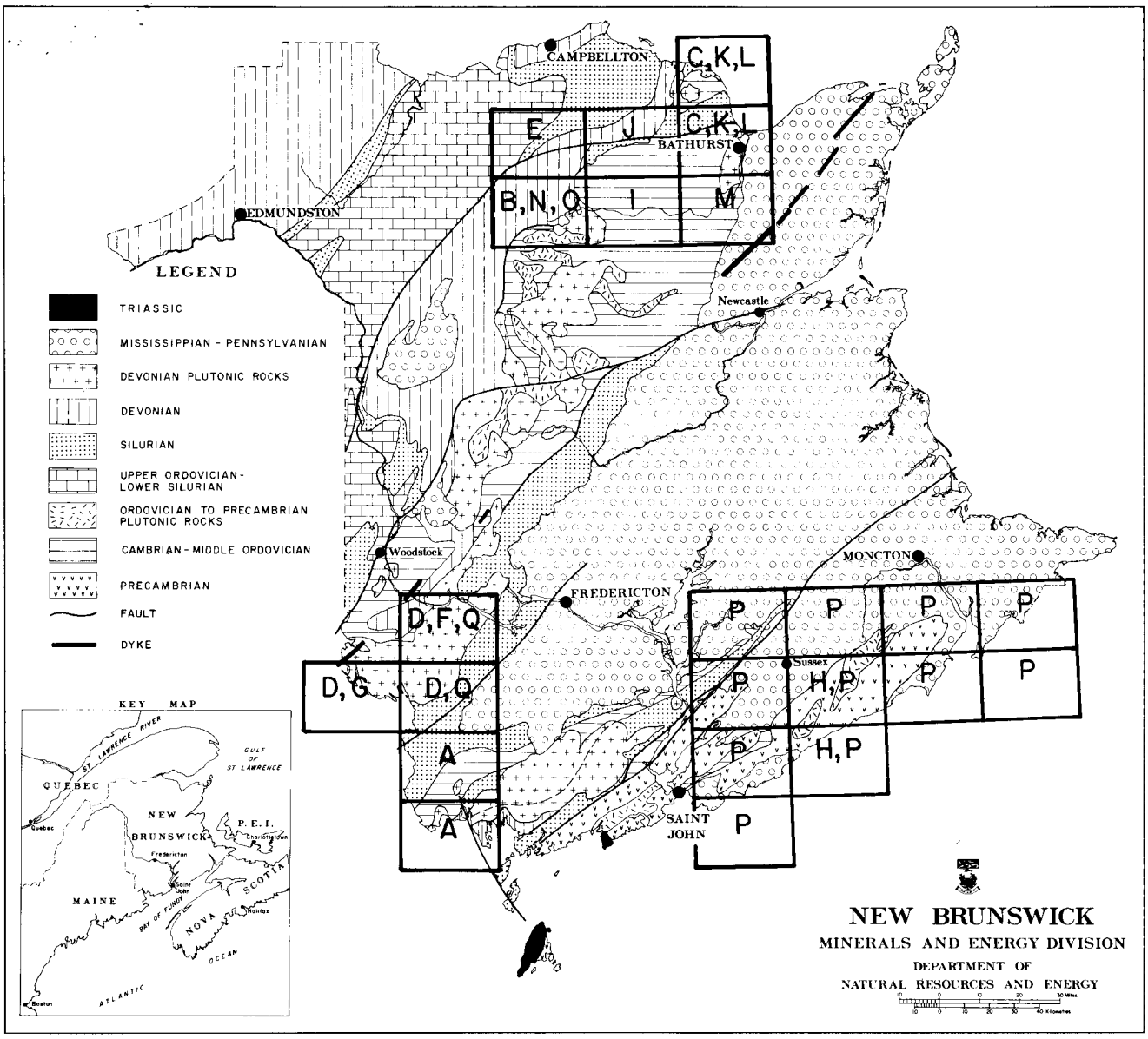

Figure 1. Geoscience program in New Brunswick.

A. Geological mapping, 1:20 000 scale - NTS 21 G/3, G/6
B. Surficial mapping and till geochemistry - NTS 21 O/7
C. Surficial geology - NTS 21 P/12, P/13
D. Stream-silt geochemical survey - NTS 21 G/11, G/12, G/14
E. Geochemical methodology study - NTS 21 O/10
F. Surficial geology - NTS 21 G/14
G. Surficial geology - NTS 21 G/12
H. Surficial geology - NTS 21 H/11, H/6
I. GIS pilot study - NTS 21 O/8
J. Murray Brook sulphide deposit - NTS 21 O/9
K. Mineral deposits - NTS 21 P/12, P/13
L. Antinouri Lake project - NTS 21 P/12, P/13
M. Brunswick project - NTS 21 P/5
N. Nepisiguit Lakes project, bedrock geology - NTS 21 O/7
O. Nepisiguit Lakes project, surficial geology - NTS 21 O/7
P. Geological compilation - NTS 21 H
Q. The Pokiok project - NTS 21 G/11, G/14

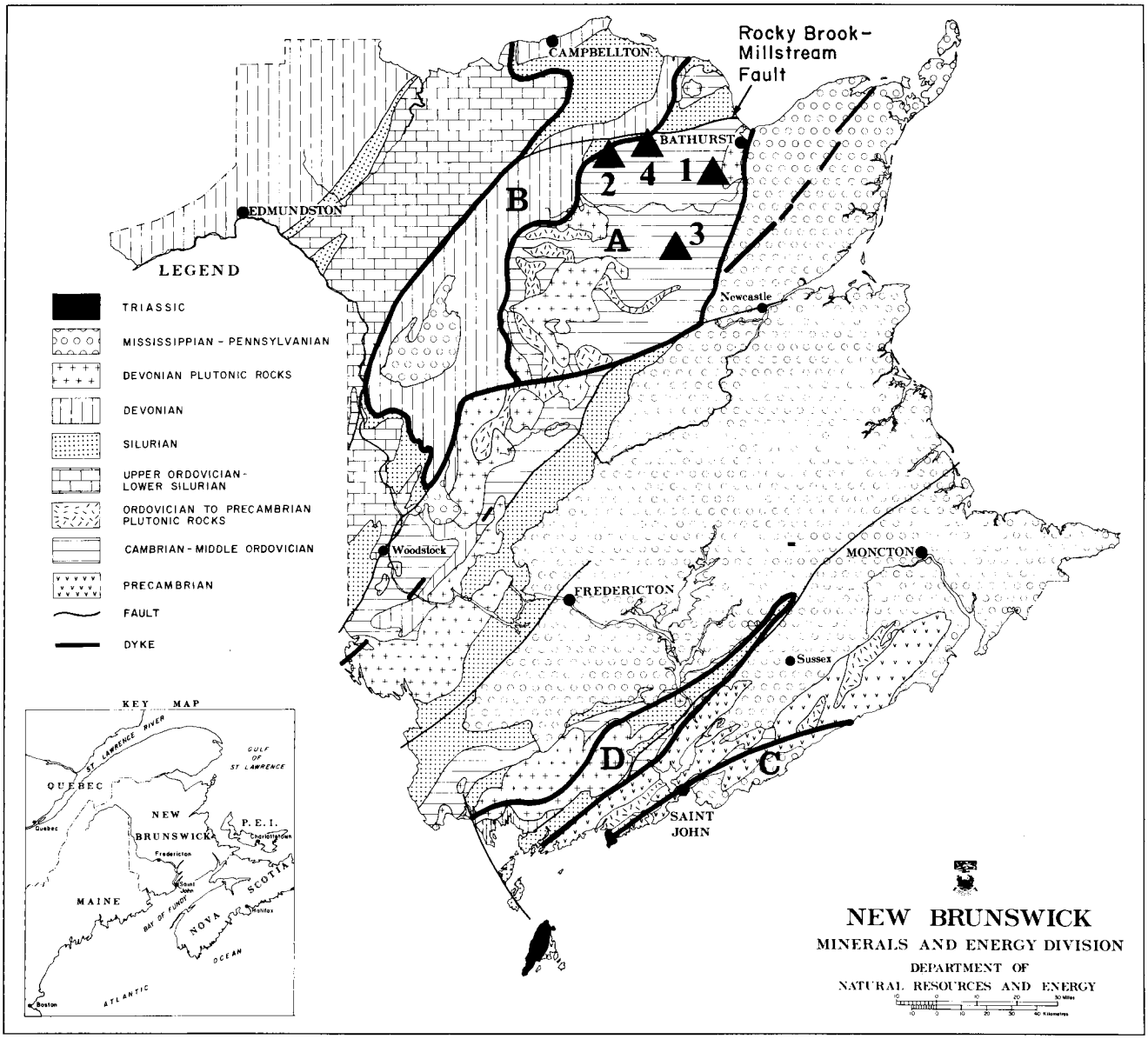

Figure 2. Mineral Exploration 1989:

A. Tetagouche volcanic complex (Bathurst–Newcastle camp)
B. Tobique–Chaleur zone
C. Bay of Fundy gold belt
D. Annidale–Nerepis belt
1. Brunswick No. 12 Mine
2. Murray Brook Mine
3. Heath Steele–Stratmat mines
4. Caribou Mine

P. Rennick mapped and compiled the available data on the Murray Brook zinc-lead-silver-copper sulphide deposit (J, Figure 1). It contains 23.6 million tons grading 1.95% Zn, 0.86% Pb, and 0.91 ounce Ag per ton, hosted by poly-deformed Ordovician sedimentary and volcanic rocks. The gossan that blankets the deposit is estimated to contain 1.67 million tons grading 1.47 ounce Ag per ton and 0.037 ounce Au per ton. Murray Brook Resources Incorporated is presently mining the gossan cap.

W.W. Gardiner, appointed Mineral Deposits Geologist in late 1989, is mapping several mineral occurrences in northern New Brunswick (NTS 21 P/12, P/13) (K, Figure 1) in association with the Antinouri Lake project (see below). He is also collecting till samples for heavy mineral analysis in granitic terranes of central and southern New Brunswick to help find new deposits of tungsten, tin and stibnite.

G. Crouse is updating the diamond-drill hole files from the core repositories in Bathurst, Fredericton and Sussex. He also expects to collect at least 20 000 m of additional core in 1990.

In northern New Brunswick, S.R. McCutcheon and his staff were involved in three major projects:

1. The Antinouri Lake project (L, Figure 1), conceived as part of the new MDA, is now into its second year. The work by S.R. McCutcheon and J. Walker entails 1:10 000 scale geological mapping in the complex Tetagouche and Elmtree terranes, and relogging of numerous drill holes to establish stratigraphy, structure, and the geological setting of the numerous mineral deposits.

