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Résumé de l'article

Large amounts of geologic field data have been produced as a result of recent geologic investigations by the New Brunswick Department of Natural Resources, financed by the Federal Department of Regional Economic Expansion. This necessitated designing a standardized system for the collection, storage and retrieval of geologic field data, which is briefly described in this report.

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Collection, Storage and Retrieval of Geological Field Data in Precambrian and Paleozoic Rocks of Southern New Brunswick

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Summary

Large amounts of geologic field data have been produced as a result of recent geologic investigations by the New Brunswick Department of Natural Resources, financed by the Federal Department of Regional Economic Expansion. This necessitated designing a standardized system for the collection, storage and retrieval of geologic field data, which is briefly described in this report.

Introduction

Vast amounts of geologic data produced as a result of recent geologic investigations by the New Brunswick Department of Natural Resources necessitated the use of a standardized system for data collection adapted to computer processing. This system was designed to: 1) insure collection of all pertinent field data, 2) reduce subjectivity in observations and recording, 3) improve efficiency of data processing.

Our system can incorporate typical lithologic and structural data of deformed Precambrian and Early Paleozoic metasedimentary, volcanic and intrusive rocks in New Brunswick. We suggest, moreover, that our method can be applied, with possible minor modifications, to tectonites in other parts of the northern Appalachians.

Other systems for computer storage and retrieval of geologic field data have been developed for regional surveys in Manitoba (Haugh *et al.*, 1967), British Columbia (Hutchison and Rodderick, 1968) and Quebec (Wynne-Edwards *et al.*, 1970). These systems were not amenable for typical field data in the northern Appalachians of New Brunswick.

Our field data have been collected in a standardized format (Fig. 1). Common lithologic and structural data as well as standard reference information were recorded in coded form (Table I). Other pertinent data were incorporated in additional notes. Emphasis was placed on structural data because most rocks in the area have been subjected to intense polyphase deformation. The field sheet has been designed for easy transfer to I.B.M. punch cards for

retrieval and processing. Our present system has been used successfully for four years. We hope that the following description of our method will be helpful to other geologists working in the northern Appalachians.

The senior author designed the data and code sheets with assistance of D. S. Secord, S. M. Buttmer, B. Jones and D. V. Venugopal. The computer program was written by D. S. Secord and it was partly modified and tested in detail by J. Chandra, as shown in this report. Professor David Bonyon of Acadia University assisted by converting his general purpose computer program to produce stereo net diagrams (Bonyon and Stevens, 1970) for punched output of our structural data.

Description of Data Sheet

This standard data sheet (Fig. 1) is divided into four sections: 1) Location and general reference, 2) Lithologic descriptions, 3) Structure, and 4) Description of sample data, formational names, geologic age and available additional data.

Location and General Reference Section. Outcrops with fundamental lithologic and structural data have been plotted on base maps

	Code	Explanation		Code	Explanation
Lithology	RT	Rhyolite, tuff	Minerals and/or Rock Types	VF	Volcanic Fragments
	ST	Sandstone		QZ	Quartz
	SK	Siltstone		MX	Matrix
	DB	Diabase		MF	Mafics (undifferentiated)
	GT	Granite		FC	Feldspar (undifferentiated)
Colour and Value	MR,1	Maroon, Mottled	Alteration	EP	Epithermal
	MR,N	Maroon, Medium		Ch	Chlorite
	GG,M	Grey-green, Medium		Ep	Epidote
	GR,D	Green, dark		HD	Hematite, disseminated
				NV	Nematite, vein
Further description	R	Interbedded	Metallization	PD	Pyrite, disseminated
	I	Intrusive			
Grain Size	M	Medium (1-5 mm)	Cleavage or Schistosity	A	Slaty cleavage
	F	Fine (0.1-1 mm)		C	Crenulation cleavage
	V	Very fine (< 0.1 mm)		B	Fracture cleavage
Texture (Primary)	19	Porphyroclastic	Veins	A	Metallized
	19	Moderately sorted		A	Diabase
	24	Well sorted	Sills or Dykes	K	Unknown
	21	Porphyritic		U	Up
	21	Granular	Faults	D	Detrital
Texture (deformation)	1	Cataclastic		S	Slip
			Unions	C	Unclassified
Linear Structure	21	Intersection bedding (S ₁) and first cleavage (S ₂)		E	Extension
	04	Intersection first cleavage (S ₁) and second cleavage (S ₂)			
	06	Intersection second cleavage (S ₂) and third cleavage (S ₃)			
Minor Folds	3	Asymmetrical (S-shaped)			
	1	Symmetrical			
	2	Asymmetrical (Z-shaped)			
Fold Group	1	Close to isoclinal folds with penetrative axial plane cleavage			
	2	Open to tight folds which have deformed bedding (S ₁) and cleavage (S ₂)			
	3	Chevron folds which have deformed structures of Group 1 and 2			

Table I
Codes used in Figure 1.