2. The Brunswick project (M, Figure 1), under the guidance of J. Langton, will investigate the structure, stratigraphy and lithogeochemistry of the host rocks of the mined-out Brunswick No. 6 zinc-lead deposit. Preliminary results indicate that (a) the quartz-feldspar-augen schist (QFAS) is a rhyolitic lava rather than a pyroclastic flow, and (b) quartz-augen and chlorite schists are sedimentary rocks. This implies that the BMS No. 6 deposit is a distal type massive sulphide deposit.

3. The Nepisiguit Lakes project (N, Figure 1) is an integrated study to assess the mineral resource potential of the Mount Sagamook–Mount Carleton caldera. R.A. Wilson reports the area is underlain by subaerial volcanic and shallow-water sedimentary rocks of the Lower Devonian Tobique Group. The ratio of felsic to mafic volcanic rocks is much higher than in the adjacent Riley Brook area, which was studied earlier. No significant mineral occurrences were noted.

M.A. Parkhill mapped the surficial geology in the Nepisiguit Lakes area (NTS 21 O/7) (O, Figure 1) and collected 264 till samples for geochemical analysis.

In southern New Brunswick, M.J. McLeod, S.C. Johnson and A.A. Ruitenberg compiled the geology in the western part of NTS area 21 H (P, Figure 1), with emphasis on the regional correlation and the geological controls on the emplacement of epithermal mineral deposits. The results of this work will appear as a coloured geology map at a scale of 1:250 000.

The Pokiok project (Q, Figure 1), designed to study the geological controls governing the occurrence of stibnite, gold and tungsten-tin deposits, emphasized the geology of the Lake George stibnite mine. A.D. Roy and J. Todd recognized 3 main joint sets. One parallels the main vein system, a second trends northeasterly parallel to bedding, and the third parallels a system of lamprophyre dykes. The attitudes of the joint sets and the offsets along the fault are thought to be the results of south-directed thrust-wrench faulting.

D.G. Rose and S. McDonald located and described significant mineral occurrences in parts of NTS 21 H, 21 I, and 21 G. These data were used to update the New Brunswick computerized, mineral occurrence data base.

B. Carroll and S. Abbott edited 45 reports and 62 maps and supervised their publication. In 1989, approximately 540 reports and maps were released by the Mineral Resources Division.

Exploration

Base metals and gold dominated mineral exploration in New Brunswick in 1989. Good prices for zinc, lead, and copper sustained interest in the Bathurst–Newcastle camp (Figure 2) where several large deposits of these metals have been found over the past 38 years. As has been pointed out several times, these deposits, characterized by shallow depths, were relatively easy to find. The current challenge for exploration geologists in this region is to find similar, but blind (deep-seated) deposits. Since these deposits are likely to be below the depth that existing exploration technology can penetrate, the search will be guided by detailed geological mapping, such as that carried out during the 1984-89 Canada–New Brunswick Mineral Development Agreement. The benefits of this detailed work are already apparent.

In November of 1989, Brunswick Mining and Smelting Corporation Limited announced the discovery of massive sulphides 2 km north of its No. 12 mine (Figure 2). A drill hole, put down to test a prediction based on detailed geology, intersected 8.5 m of sulphides grading 9.91% zinc, 4.61% lead, 0.22% copper, 183.4 g/t Ag and 1.6 g/t Au, at a depth of approximately 1100 m. The discovery is directly linked to predictions made by C.R. van Staal of the Geological Survey of Canada who recently completed detailed structural mapping in the area.

Other highlights of the year included the opening of the Murray Brook gold mine, and the Heath Steele–Stratmat and Caribou base metal mines (Figure 2; 2-4).

Gold exploration continued to be strong and, again, was most intense in northern New Brunswick in the Tobique–Chaleur zone as well as along the eastern end of the Rocky Brook–Millstream Fault (Figure 2). In southern New Brunswick, the search continued in the Bay of Fundy gold belt and the Annidale–Nerepis belt (Figure 2; C and D, respectively).

NOVA SCOTIA DEPARTMENT OF MINES AND ENERGY GEOSCIENCE ACTIVITIES

INTRODUCTION TO THE DEPARTMENT

The Nova Scotia Department of Mines and Energy has a dual mandate to encourage research and development leading to enhanced documentation of mineral and energy resources and to promote their orderly regulation and use. In fulfilling these mandates, the Department is divided into the Mines and Minerals Branch and the Energy Branch. Three divisions in the Department, Mineral Resources and Mineral Development from the Mines and Minerals Branch and Energy Resources from the Energy Branch, administer geoscience projects.

Developing and Encouraging Geoscience Activities

Nova Scotia signed the Canada-Nova Scotia Cooperation Agreement on Mineral Development in August 1990. This new agreement provides $9 million over two years (1990-1992) to encourage the economic development of the mineral industry in Nova Scotia. Of this total, $3.2 million is budgeted for the Geoscience Program. The Department will spend $1.4 million over two years supporting the provincial geoscience projects.

GEOSCIENCE ACTIVITIES

A wide variety of geoscience activities are being undertaken by the staff of the Department. These projects can be categorized as follows: 1) energy resources studies; 2) metallic and non-metallic

mineral resources and deposit studies; 3) regional mapping; 4) geochemistry and Quaternary research; and; 5) services to industry and the public. Most of these activities are supported by the Cooperation Agreement.

Energy Resources Studies

Evaluation of the province's energy resources includes geological mapping onshore of coal, peat and oil shale deposits and monitoring offshore of private sector geological exploration for petroleum and natural gas. The Department, through the Energy Resources Division, is responsible for all petroleum and natural gas exploration monitoring and development activities onshore. It works in conjunction with the Canada-Nova Scotia Offshore Petroleum Board in administering offshore energy resources.

An onshore source rock study, consisting of a report and map, will be completed in the spring. The report will assist the oil exploration industry in their future exploration efforts by providing a significant geochemical database. Coal seam methane gas resources are being reviewed in Nova Scotia as future energy resources.

In the offshore, geologists from the Department are working with LASMO and Nova Scotia Resources Limited in the review and development of the Panuke–Cohasset oil fields adjacent to Sable Island. In another study, detailed work on the Jurassic carbonate bank that runs the length of the Scotian Shelf shows a potential for gas-filled fractured dolomite.

Coal resources in the western Cumberland Basin, Stellarton Graben and Cape Breton were part of a continuing program of regional mapping and coal seam investigations. In the Sydney coalfield, the Harbour Seam is the focus of detailed sedimentological study to define the influence of paleo-ground water on the distribution of peat bogs, mires and lakes. In addition, the Cooperation Agreement is funding a study of metals (major, minor and trace elements) in coal and coal petrography that will generate primary data about Nova Scotia coals.

Mineral Resources and Deposits Studies

Both metallic and non-metallic mineral deposits are being investigated to increase the knowledge and understanding of the mineral potential of Nova Scotia.

Studies of metallic mineral deposits have begun during the 1990 summer to document the Tangier gold deposit, the Gays River lead-zinc deposit and the tin and base-metal deposits in southwestern Nova Scotia. Carboniferous sediment hosted, copper-silver occurrences and deposits in northern Nova Scotia continue to be studied for their uniqueness and mineral potential.

A study of gypsum and anhydrite resources and additional uses is complete and the report will be published during 1991. Work on describing the occurrences and mineral potential of silica, barite, andalusite, mica and garnet continues.

Aggregate resources were investigated during the 1990 field season at many localities in the province. Bedrock samples of potential granular aggregate material have been sampled and are being analyzed. Some of the potential aggregate sites will be drilled before the next field season.

Regional Mapping

During the term of the Cooperation Agreement, the major regional mapping project will be in the Cape Breton Highlands. The recent interest in gold and base metals in the Highlands has generated considerable exploration activity. In an effort to understand the geological context of these mineral occurrences and deposits, the project will have concurrent bedrock and surficial mapping components. This work will build on the previous mapping and mineral investigations in the Highlands developed under the auspices of the Canada–Nova Scotia Mineral Development Agreement (1984-1989).

Smaller area investigations continue at many locations in the province to define the Mid to Late Devonian Acadian Event. This period of folding, metamorphism, deformation, plutonism and mineral deposit formation is crucial to the geological understanding of southern Nova Scotia.

Quaternary Studies and Geochemistry

Compilation of a thematic Quaternary geological map was started in the spring of 1987. The map will be published in 1991. Regional Quaternary mapping of mainland Nova Scotia and Cape Breton Island by the Geological Survey of Canada and the Department at scales of 1:100 000 and 1:125 000 is complete.

The follow-up geochemistry project is designed to document the geochemical "signature" of selected mineral deposits. Glacial till, soil, stream sediment and vegetation samples will be systematically collected to describe the geochemical characteristics of selected deposits. Canfield Creek Cu-Au and Yava Pb-Zn-Ag deposits were sampled in 1990.

Service to Industry and the Public

The Department maintains a regional office at Stellarton with a library, core storage facilities and core library. Over 500 000 m of core from industry and department drilling programs are stored here. Facilities are available at the Core Library for core study and sampling. Private sector exploration activities are monitored from this office.

Large databases including GEOSCAN are available for use. The information covers bibliographic data, mineral occurrences, drill hole information, geological and geophysical maps, and coal geology.

The Mineral Land Use Policy Development Project provides information needed to formulate policy ensuring the protection, conservation and proper management of energy and mineral resources. Mineral Resource Land Use (MRLU) maps and accompanying handbook are now available for most of central Nova Scotia.

The Education and Public Awareness Program promotes an understanding of the mineral resources and potential, geology and mineral industry in Nova Scotia. It is an essential part of the Cooperation Agreement and describes and promotes the programs and projects of the Agreement. Prospecting courses, displays, seminars, interpretive walks, publications, and educational materials for schools are part of the program.

CONCLUSION

The geoscience projects described here support and encourage mineral exploration and strengthen the province's mineral industry through the Canada-Nova Scotia Cooperation Agreement on Mineral Development. The steady production of industrial minerals, coal, aggregates, base metals and tin provides a stable and diversified mineral industry. This strong mineral industry coupled with a variety of geological environments makes Nova Scotia an attractive location for mineral exploration and development.

NEWFOUNDLAND AND LABRADOR
DEPARTMENT OF MINES AND ENERGY
GEOLOGICAL SURVEY BRANCH

Introduction

The Geological Survey Branch of the Department of Mines and Energy continued geoscientific studies at a reduced level, in 1989–90, following the end of the Canada–Newfoundland Mineral Development Agreement in March, 1990. Programs included bedrock geological mapping, geochemical and geophysical surveys, mineral deposit studies, Quaternary mapping, and information services.

Geological Mapping Program

The Branch's bedrock mapping program has the long-term objective of complete coverage of the island of Newfoundland at 1:50 000 scale, and of Labrador at 1:100 000 scale. That program, which has been underway since 1972, is slightly more than 50% complete.

Four mapping projects were active on the island of Newfoundland in 1990. Mapping of the Cambro–Ordovician carbonates on the west coast, which has been underway for some years under the direction of Ian Knight, was extended into the Bay of Islands area. Stratigraphy and faunal sequences, established earlier near the northern tip of Newfoundland, were recognized in this new area. The project also identified a non-dolomitized, fossiliferous carbonate section that spans the Cambro!Ordovician boundary.

In Notre Dame Bay, work continued on a project initiated in 1989 by Brian O'Brien, aimed at describing the stratigraphy and structure of the volcanic and sedimentary sequences in the area. The project discovered a number of new fossil localities which require changes in previously assigned ages, with major implications for the timing of terrane accretion and mineral potential assessment. New mineralogical indicators of hydrothermal activity in the pre-Caradocian Exploits Group were also discovered.

Two projects were carried out in the Gander–Avalon Zone boundary area. Pat O'Neill's mapping revealed ultramafic bodies in the eastern half of the Gander Zone. Bob Holdsworth mapped the Dover Fault, which is the contact between the two zones, in detail. His work revealed sinistral ductile shear at the eastern edge of the Gander Zone, associated with migmatization and Silurian granite emplacement.

Two mapping projects were carried out in Labrador. Don James, a new addition to the Labrador Mapping Section, led a major project in the western Grenville, while Bruce Ryan spent a shorter season examining the Nain anorthosite and associated rocks. The western Grenville project involved 1:100 000 scale mapping of parts of the previously defined Lac Joseph and Churchill Falls terranes. The work completes 1:100 000 scale mapping in this part of Labrador.

Field work in the Nain area has revealed that the Archean gneisses there are cut by at least four generations of deformed basic dykes, in contrast to the single generation farther north. Rocks previously mapped as part of the anorogenic Nain Plutonic Suite have been shown to be affected by a regional tectonothermal event. These findings require reassessment of previous interpretations of the geology and mineral potential of the Nain area.

Reconnaissance work along the northernmost Labrador coast, carried out by Dick Wardle in co-operation with Derek Wilton of Memorial University, confirms that reworked Archean rocks contiguous with those of Nain Province extend to the northern tip of Labrador. These rocks lie within the foreland zone of the Churchill Province, and are variably reworked in ductile shear zones.

GEOCHEMISTRY AND GEOPHYSICS SECTION

The Geochemistry–Geophysics Section is responsible for geochemical and geophysical surveys, geochemical data base management, and the geochemical laboratory.

Analysis of archived lake sediments for gold and related elements continued in 1990, under the general direction of Peter Davenport. Release of results for NTS map sheets 1 M, 12 A, and 1 N resulted in considerable new staking; 95 km^2 were staked on the Burin Peninsula following the release of the 1 M map sheet.

John Mcconnell and Pauline Honarvar continued their assessment of overbank (floodplain) stream sediment as a sampling medium for exploration. Areas of the Baie Verte and Springdale peninsulas were sampled.

In the geophysics area, Gerry Kilfoil led a project aimed at the production of a corrected, levelled and internally consistent aeromagnetic data file for the Island of Newfoundland and adjacent nearshore areas, using the existing GSC national aeromagnetic survey data. The gridded data files have been released by 1:250 000 scale NTS sheet, and are designed for image processing. A computer program named DISPLAY, for use with an IBM-AT–type microcomputer, is provided with the aeromagnetic data, enabling production of colour shaded-relief displays from the data.

The database management project, led by Jim Butler, is currently aimed at the collection, verification and documentation of geochemical data sets (stream and lake sediment, soil, till, and rock) from government surveys in the province. The goal of the project is to provide this data in readily usable digital form to users inside and outside the department. This project will be extended to encompass geophysical and geological data in digital form.

The geochemical laboratory, under the direction of Hank Wagenbauer, provides high quality analysis of geological materials. The laboratory this year again participated in the characterization of international reference materials from Canada, the USA and France. Reliable reference standards are becoming increasingly important in geochemical analysis, to permit proper comparison of data between laboratories.

MINERAL DEPOSITS SECTION

The Mineral Deposits Section is responsible for metallogenic studies, mineral deposit inventory and industrial mineral assessments.

Two metallogenic projects were active in the field in 1990. Dave Evans continued work on gold deposits in central Newfoundland, concentrating on gold and antimony prospects in the northeastern part of the Dunnage Zone. Documentation of the mineralogical, alteration and structural features of these deposits was achieved through detailed mapping and logging of diamond-drill core.

Field work was initiated on a new metallogenic project, aimed at evaluation of the rare metal potential of calc-alkalic and peralkaline intrusive and volcanic rocks in central and eastern Newfoundland. The project leader is Randy Miller, who has just completed a similar assessment of peralkaline intrusive suites in Labrador. As a result of this summer's reconnaissance work, areas of high potential have been identified in the King's Point Complex, the Cross Hills Complex, and the Bull Arm Formation; these will be the focus of more detailed examination in subsequent years.

The Mineral Inventory Project, under the direction of Cyril O'Driscoll, completed preparation of a new mineral occurrence map for NTS area 12 A. A microcomputer version of the mineral occurrence data will be available for display and sale late in 1990.

Two industrial mineral assessment projects were carried out in 1990. The first, under the leadership of Ambrose Howse, concentrated on carbonate rocks on the west coast of the Island, primarily those of

Carboniferous age in the northern part of the St. George Basin, and those of Ordovician age on the Great Northern Peninsula. Areas which appear to have good potential for development of limestone resources as aggregates and scrubbers have been identified.

The second industrial mineral assessment project, under Jamie Meyer, included an examination of surficial deposits in the Lake Melville area of Labrador, to evaluate the potential of titanium deposits in heavy mineral sands. Sedimentological models for surficial deposits in the area are being developed and potentially interesting deposits have been pinpointed. This project also continues to play an active role in encouraging development of dimension stone in northern Labrador (anorthosite) and in Newfoundland (pink and black granite), and of slate in eastern Newfoundland.

TERRAIN SCIENCES SECTION

The Terrain Sciences Section carried out a number of mineral aggregate assessment and Quaternary mapping projects in 1990.

Dan Bragg continued his assessment of potential bedrock aggregate sites in the Province. Ten sites with potential to supply bedrock aggregate were identified in the Great Mosquito Cove area of Bull Arm, where construction of concrete platforms for offshore oil exploration and development will take place. Abrasion, soundness, and alkali reactivity tests were completed on samples collected in 1989 along the south coast of Newfoundland; these tests indicate that six sites have excellent potential to supply the export market for concrete aggregate. The survey of bedrock aggregate sites along transportation routes was extended from the Gander area westward to the Baie Verte Peninsula, completing this survey for eastern and central Newfoundland.

Jerry Ricketts continued his assessment of granular aggregate resources in the Province, completing a survey of the Grand Falls–Bay of Exploits area in central Newfoundland.

Martin Batterson continued mapping of surficial deposits in the Gander area, defining two major directions of ice flow. Similar work in the Springdale area, by Dave Liverman, reveals a single major ice flow converging on Halls Bay, and considerable evidence of marine incursion. Striation mapping in the Notre Dame Bay area, by Lloyd St. Croix and David Taylor, part of an Island-wide reconnaissance program, has documented two main ice flow directions, east and north, with the northern flow deviating toward low lying areas near the coast.

INFORMATION SERVICES

Major publications in 1990 include a new geological map of the island of Newfoundland (the first since 1967), a reconnaissance surficial map of the island, an industrial minerals map of Newfoundland, and a metallogenic map of the pre-Caradocian of central Newfoundland. The Publications and Information Section also compiled a summary report on the 1984–1990 Canada–Newfoundland Mineral Development Agreement.

Results of the 1990 program will be released in preliminary form at the annual review of activities in November, in *Current Research* (Report 91-1), and in individual project reports.

INDIAN AND NORTHERN AFFAIRS CANADA
NORTHWEST TERRITORIES GEOLOGY DIVISION

During 1990, the NWT Geology Division carried on its provincial-type mineral resource-geology responsibilities. These included: monitoring developments in mining, mineral exploration, diamond drilling and geology, and reviewing technical assessment reports for mineral claims and Prospecting Permits – all required under the Canada Mining Regulations. As well, the Division conducted mineral deposit studies and geological mapping, and collected material and information to be made available through the Mineral Exploration Archive and the C.C. Lord Core Library. A 136-page field guide to selected mineral deposits of the Archean Slave Province was prepared for the International Association on the Genesis of Ore Deposits (IAGOD) Field Trip #13. This was published as Geological Survey of Canada Open File 2168. The field trip, which was directed by NWT Geology staff, was attended by 21 people from 9 countries on 5 continents.

Public releases during 1989 included: 26 open file maps and reports; an overview of mining, exploration and geological research; and a preview of 1990 mineral exploration. A list of all Division publications is available from the NWT Geology Division in Yellowknife; this list is regularly updated. Publications are also indexed in GEOSCAN, a listing that is updated yearly.

Geological studies were supported under 9 contracts: one to a consulting company, one to a private consultant, seven to Canadian universities, and one to an American university; these projects are listed in Table 1. In addition, the NWT Geology Division provided technical direction, logistical support and, in some cases, equipment, supplies and field personnel, to assist the Canada–Northwest Territories Mineral Development Agreement (CNWT MDA) projects described in Table 2. These projects were co-ordinated with the Geological Survey of Canada (GSC) MDA projects listed in Table 3.

Val Jackson, Project Geologist, completed mapping of the Kathawachaga Lake area (NTS 76 L). Other geological staff continued with geological studies on various topics, but the technical support requirements of the NWT MDA and the need to review many millions of dollars of assessment work, generated during the recent exploration boom, severely restricted progress on these studies.

The Canada–Northwest Territories Mineral Development Agreement progressed satisfactorily on most fronts in 1990. The field work for projects in the District of Keewatin were completed in the 1989 season.

Expenditures on the MDA Geoscience Program, administered by the NWT government, are included in the table – 1989–90 Review of Activities – (p. 28) showing expenditures by INAC for A-base NWT Geology Division Programs. Only the total expenditure for the Geological Survey of Canada administered portion of the MDA Geoscience Program is included. Considerable operational savings have been effected by the co-ordination of logistics and technical field support, particularly expediting, between MDA and A-base programs, and between programs administered by NWT Geology Division, the CNWT MDA and the GSC.

Results of the various MDA, NWT Geology Division and many GSC programs were also reported at annual Geoscience Forums in 1989 and 1990. The 1990 meeting was the 18th annual forum. These meetings take place in Yellowknife during the last week of November.

An Annual Report (1989) of CNWT MDA Geoscience projects was produced by the MDA office. This report gives details on the NWT MDA projects and includes summaries of MDA contract projects and GSC MDA projects.

Table 1. 1989–90 Geological Contracts.

Advisor, University	Description	Student, Degree
1. D. Kerr, Environmental Consulting Services, Alberta	Reconnaisance-scale surficial geology of the Yellowknife River Basin	
2. S.A. Bowring, Washington University of St. Louis	Geochronological studies in the Slave Province and mapping related to geochronological sampling, mainly in the Yellowknife area	C. Isachsen, Ph.D.
3. H. Helmstaedt, Queen's University	Mapping and studies of sheeted dyke complexes in the KAM Group and sub-KAM stable shelf association, Yellowknife volcanic belt (NTS 85 J/9, 85 J/16)	
4. G. Skippen, Carleton University	Studies of supracrustal rocks in the Torp Lake domain	K. Venance, M.Sc.
5. R. James, Laurentian University	Studies of auriferous iron formation, Tehek Lake area, Keewatin District	A. Armitage, M.Sc.
6. W.K. Fyson, Ottawa University	Studies of the structure of Slave Province and relate the structural succession to gold metallogeny	
7. A Lalonde, Ottawa University	Studies of the geology and structure in the region around the Turner Lake gold deposits	S. Schaan, M.Sc.
8. L. Aspler, Consultant, Ottawa	Determination of the origin and economic significance of gossanous formations in the Hawk Hill Lake area, Keewatin District	
9. M. Zentilli, Dalhousie University	Investigatation of the occurrence and distribution of carbon, and the relation of carbon to gold mineralization in the Gordon Lake area, MacKenzie District (NTS 85P)	T. Stokes, M.Sc.
10. E. Spooner, University of Toronto	Continuation of studies of quartz-vein- gold mineralization in the granitoid rocks of Anialik River granite gneiss, MacKenzie District (NTS 76 M)	A. Abraham, Ph.D.
11. M. Jebrak, Universite de Montreal J. Gebert, field advisor	Detailed mapping of an area around the Ida Point silver showings, MacKenzie District (NTS 77 A)	S. Leclair, M.Sc.

1-9 NWT Geology Division (DIAND); 10-11 Canada-NWT NDA

Table 2. 1990 NWT Geology Projects.

Project	Description	Geologist in Charge Liaison
1. Indin volcanic belt	Structural and stratigraphic studies to fit the numerous and varied gold deposits of this belt into the geology of the area, and to elucidate the relations between the volcanic and sedimentary successions. Minimal field work was done in 1990.	Dr. J. Morgan (Dr. D. Atkinson)
2. Yellowknife volcanic belt	Structural and stratigraphic studies to fit the numerous and varied gold deposits of this belt into the geology of the area, and to elucidate the relations between the volcanic and sedimentary successions.	Dr. M. Stubly (Dr. D. Atkinson)
4. Arctic Sound (NTS 76 N), Mara River (NTS 76 K)	Mapping (1:40 000) of the lower Hood-James River area, an area that contains abundant turbidite sediments hosting Lupin-type (banded iron formation) gold deposits.	R. Johnstone (V. Jackson)
5. Rideout Island (NTS 76 O)	Mapping (1:50 000) of an area with abundant volcanic rocks with potential for native silver, volcanogenic massive sulphide and gold deposits.	J. Gebert (Dr. W.A. Gibbins)
6. Hepburn Island (NTS 76 M), Kathawachaga Lake (NTS 76 L)	Mapping (1:50 000 and 1:25 000) of granite-greenstone terrains. Field work was concentrated in 76 L/SE.	V. Jackson
7. Slave Province (NTS 86 G)	Mapping and collecting material for geochronology and petrological studies of gneissic terrain (pre-3.5 Ga).	Dr. W.A.Padgham Dr. S.A.Bowring
8.Reid Lake (NTS 85 I/11)	Studies of turbidite-hosted mineral deposits in the western part of the Yellowknife sedimentary domain. Final open file report released in 1990.	J.B. Seaton

1-5 are Canada-NWT MDA projects; 6-8 are NWT Geology Division projects

Table 3. Geological Survey of Canada Administrated MDA Projects. Canada–Northwest Territories Mineral Development Agreement.

Project	Description	GSC officer (Student or Contractor)
Regional Geology (LCSD)		
1. Contwoyto–Nose Lake area	Field work directed at understanding the regional tectonic setting of Lupin-type mineralization.	J. King (C. Relf, Ph.D., Queens)
2. Tavani greenstone belt	Mapping parts of NTS 55 K/3, K/4, K/5, and K/6 (1:50 000), with emphasis on geochemistry, geochronology, structure and stratigraphy.	S. Tella (S. Rasler, A. Park, U of New Brunswick)
3. Muskox Intrusion	Detailed mapping, geochemical and petrological studies of marginal rocks of the Muskox Intrusion, and selected areas of the Coppermine lavas and Mackenzie dykes, to model magmatic processes and PGE deposition.	W.R.A. Baragar, (D. Frances, McGill)
4. Cameron River volcanic belt	Mapping, (1:50,000) of the Cameron River volcanic belt north of latitude 63-, and making a structural and stratigraphic analysis of the volcanic belt and adjacent granitoid and sedimentary terranes.	M. Lambert (D. James)
Mineral Deposits (MRD)		
5. Gold metallogeny - Slave Province	Mapping gold deposits throughout the Slave Province to identify empirical exploration guidelines, improve genetic models, and assess the potential of areas where deposits have not been found.	C.W. Jefferson, et al
6.Gold metallogeny - Churchill Province	Detailed mapping of gold showings in Henik Group greenstones and equivalents, investigating the impact of Archean sedimentation-tectonism and Proterozoic tectonism on the distribution of gold, and comparing gold metallogeny of the Churchill Province with that of the Slave.	A. Miller
7. PGE in ultramafic-mafic rocks, NWT	Characterizing mafic-ultramafic bodies and their potential for magmatic sulfide (Ni-Cu-PGE) and oxide (Cr-Ti-V) deposits.	L. Hulbert et al

8.Rare metals - Slave, Churchill and Bear provinces	Documenting rare metal distribution in deposits and the metal potential of alkalic igneous provinces; comparing the geochemical signatures of these rocks to similar geological environments in Canada.	W. Sinclair
9. Pine Point and Polaris deposits	1) Polaris: detailed underground and surface mapping and drill core logging, recognition and definition of regional and local markers in host rocks, study of "internal sediments" to determine their age and origin. 2) Pine Point: studying oxygen,carbon and hydrogen isotopes of gangue carbonates whose paragenetic relations to ore have been established through previous studies; studying fluids involved in development of rocks and ore at Pine Point.	D. Sangster 1) R. Randall, Ph.D., U. of Toronto 2) H. Ching, Ph.D., McGill U.
10. Metal-stressed vegetation	Mapping, with remote imagery, vegetation and till around gold- and PGE-bearing gossans to detect spectral anomalies of gold and related trace elements, and PGEs, in vegetation along mineral belts; integrating the biogeochemical response of stressed vegetation with geology to delineate belts of mineral potential.	A.N. Rencz

Quaternary Geology and Geochemistry (MRD)

11.Gold and PGEs in till - Churchill and Slave provinces	Determining how Au and PGE mineralization is reflected in associated till and demonstrating till geochemistry as an exploration method; defining patterns of glacial dispersal in areas of gold and PGE mineralization in central Keewatin District and the Contwoyto Lake area.	W. Coker

LCSD - Lithosphere and Canadian Shield Division
MRD - Mineral Resources Division

INDIAN AND NORTHERN AFFAIRS CANADA
EXPLORATION AND GEOLOGICAL SERVICES DIVISION, YUKON

Exploration and Geological Services Division is part of the Mineral Resources Directorate of the Northern Affairs Program, one of five programs of Indian and Northern Affairs Canada. The division consists of five geologists, an office manager, a map sales manager and a secretary, and is responsible for mineral resources management in the same way as any provincial department of mines.

As part of its mandate, the Geology Division produces an annual review of mineral exploration; the results of assessment work are compiled in another annual publication, the "Yukon Exploration" series. The "Yukon Geology" series is a vehicle for publishing the results of geological research on a variety of topics. Geological maps, at a scale of 1:50 000, are available in Open File format in certain areas of interest to the mining industry. A complete publications list is available from the Canada Map Office, Indian and Northern Affairs Canada, 200 Range Road, Whitehorse, Yukon, Y1A 3V1.

GEOLOGY DIVISION PROJECTS –1989

S.R. Morison Chief Geologist	Appointed to the Chief Geologist position in September. Chaired the committee which planned and organized the 17th Annual Yukon Geoscience Forum. Assisted with the planning of future Economic Development programs including the 1989 Mineral Resources Subagreement; assisted the Yukon Placer Implementation Review Committee as chairperson of the subcommittee responsible for the hydrology and sedimentology components of the Phase II contract, dealing with the effects of placer mining on fish and fish habitat. Visited and mapped active placer properties in the Mt. Nansen and Klondike regions. Visited two developing hardrock mines and several developing properties. Responsible for supervising and co-ordinating the activities of the Geology Section and representing the Mineral Resources Directorate on several national and local committees.
Grant Abbott Minerals Geologist	Carried out 1:50 000 scale mapping of NTS map sheet 106 D/1, near the MARG massive sulphide deposit. Acted as editor and scientific authority for several 1:50 000 scale mapping contracts carried out under the Canada–Yukon Economic Development Program. Produced open file map on the geology of the MacMillan Pass area.
Trevor Bremner Staff Geologist	Visited mining properties in the Whitehorse and Watson Lake Mining districts; continued to map the area around the Wellgreen copper-nickel-platinum deposit in the Kluane region, at 1:50 000 scale.
Diane Emond Staff Geologist	Approved, catalogued and indexed assessment reports from the Watson Lake Mining Division. Visited active exploration projects in the Whitehorse and Watson Lake Mining Divisions. Examined core and trenches on the LOGAN zinc-silver property (NTS 105 B).
Bill LeBarge Staff Geologist	Approved, catalogued, and indexed assessment reports from the Mayo and Dawson Mining divisions, and all Yukon placer reports. Directed operations of the H.S. Bostock Core Library. Visited several mining properties being actively explored in the Dawson District; collected geotechnical information and samples from placer operations in the Dawson area.

University Thesis Projects

Jay Jackson University of Arizona	PhD study of the tectonic relations between the Stikine, Nisling and Northern Cache Creek Terrane boundaries in northern B.C. and southern Yukon.
Ken Ridgeway University of Rochester	PhD study of the relation of Denali strike-slip movements to the stratigraphy of the Amphitheatre Formation.
Tim Liverton University of London	PhD study of igneous intrusions in the Englishman's Range.

CANADA–YUKON ECONOMIC DEVELOPMENT PROGRAM MINERAL RESOURCES SUBAGREEMENT

Economic Development Agreement Extension Geological Mapping and Related Studies

NTS map sheets 105 D/2,3,6 and 11 were revised by Aurum Geological Consultants Ltd., on the basis of new geochronological data which was collected in 1988.

Reports Released:

EGSD Open File 1989-1 "Geology of Carcoss (105 D/2) and part of Robinson (105 D/7) map areas" by C.J. Hart and K. Pelletier, Aurum Geological Consultants Ltd.

EGSD Open File 1989-2 "Geology of Whitehorse map area", by C.J. Hart and K. Pelletier, Aurum Geological Consultants Ltd.

Economic Development Program Regional Stream Sediment and Water Geochemical Surveys

G.S.C. Open FIle 1960 NTS Map Sheet 105 E

G.S.C. Open File 1961 NTS Map Sheet 105 K (W) and 105 L

G.S.C. Open FIle 1962 NTS Map Sheet 105 M

GEOLOGICAL PUBLICATIONS

During the March 1989 meeting of the Provincial Geologists it was decided that the listing of provincial and territorial geological publications would no longer be included in this Journal. A list of publications may be obtained from the National Geoscience Centre in Ottawa. For more information, contact David Reade, Geoscan Centre, Geological Survey of Canada, 601 Booth Street, Ottawa, Ontario Canada K1A 0E8 (613)992-9550.

ARTICLES

SURVEY OF FEDERAL - PROVINCIAL MINERAL DEVELOPMENT AGREEMENTS IN 1990

Province or territory	Total $ value of agreement ($ million)	Cost sharing formula	Time period	Delivery % Canada % Province	Major components/projects Project name	Budget ($,000's)	Delivery (prov. or Canada)	Contact person & tel. no.
British Columbia	$10	50/50	1985-1990	96% B.C. 4% Can.	Geoscientific Surveys	6 650	90% B.C.	G. McKillop (604) 356-2854
					Geoscience Data Systems	450	94% B.C.	
					Market, Technical & Feasibility Studies	1 250	100% B.C.	
					Financial Assist. for Mine Development	1 120	100% B.C.	
					Management, Public Info. Evaluation	530	100% B.C.	
Ontario	$30	50/50	1985-1990	63% Ont. 37% Can.	Geoscience Program	18 350	64% Ont.	
					Information Exchange	1 900	100% Ont.	(416) 965-1546
					Productivity & Technology	3 550	100% Ont.	
					Economic Development	4 500	96% Ont	
					Public Information, Evaluation and Administration	1 700	59% Ont.	
			1990-1991		Funding for publication completion			
Québec	$100	50/50	1985-1990	96% Qué. 4% Can.	5 Volets			
					1. Activités géoscientifiques	34 750	Québec	J.L. Caty 643-1803
					2. Recherche et développement sur l'amiante	8 000	Québec-Canada	à déterminer
					3. Infrastructure de développement minéral	42 000	Québec	A. Jean 643-4896
					4. Désenclavement de l'industrie québécoise du mineral de fer	15 000	Québec	G. Richard 643-4410
					5. Information au public	250	Québec	M. Lecours 643-1803
Yukon Mineral Resources Subagreement	$1.02	70/30 Can./Yukon	1989-1990		1. Geological Mapping	.50	100% Can. (DIAND)	S.R. Morison (DIAND) (403) 667-3200
					2. Geochemistry	.39	100% Can. (G.S.C.)	D. Hornbrook (GSC) (613) 992-6559
					3. Mining Research & Development	.13	100% Y.T.	B. Holmes (403) 667-5888
Northwest Territories	$7.0	70/30 Can./N.W.T.	1987-1991	41% Can. 59% N.W.T.	Geoscience	5.900	52% N.W.T.	M. Irving
					Technology	800	94% N.W.T.	(403) 920-3125
					Information	300	100% N.W.T.	

Survey of Hard Rock Drill Core Programs in Canada
Fiscal Year 1989-90

	B.C.**	Alberta	Sask.	Man.	Ont.	Que.	N.B.	N.S.	Nfld./Lab.	P.E.I.	Yukon	N.W.T.
Number of facilities	1	1	2	4	7	4	3	4	6	1	1	1
Staff-person days work 1988-89	10	40	130.5	220	3282	1	740	1,115	601	—	135	100
Capital cost 1989-90 ($ x 000)	5.4	nil	nil	0.5	1.0	—	—	13.0	65.0	—	63.0	0.3
Operating cost 1989-90 ($ x 000)	5.0	20.0	7.5	12.0	155.2	73.0	74.0	194.5	137.0	—	7.0	19.2
Core collected and/or delivered 1989-90		5,000 m	2,855 m	9,222 m	72,932	35,000	20,800	10,225	8,000	—	5,735	7.5
Core reduction*	nil	nil	nil	nil	6529	nil	nil	1139 m	nil	—	nil	nil
Use of facilities person days (pd) 1989-90 visits (v)	15 pd	25 pd	23 pd	14 pd	1,888 pd	375 pd	220 pd	326 pd	40 v	2	50 pd	33 v
Total core in storage (from all years)	150,000 m	38,000	69,205	184,600	783,694	312,400	302,000	460,086	675,783	1,298	126,912	30,056
Total exploration drilling 1988-89	26,967 m	7,000	158,203	178,000	540,000	1,600,000	150,000	31,000	102,000	—	50,000	185,430

* Over last year
** Coal core is not hard rock. There are no facilities for hard rock in B.C. – figures are for coal.

1990/91 Annual Review of Activities
Provincial and Federal Geoscientific Organizations

Province or Territory Location	Date(s) (no. of days)	Time for talks	Universities involved?	Industry involved?	Poster session	Universities involved?	Industry involved?	Publication	Energy[1] matters	Other[2] topics	Comments
British Columbia Vancouver	30 Jan 91	1 day	Yes	Yes B.C. & Yukon Chamber Annual Meeting	Yes	Yes	Yes	- Geological Fieldwork - B.C. Mineral Exploration Review, 1990	Yes	Yes	Part of "Cordilleran Geology and Exploration Roundup" 29 Jan. - GSC; DIAND - Yukon 30 Jan. BCEMPR 31 Jan. BC-YCM 1 Feb.
Yukon Territory Whitehorse (DIAND)	26-28 Nov. 90 Whitehorse (2)	2 days	Yes	Yes	Yes 2 days	Yes	Yes	No	No	No	Contributions from DIAND, GSC Review of current projects
	29 Jan. 91 Vancouver (1 or 4)	one 1-hour sessions	No	No	Yes	Yes	No	No	No	No	Part of "Cordilleran Geology and Exploration Roundup" with BCEMPR, BC-YCM, GSC
Northwest Territories (DIAND)	27-29 Nov. 90 (3)	3 days	Yes	Yes	Concurrent	Yes	Yes	Exploration, Mining and Geology Overview	Coal only	as required	Organized with NWT Chamber of Mines, GSC involved. Also take part in "Cordilleran Geology and Exploration Roundup", Vancouver.
Alberta (to be determined)	Bi-Annual: Scheduled Fall 1991										
Saskatchewan Regina	20, 21 Nov. 90 (1.5)	0.5 day	Yes	No	1 day	Yes	Yes	Summary of Investigations	No	No	Saskatchewan Research Council and GSC involved.
Manitoba Winnipeg	19, 20 Nov. 90 (1.5)	1 day	Yes	Yes	1.5 days	Yes	Yes	Rept. of field activities (RFA)	No	Yes	Expanded Core Stack GSC projects (3) reported in Provincial RFA.
Ontario Toronto	10-12 Dec. 90 (2.5)	2.5 days	Yes	Yes	2 days	Yes	No	2 reports of activities	Yes	Yes	Research oriented, Mineral Dev. Forum
Quebec Quebec City	21, 22 Nov. 90 (2)	2 days	Yes	Yes	2 days	Yes	No	Report of activities	No	Yes	Special publications of talks presented.
New Brunswick Fredericton	13, 14 Nov. 90 (1.5)	1.5 days	Yes	No	1.5 days	Yes	Yes	1990 Project Resumes	Yes	Yes	GSC involved.
Nova Scotia Halifax	15, 16 Nov. 90 (1.5)	1.5 days	No	No	1.5 days	Yes	No	Program and Summaries	Yes	Yes	GSC involved; also symposium, N.S. Chamber of Mineral Resources/GSC.
Newfoundland St. John's	1 Nov. 90 (1)	1 day	Yes	Yes	0.5 day	Yes	No	Yes	Yes	Yes	GSC involved.
Prince Edward Island Charlottetown	No Review of Activities scheduled for 1990/91										
Geological Surv. Can. - Ottawa	21-23 Jan. 91 (2)	1.5 days	Yes	No	1.5 days	Yes	No	Current Research Pts. A-D	Yes	Yes	1.5 day short course on interpretation of gravity/magnetic ????? for non-specialists Jan. 23, 24.

[1]Energy Matters (e.g. oil, gas, coal, oil shales, peat). [2]Other Topics: (e.g. administration, engineering, regulations, legislation, etc).

Discovery Methods for Canadian Metal Mines that Opened in 1989

Province: Ontario

Mine:	Stock Township Mine (Quebec-Sturgeon)	Shebandowan Mine	Dona Lake Mine	Magnacon Mine
Discovery:	New	Old	New	Old
Date of discovery: (Reassessment)	1972	Reactivated 1989	1984	1930's (1985)
Discovery technique:	Diamond Drilling	Prospecting, Diamond drilling	Airborne MAG survey Ground Geochemistry	Prospecting
Reserves:	Proven 695,690 tonnes grading 5.0 g/t	Proven 2.5m tonnes	Proven 453,500 tonnes @ 9.6 g/t.	1.33 million tonnes @ 5.9 g/t.
1989 production:	6,174 tr oz Au	N/A	33,940 tr.oz. Au	14,865 tr.oz. Au
Mining type:	Underground	Underground	Underground	Underground
Milling rate:	500 tons/day	2,000 tons/day	550 tons/day	600 tons/day
Commodities:	Au	Ni, Cu	Au	Au
Deposit classification:	Vein	Ultramafic hosted	Replacement	Vein

Discovery Methods for Canadian Metal Mines that Opened in 1989

Province: B.C.

Mine	Ajax	Golden Bear	Lawyers	Premier	Samatosum	Shasta
Discovery (New or Old)	O	N	N	O	N	N
Date of original discovery (Reassessment)	1904 (1987)	1981	1974	1910 (1986)	1986	1984
NTS	92I/9	104K/1	94E/6	104B/1	82M/4	94E/6
Location	8.7 miles west of Kamloops	87 miles west of Dease Lake	175 miles north of Smithers	10 miles north of Stewart	37 miles north of Kamloops	175 miles north of Smithers
Years of operation	—	—	—	Premier: 1918-1953, 1959-1968 Big Missouri: 1927-1942		
Methods of discovery (Reassessment)	Trenching, percussion and diamond drilling (Geology, Diamond Drilling)	Geology, geochemistry	Prospecting, diamond drilling, trenching	Prospecting (Diamond drilling)	Prospecting, trenching, diamond drilling	Prospecting, trenching, diamond drilling
Methods of later developments	Diamond Drilling, AFTON MINE Expansion	Diamond drilling, underground	Underground	Diamond drilling	Diamond drilling, underground	Diamond drilling
Discovered (reassessed) reserves	27,000,000 tons grading 0.46% Cu & 0.01 opt Au	2,640,000 tons grading 0.543 opt Au	1,937,000 tons grading 0.198 opt Au & 7.08 opt Ag	(8,084,000 tons grading 0.056 opt Au and 1.905 opt Ag)	841,500 tons grading 24.24 opt Ag, 0.047 opt Au, 1.0% Cu, 2.9% Zn, & 1.4% Pb	1,389,000 tons grading 0.15 opt Au equiv.
1989 production	1,322,800 tons yielded 9238 oz Au & 19,915 oz Ag plus copper	Jan. 31/90	Start up (Commercial): Mar.1 154,960 tons yielding 48,500 oz Au, 918,300 oz Ag	Previous totals: 5,938,896 tons yielded 1,877,386 oz Au & 41,034,928 oz Ag 1989: Start up (commercial)Jan.1/90 Apr 1/89-Jan 1/90 - 382,132 tons yielding 14784 oz Au & 178972 oz Ag	Start up: May/89 87,000 tons yielding 1,018,000 lbs Cu; 4,844,000 lbs Zn; 2,801,000 lbs Pb; 2,925 oz Au; 1,741,000 oz Ag	Start up: Oct/89 14439 tons yielding 975 oz Au & 67816 oz Ag
Mining type	OPEN PIT	Open pit/underground	Underground	Open pit	Open pit/underground	Open pit/underground
Milling rate	11,000 tons/day	400 tons/day	550 tons/day	2000 tons/day	500 tons/day	200 tons/day
Commodities	Cu, Au	Au, Ag	Au, Ag	Au, Ag	Ag,Au,Cu,Zn,Pb	Au, Ag
Deposit classification	PORPHYRY	Vein - mesothermal	Vein - epithermal	Vein - epithermal	Vein/Massive sulphide	Vein - epithermal
Key reference	MI 92INE012	MI 104K008	MI 94E066	MI 104B054,046	MI 82M244	MI 94E050

SUSTAINABLE DEVELOPMENT

Diana Purdy, Alberta Department of Energy

Sustainable development is a concept that has become widely popular in recent years. It was used originally at the beginning of the last decade as part of the World Conservation Strategy. It came to the forefront, however, in 1987 with the publication of Our Common Future; the report of the Brundtland Commission. Nevertheless, the concept remains elusive in definition and difficult to make operational.

In Canada, the National Task Force on Environment and Economy was established in 1986. It was given the responsibility of reviewing the Brundtland Commission report, from the Canadian perspective, and preparing an official response. The Task Force report outlined 40 recommendations, one of which was the establishment of federal, provincial and territorial Round Tables on Environment and Economy. The recommendations reflect a fundamental belief that environmental and economic planning cannot proceed separately.

The National Task Force concluded that Canadians cannot expect to maintain economic prosperity unless the environment and the resource base on which economic development depends are protected. All resources, including the environment, must be managed for the long term, taking into account their anticipated value in the future as well as their current value.

Rather than try to establish a precise definition of sustainable development, for the purposes of this paper it is considered to be based on a set of values wherein development meets the needs of the present without compromising the ability of future generations to meet their own needs. This view of sustainable development is consistent with the Brundtland Commission report and numerous other documents pertaining to sustainable development and, in particular, a discussion paper prepared by the Natural Resources Advisory Committee (NRAC). NRAC is a long-standing, interdepartmental committee of Assistant Deputy Ministers, in Alberta, reporting to the Deputy Ministers. The primary purpose of NRAC is to coordinate interdepartmental environmental issues from a strategic perspective.

There are, however, many definitions for sustainable development. Morley Connaghan, chairman of the newly established British Columbia Round Table on Environment and Economy, stated that "sustainable development is something like beauty: it is in the eye of the beholder." Earlier this year, Terence Corcoran, a columnist, wrote in The Globe and Mail that "sustainable development...is fast becoming a landfill site for every environmental idea in existence and every state economic intervention imaginable."

Mr. Corcoran went on to say that "the snowball of sustainable development is picking up every sector of the economy as it rolls relentlessly forward. Sustainable development appears to offer a middle road between the economy (business, growth, investment, technology and development) and the environment (clean air, water and land)."

Sustainable development is a powerful idea whereby the potential for mutual cooperation between industry and environmentalists is made possible. It also has the promise of building a broad consensus between these groups, stemming from its ability to cut across intellectual, sectoral and political boundaries.

Sustainable development is a descendent of two precepts that evolved during 1960s' conservation movement. First was the belief that nature should be preserved, and second was the moral injunction that man should act as a steward of the land. As a result, man and nature had to be viewed as part of one integrated system. It follows, therefore, that if man analyzes the elements of sustainable development in isolation, he will seriously compromise its attainment. Holistic approaches to sustainable development problem-solving must be employed.

Sustainable development presents highly complex questions for policy-makers. Governments must grapple with the thorny issue of which trade-offs will be supported by the public, knowing the public will not accept anything that compromises its health. The long-term well-being of the environment and the economic future of the country, province or territory must, therefore, include efficiency of resource use, conservation, pricing and lifestyle changes.

For Canadians to move toward a sustainable future, many fundamental changes will be necessary in our approach to economic development and environmental protection. Difficult decisions will have to be made by government, industry, institutions and individuals. Development cannot subsist upon a deteriorating environment. The environment cannot be adequately protected, however, when economic growth does not account for the costs of environmental degradation. Environmental protection and economic development can and must be reconciled, with a single common vision of our future emerging.

Despite the common myth of an approaching environmental maelstrom, the earth has more in its favor now environmentally, than it did 30 years ago when the environmental movement first rose to national prominence. In Canada, there are numerous areas where air and water quality are better now than in 1970. Today there are more people concerned about the earth's environmental health, which offers a positive outlook for the future.

Environmental degradation is, first of all, a scientific issue. The scientific community has established that the earth has a finite capacity to absorb pollutants, whether within air, water or land. Environmental awareness is no longer an option that industry can select if it so chooses; it is an economic necessity.

Sustainable development is not just a scientific issue, it also involves policy making. If sustainable development policy is to be pertinent, it must recognize and properly assess the issues at hand and apply scientifically valid solutions that are consistent with economic growth and other national priorities. Some believe that environmental objectives should take precedence over the requirements for economic prosperity. Sustainable development recognizes that it is not a choice between protecting the environment or developing resources, but rather that the two are intertwined.

A national sustainable development policy must obtain a national consensus with respect to sustainable development objectives and set a realistic timetable by which these objectives can be met. The economic costs to the consumer for achieving these objectives, and the impact on national competitiveness in the world market, must be analyzed fairly, realistically and publicly. The role of government in this regard should be to establish standards and time frames for implementation of objectives, and then let industry and the public determine the optimum, cost-effective means to achieve them.

Policy established for sustainable development must be based on the best scientific data and methods available. Arbitrary, mandated programs will not be as effective as those in which their development was shared by industry and the public.

Nonrenewable Resources

With the exception of those forms of renewable energy resources, resources used to meet the world's need for energy, metals and industrial minerals are, by definition, nonrenewable. Their exploration, development, processing, transportation and use can be accomplished within the context of sustainable development. Canada's nonrenewable resources used for energy production comprise natural gas, crude oil, bitumen, coal and uranium. Nonrenewable resources that are not required for energy uses comprise metallic and industrial minerals and structural rock materials.

For nonrenewable resources, sustainable development implies an environmentally responsible approach to resource exploration, production and use. In the longer term, it also implies substitution of

resources to meet essential needs as those currently being used are depleted. Such substitution must also occur without adverse environmental impact.

Sustainable, nonrenewable resource development means using these resources in the most economically efficient manner possible. It means considering environmental impacts and society's needs at all stages of use from initial exploration and preparation for mining, through the actual mining and land reclamation to processing of the mineral. The goal is to minimize negative environmental impacts at all stages of nonrenewable resource activity.

Nonrenewable resource processing must minimize consumption through efficient use, substitution and recycling. Such production efficiencies and recycling will contribute to waste reduction, reduce disposal problems and minimize impacts on the natural environment.

In the eyes of the public, mining is a political issue with respect to sustainable development because of its role as an environmental antagonist. Supply, with respect to metallic minerals and coal, isn't an issue as there is no apparent shortage. A public outcry will not occur until supply becomes a crisis as is now the case with conventional crude oil. The recent events in the Middle East, combined with Canada's dwindling production of conventional oil, are precisely the reasons for Alberta's support for the mining of bitumen.

Some environmentalists believe that environmental considerations clearly outweigh the economic prosperity derived from nonrenewable resource development. As a partial solution, a balance needs to be created between environmental values and the need for such development. As Frank Dabbs stated in the April 23, 1990 issue of Oil Week, "It's a precariously short step from environmental responsibility to environmental terrorism – the hijacking of the economic process." What is needed is responsible development of nonrenewable resources, which may mean flattening the demand curve or even reducing use. Canadians need to be aware of the associated costs, however, and agree on a course of action jointly determined by government, industry, and the public.

Sustainable development provides the opportunity for environmentalists and the mining industry to meet on equal terms. Improvements on air and water quality, many initiated by the mining industry, demonstrate that nonrenewable resource companies care more about the environment now than in the past. Having said this, it is still felt by some that the industry does not care enough. If it did, there would be fewer environmental mistakes and better solutions to environmental problems.

Twenty years ago, the mining industry resisted environmental regulations. Today, the industry initiates guidelines with respect to environmental issues. Many companies have restructured their operations to create environmental divisions. This is evidence enough that industry is now moving toward a sustainable development ethic.

Mining in the 1990s

Over the years, numerous public opinion surveys regarding environmental issues have been taken. The 1990 Canadian Gas Association (CGA) Goldfarb Survey found that 53 per cent of Canadians are "very concerned about the environment." The 1989 Mining Association of Canada (MAC) Angus Reid Survey found that 45 per cent of Canadians are "aware of specific mining activities that harm the environment." How, then, can Canadians be convinced that mining is compatible with the concept of sustainable development? Particularly when they do not believe the industry is being truthful in what it says.

The mining industry has two choices in this matter. First, it can try to convince Canadians through rhetoric. This will be difficult. According to the CGA Goldfarb Survey, 86 per cent of Canadians said they "rely on the media to get their facts about the environment." If this survey is accurate, then the mining industry will first have to convince the media, who, in turn, will help to convince the general population. This could be a laborious exercise, and the mining industry would have little control over the agenda. As

Moira Jackson stated in her recently published paper, Pilloried in the Post: The Mining Industry Meets the Press, "It's much easier to control an agenda of one's own choosing than to respond to someone else's."

The second, more preferred method is for the mining industry to convince Canadians through direct action. The industry must not just pay lip service regarding its intention to "...operate ... facilities in compliance with all applicable legislation providing for the protection of the environment ...", as stated in the Environmental Policy of the MAC; companies must operate in this manner without exception. Actions always speak louder than words.

Public perception must be changed. In some instances, perception is not based on fact. The MAC Angus Reid Survey found that 40 per cent of Canadians believe that "industry has improved its performance on air pollution over the past ten years", and yet 51 per cent believe that "the mining industry performance on acid rain is worse now than it was ten years ago." Because public opinion is fickle, and if you believe the CGA Goldfarb Survey, controlled by the media, the mining industry, government and the public must develop, implement and monitor a mutually agreed upon national action plan that addresses mining and sustainable development.

Mining in the 1990s can be viewed as a continuum that ranges from exploration and preparation for mining, through the actual mining and land reclamation, to processing of the mineral. As such, some elements of sustainable development, such as environmental protection are applicable at each stage of the continuum. Others, such as recycling are only applicable at specific stages. Any action plan that is developed should address each element of sustainable development at each stage of the mining continuum. Development of the plan should commence by the end of 1990 with completion by the 50th Annual Mines Ministers' Conference in 1993.

Once implemented and adhered to, the action plan will provide the litmus test of credibility for the mining industry, as all Canadians will be able to form their own, independently derived, perception regarding the industry's sustainable development ethic in the 1990s. Such a plan should contain the following components:

(1) explicit goals with respect to each element of sustainable development;

(2) identification of the problems and issues associated with each of these goals;

(3) sufficient comprehensiveness to deal with all of the considerations associated with each of the identified goals, problems and issues;

(4) flexibility to allow for changing needs and future circumstances;

(5) ability tto recognize need for modification, adaptation and revision as required;

(6) options with a clear understanding of their implications;

(7) opportunity for participation by industry, the public and government;

(8) systematic implementation to ensure commitment at each stage;

(9) defined responsibilities for implementation; and

(10) awareness of the limitations and costs of implementation.

Initiatives in Alberta

The Government of Alberta has taken a number of initiatives with respect to sustainable development. Some of these initiatives, applicable to mining and other resource development projects, are as follows:

Environmental Protection and Enhancement

Earlier this year, the Government of Alberta introduced a discussion paper with appended legislative ideas regarding a proposed Alberta Environmental Protection and Enhancement Act (AEPEA). The AEPEA represents an important step in putting the Government's commitment to sustainable development into practice. This Act consolidates nine existing acts that deal with the environment. It will allow for an integrated approach the management of air, water and land.

This single piece of legislation will result in straightforward, streamlined and effective environmental laws for Albertans and the mining industry and eliminate duplications and redundancies among existing acts. The new legislation, to be introduced in the Alberta Legislative Assembly in the spring of 1991, will provide a consistent framework for future laws and guidelines.

Recognizing that environmental concerns and impacts are not confined by physical or political boundaries, the Government of Alberta is committed to cooperating with other governments in the management of environmental issues that affect our neighboring provinces. The proposed legislation contributes to effective intergovernmental cooperation, while reinforcing Alberta's constitutional responsibilities for environmental management in our province.

Clean Air Strategy

In March 1990, the Government of Alberta announced that the Clean Air Strategy for Alberta would be managed jointly by the departments of Energy and Environment. The purpose of the strategy is to have an informed public discussion on air emissions that result from the production and use of nonrenewable sources of energy, primarily fossil fuels. The strategy has a twofold objective: (1) to help identify and clarify the possible impact of energy-related emissions on the environment, including those from the mining of bitumen and coal; and (2) to outline practical and achievable actions that can be taken by consumers and producers to reduce emissions.

The strategy complements other Government of Alberta sustainable development initiatives as well as national and international endeavors related to air emissions and global warming. The final report will be submitted to Alberta's Round Table on Environment and Economy in 1991. The report will help formulate Alberta's policies on air emissions and will be used in developing Alberta's input to Canadian policies and positions with respect to sustainable development.

The strategy represents one of the most comprehensive and coordinated efforts in Canada to deal with energy-related emissions and the environment. The goal of the strategy is to identify realistic and achievable measures supported by both energy consumers and producers. In developing the strategy, the Government of Alberta has demonstrated its firm commitment to public participation. Through discussions, workshops and the establishment of an advisory group, the Government is determined that the concerns of all stakeholders will be taken into account.

Natural Resources Conservation Board

During the 1990 spring sitting of the legislature, the Government of Alberta introduced the Natural Resources Conservation Board Act. This legislation outlines the framework and procedures for reviewing and approving projects involving non-energy resources in Alberta including the mining of metallic or quarriable minerals.

The legislation will create a quasi-judicial, independent Natural Resources Conservation Board (NRCB) with broad powers. It will assess the social, economic and environmental effects of proposed natural resource development projects before their commencement. The powers of the NRCB complement

the intent of the AEPEA and the Clean Air Strategy for Alberta with respect to sustainable development. The legislation will provide Albertans with the most progressive and stringent review and approval process for natural resource projects found anywhere in the world.

Projects approved by the NRCB will be subject to further approval by Cabinet. Following this approval, projects will still have to obtain the necessary licences, permits and approvals from the other regulatory agencies before the project can proceed. NRCB decisions to reject applications or defer consideration cannot be overturned by Cabinet. The decisions can be appealed to the Court of Appeal only on matters of jurisdiction and errors in law.

The NRCB will clearly outline the procedural mechanism that will ensure a balanced and impartial process for reviewing and approving natural resource projects. It will set rigorous new standards for sustainable resource development. Mining and other resource projects will not proceed without a detailed environmental assessment and full public input. Members of the NRCB will have all the powers, privileges and immunity of commissioners appointed under the Public Inquiries Act.

During the spring sitting of the legislature, the Government decided not to bring forward the NRCB Act, because the public requested more time to review the proposed legislation. Therefore, the review period has been extended, and comments received will be evaluated in an effort to make the legislation even more effective.

Energy Efficiency, Conservation and Resource Substitution

In Alberta, resource conservation and efficient energy use are encouraged. Efficient energy end-use practices and technologies are promoted by the Alberta Department of Energy through information and education programs such as industrial energy audits. Services are available for all energy end users in the residential, commercial, industrial and transportation sectors. Energy use databases, telephone hotlines, on-site energy audits, and technical publications are all available to Albertans. Even future energy consumers are addressed through educational programs and resources for school students.

Conservation practices for energy resources in the field, which originated in legislated measures enacted in 1938 and most recently have stressed enhanced oil recovery, are now being complemented by end-use efficiency and new conservation programs. End-use efficiency and conservation programs include the reduction of gaseous emissions, examination of the potential for production of natural gas from coal and the development of technology to meet these ends. These measures are being coupled with initiatives to develop solar and wind resources.

The Energy Resources Conservation Board (ERCB), established in the late 1930s, is responsible for ensuring that provincial energy resources are developed in a safe, orderly manner that avoids waste, controls pollution and is in the public interest. The ERCB ensures that the recovery of energy resources is optimized, or conserved, and not wasted. In addition to providing regulatory control of the production and distribution of all energy resources, the ERCB provides an important interface between the energy industry and government.

Within the energy sector, resource substitution poses a challenge for Alberta where current energy use is focused on relatively clean fossil fuels – oil and natural gas. Bitumen and coal form an immense resource base in Alberta and, over time, have the potential to play an increasingly larger role in the energy mix. Bitumen mining in Alberta presently contributes approximately 33,000 m^3 per day (207,000 barrels) of synthetic crude oil to the marketplace, while 30.8 million tonnes of coal were mined in the province in 1989. The challenge of ensuring that bitumen and coal fill this expanded role within a sustainable development framework requires new technology development, increased energy efficiency and energy conservation.

Integrated Resource Management

Regardless of its definition, sustainable development is only a societal goal. In order that this goal might be achieved, all Canadians must cooperate to develop a comprehensive strategy that encourages long-term prosperity while ensuring a vibrant, sustainable environment. The initial focal point for such a strategy is the resource base that comprises the earth's ecosystem, since it is from this base that economic prosperity is derived. The one common factor in this regard is the land.

Virtually every kind of economic activity is tied to the land. In this sense, land is defined as the earth's ecosystem and includes air, water, land and living organisms. Land use planning and management is, therefore, the most initially valuable instrument for achieving sustainable development. According to Nigel Richardson in his recently published document Land Use Planning and Sustainable Development in Canada, planning is "an ordered procedure for making decisions as to how land should be used; a procedure in which the plan, including written policies, standards and criteria, provides guidance."

Richardson suggests that land use planning and management contributes to sustainable development in the following ways: (1) promoting efficient use of land; (2) allocating resources; (3) protecting lands and resources; (4) resolving competing demands; (5) encouraging and facilitating environmentally sound economic development; and (6) reducing environmental pollution.

Although Alberta became a province in 1905, ownership of the province's resources was not transferred from the Government of Canada to Alberta until 1930. Since that time, the process of land use planning and management moved from single-sector management in the 1930s and '40s, to multiple-use management in the '50s and '60s, to integrated management in the '70s and '80s. For the '90s and beyond, management that ensures sustainable development will be what is demanded by Albertans.

The integrated resource management framework now used by Alberta was endorsed by the government in 1978 in a document entitled, A System for Integrated Resource Planning on Public Lands in Alberta. The central tenet of the framework is that it "endeavors to optimize use of the provincial resource base to achieve maximum benefits for Albertans, now and in the future." The integrated resource planning system is based on the following principles: (1) a comprehensive approach to resource management; (2) shared, hierarchical decision-making; and (3) commitment to public involvement. Although not originally conceived as such, the integrated resource management framework employed by the Government of Alberta provides, according to Richardson, "within its limits, almost a model land use planning system" for achieving sustainable development.

Issues of General Concern

Carbon Tax

Federal Finance Minister Michael Wilson has expressed concern about the cost of environmental programs currently being proposed by the Government of Canada. An Environics opinion survey conducted in April 1990, suggests that 73 per cent of Canadians would be "very willing" or "somewhat willing" to pay higher taxes if they knew the money would be spent on protecting the environment. Some individuals have speculated, therefore, that the Government of Canada may impose a tax on carbon-based fuels to pay for the federal initiatives on the environment.

Alberta is not in favor of a carbon tax at this time for the following reasons:

(1) not enough work has been conducted to determine if a carbon tax would be effective in meeting environmental objectives;

(2) a carbon tax focuses on a single environmental pollutant, rather than recognizing other contributors to greenhouse gases, some of which are increasing faster than carbon dioxide;

(3)

a carbon tax should be evaluated with a variety of options including regulatory approaches, tradeable emission permits and tax incentives; and

(4) the Clean Air Strategy for Alberta initiative needs to be completed and assessed before considering a carbon tax.

Environmental Assessment Act

The proposed Canadian Environmental Assessment Act will permit the Government of Canada to exercise jurisdiction over environmental aspects of major nonrenewable energy projects, including the mining of bitumen, given that the legislation applies to all projects involving federal assistance. The act does not permit environmental approval processes to be delegated to provincial jurisdiction, even when federal involvement in the project is minor or administrative only.

Federal and provincial environment ministers have agreed that a cooperative approach to environmental assessment that will respect traditional provincial and federal jurisdictional responsibilities is necessary. Decision-making processes such as environmental impact assessments, must be cost-effective, provide for minimum overlap and duplication, and encourage cooperative action. Governments at all levels need to recognize each other's strengths and capabilities and cooperate in the spirit of partnership, particularly in the development of environmental legislation, regulations, policies, programs and projects. Alberta is prepared to undertake joint environmental reviews of energy projects with the Government of Canada only where the federal government is a significant player.

Minesite Reclamation

Beyond the topographical disturbance associated with the development of mineral resources and possible usability of abandoned minesite locations, is the very serious problem of the pernicious effects of acid drainage. Although it is agreed that minesite reclamation should occur, the approaches to reclamation and the enforcement of obligations varies among the provinces.

There is general agreement among the provinces that responsibility for minesite reclamation lies with the mining company, although minesites have often not been reclaimed and the mining companies have disbanded, either through corporate failure or termination of operations. Alberta has avoided this problem through legislation which requires a reclamation plan for coal and bitumen mines to be submitted as a precondition to the issuance of an operating permit. Reclamation activity is monitored during the life of the project. In addition, further security may be required under the Land Surface Conservation and Reclamation Act in the form of bank guarantees, letters of credit or cash deposits based on the reclamation costs of specific sites.

Because of the problems resulting from abandoned, unreclaimed minesites elsewhere in Canada, the idea of mandated contributions to reclamation funds, similar to that occurring in Alberta, has received serious consideration by other provinces. Unfortunately, existing income tax legislation does not permit contributions to reclamation funds to be deducted from taxable income when it is calculated. The Government of Alberta advocates appropriate amendments to Federal income tax legislation that would provide equitable treatment of contributions made to provincial minesite reclamation funds. These changes would achieve the desired attainment of social and environmental goals and create fairness in the fiscal structures affecting taxation of reclamation activities.

Tailings Reprocessing

Tailings deposits often contain significant quantities of recoverable minerals. There is potential that the reprocessing of tailings dumps could be a part of the reclamation of minesites, including those previously abandoned. Such a reprocessing project must be economically attractive, and while that attractiveness may stem primarily from strong commodity pricing and reasonable operational costs, income tax treatment is also a factor.

At present, tailings deposits are not classified as "mineral resources" for income tax purposes, thus restricting them from receiving the same treatment for tax purposes as for other "mineral resources", such as ore deposits. Although tailings may not be developed in the same manner as ore deposits, the significant risks associated with their reprocessing warrant comparable income tax allowances. Alberta believes that tailings reprocessing is environmentally desirable and can be economically beneficial. Therefore, the Government strongly supports modification of federal income tax regulations to permit classification of tailings deposits as "mineral substances." This would then accord them the same treatment as ore deposits under the provisions of the Income Tax Act.

NATMAP: CANADA'S NATIONAL GEOSCIENCE MAPPING PROGRAM

Mike Cherry, Geological Survey of Canada

Introduction

NATMAP is a cooperative federal-provincial program to improve the quality, relevance and completeness of the bedrock and surficial geological database for the Canadian landmass. NATMAP will meet this objective by supporting coordinated, multidisciplinary geoscience programs to resolve concerns about environmental trusteeship, hazards amelioration and sustainable resource development.

Although faced by the difficulties inherent to the implementation of any complex, multi-agency program, NATMAP has evolved steadily since first being presented to the Canadian geoscience community in March 1990. THe program's development will be accelerated by experience gained in the planning and operation of pilot projects in 1991.

History and Scope of NATMAP

NATMAP has been developed to address the problem of a widening gap between the demand for and publication of geoscience maps in Canada (Andrews and Lawton, 1988; Canadian Geoscience Council Review Committee, 1988). The concept for the program originated in 1988-89 with an ad hoc committee of the Geological Survey of Canada. A proposal drafted by this committee was the subject of a workshop convened by the GSC in Toronto in March 1990, and attended by representatives from all parts of Canada's geoscience community (federal, provincial and territorial surveys, mineral explorationists and universities). The results of the workshop were published as Open File 2256 of the Geological Survey of Canada (St-Onge, 1990a), and summaries of the proceedings have appeared in the Northern Miner (Ward, 1990) and Geoscience Canada (St-Onge, 1990b).

The 70 workshop participants reached general agreement on an ambitious NATMAP program. Their principal recommendations were that:

- NATMAP should emphasize regional bedrock and surficial geological mapping of the continental landmass. Systematic regional geophysical and geochemical mapping projects would not be undertaken as NATMAP projects. All available information from such surveys would be used to assist mapping, and new information would be acquired where essential. Similarly, transect studies and major compilation programs would not be the principal components of NATMAP projects, but would be supported where they supplemented mapping activities.

- NATMAP should foster coordination of mapping activities among government agencies. It should emphasize multidisciplinary studies, taking advantage of shared logistics and assembling teams of geoscientists for data acquisition and interpretation.

- NATMAP should ensure a future supply of geoscientific mappers in Canada by supporting university-based projects, and by employing undergraduate and graduate students, thereby providing high quality, continuing field training. NATMAP should also lobby NSERC to recognize geoscience mapping as research and provide funding for mapping.

Other recommendations included establishing a permanent NATMAP secretariat and a management committee, establishing national cartographic standards, and encouraging digital data capture and storage, including the development of national standards for such capture and storage. However, the workshop recommended that NATMAP not undertake the development of digital mapping technologies. It also acknowledged that an overall goal of complete national map coverage at any one scale was inappropriate, given Canada's size and the very different mandates of the federal and provincial surveys.

Analogous Programs

The problems faced by Canada's geoscience mapping agencies are not unique to Canada. National mapping programs have been established in the United States and Australia in response to similar needs.

The growing demand for geoscience information in the United States and the difficulties of meeting this demand are clearly described in a brief report published by the United States Geological Survey (USGS, 1987). The USGS has developed a National Geological Mapping Program to resolve these difficulties. This program, in which the USGS has the lead role, has 3 main goals: (1) to increase geological mapping in the U.S.; (2) to improve coordination among federal, state, and university producers of geologic maps; and, (3) to adopt new technologies and innovative methods for improving geologic mapping, map production, and integration of different geoscience data sets. The program sets clearly defined roles for its participants, which include the USGS, state geological surveys, universities, the National Academy of Sciences, and the private sector. It also recognizes that a significant improvement to the national geoscience database will require time (estimated to be a minimum of 15 years). The program is anticipated to have its greatest impact by improving the organization and direction of existing mapping endeavors, and through the establishment of a formal USGS mapping program.

Australia's National Geoscience Mapping Accord was developed by the federal and state/territory geological agencies in response to a recommendation by industry to the Woods Review of the federal Bureau of Mineral Resources. The Accord is meant to assist in developing an integrated approach to sustainable development of Australia's petroleum, mineral, soil and water resources by fostering cooperative activity between federal and state surveys, in consultation with industry. Most of Australia has been mapped at 1:250,000 scale, and one long term goal of the Accord is to produce digital geoscience databases and maps of all of Australia by 2010, through 5-year programs in high priority areas. Computer technology will be used for all data handling, enabling data updating and manipulation, and integration of different data sets. Maps will be produced in both digital and traditional paper formats.

These three national mapping programs have been developed in response to essentially the same problems — growing demands for geoscience information (in both traditional and new formats) from both traditional and new clients, escalating costs of acquiring and publishing new geoscience information, and constant or declining financial and human resources. All three contain similar strategies to resolve these problems. All stress cooperative federal-provincial/state programs, to reduce logistical costs and make better use of human resources. Each recognizes the invaluable training role of mapping for the next generation of geoscientists. And all three state the necessity of developing computer technologies for all aspects of mapping, from initial data capture through data manipulation and storage to map publication.

Progress and Planned Activities

An interim Steering Committee was established after the Toronto workshop to refine the NATMAP concept and to develop an organizational structure to manage its implementation and growth. This committee, which is co-chaired by Sandy Colvine (GSC) and Dave McRitchie (Manitoba Geological Services Branch), met in June 1990 to begin actions that will move NATMAP from concept to reality.

Since that June meeting, the NATMAP secretariat has been established at the GSC in Ottawa, with the appointment of a NATMAP Coordinator. Several pilot projects will operate in the 1991 field season: these will be selected by the Steering Committee from proposals that have been received from both the provinces and the GSC. Experience gained from the pilot projects will help shape guidelines for the implementation and long term operation of NATMAP, including such requirements as project criteria, approval mechanisms, management and methods of increasing both professional and public awareness.

It was generally acknowledged at the workshop and at the initial meeting of the Steering Committee that NATMAP's ultimate success will depend in large part upon an infusion of resources. However, major

new financial support for NATMAP is unlikely in the immediate future. Nonetheless, an opportunity exists now to use existing resources for pilot projects that can be used to demonstrate NATMAP's importance to the Canadian geoscience community.

NATMAP can significantly increase the level of geoscience mapping activity in Canada. This goal can best be met by developing mechanisms that result in truly cooperative, multidisciplinary investigations that make the best use of the vast range of geoscience knowledge and expertise that resides in Canada's government geological surveys, universities, and minerals industry. The different strengths of these institutions have long been recognized, but seldom combined effectively. NATMAP can have perhaps its greatest impact by making that integration common.

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