MINERAL RESOURCES BRANCH, SOUTHERN NEW BRUNSWICK														
Card No. <input type="checkbox"/>		Field Map No. P28		o/c No. B027		Card No., Field Map No., o/c No. appear in the first 8 columns of each card								
Air Photo No. 514-0214		Geologist RPM		Date 280771		Project No. 9315								
o/c Location Longitude 654840		Latitude 452207		o/c Dimensions Length 0030		Width 0020								
o/c Orientation 030		Correlative Field Map No. Q27		o/c No. 0014		END CARD 0								
LITHOLOGY														
CARD 1														
Rock Type	RT		ST		SN		DB		GT		NOTES			
Percentage	10		30		40		05		15		CARD 8 Subject Code			
Colour & Value	MR T		MR M		GG M		GN D		GG M		G T H E I S			
Further Description	B		B		B		K		I		R A N I T E I S			
Grain Size	M		F		V		F		M		I N T R U D E D B			
Texture Prim & Metam	19		09		08		04		01		Y T H E D I A B			
Deformation	I		I		I		I		I		A S E - T H E R H			
Minerals & Percent	VF 4		QZ 5				FP 2		MU 2		Y O L I T E T U F			
And/Or	FU 1		QT 4				MX 8		FK 2		F H A S A W E			
Rock Types & Percent	MX 4		RL 1						FP 4		A K E U			
(If Detrital)	QZ 1								QZ 2		T A X I T I C			
Alteration Product									C		F O L I A T I O N			
Metalization & Description	H D		H V				F D				W H I C H H A S			
											B E E N R E C O			
											R D E D U N D E R			
											F L O W S T R U			
											C T U R E			
											END CARD 9			
PLANAR STRUCTURE														
END CD 3														
Info	1		1		1		A		C		B			
Strike	013		049		139		032		112		134			
Dip	60S		40N		47S		71N		80S		30N			
Rel Age	U		K		K		1		2		3			
Topo														
FAULTS														
Info	1		1		1		1		1		1		1	
Strike	085		085		178		60N		60N		60N		60N	
Dip	20S		20S		20S		20S		20S		20S		20S	
Rel Age	1		1		1		1		1		1		1	
Str. Pch	075		075		075		075		075		075		075	
Series	D		D		D		D		D		D		D	
LINEAR STRUCTURE														
CONT CD 6														
Type	01		04		06		01		04		06		01	
Azimuth	130		270		020		130		270		020		130	
Plunge	58		67		28		58		67		28		58	
MINOR FOLDS														
CARD 7														
Symmetry	3		1		2		3		1		2		3	
Closure	3		1		2		3		1		2		3	
Strike	112		032		134		112		032		134		112	
Dip	80S		71N		30N		80S		71N		30N		80S	
Azimuth	281		026		114		281		026		114		281	
Plunge	50		18		10		50		18		10		50	
Group	1		2		3		1		2		3		1	
JOINTS														
CARD 6														
Type	S		U		E		S		U		E		S	
Strike	140		114		050		140		114		050		140	
Dip	88S		246		75N		88S		246		75N		88S	
Intensity	04		05		10		04		05		10		04	
CONT. CD 7														
Grab Sample	1		1		1		1		1		1		1	
Oriented Sample	1		1		1		1		1		1		1	
Mineralized Sample	1		1		1		1		1		1		1	
Chip Sample	1		1		1		1		1		1		1	
Fossil	1		1		1		1		1		1		1	
Chemical Analysis Bulk	1		1		1		1		1		1		1	
Specific	1		1		1		1		1		1		1	
Thin Section	1		1		1		1		1		1		1	
Polished Section	1		1		1		1		1		1		1	
Photo	1		1		1		1		1		1		1	
Formation Name	CB		CB		CB		CB		CB		CB		CB	
Age	PC		PC		PC		PC		PC		PC		PC	
Additional Data	1		1		1		1		1		1		1	
END CARD 7														

Figure 1
Field Data Sheet.

(scale one inch equals one quarter mile), which are designated by a letter and two-digits (card 0 – columns 2-4). Outcrops have been identified by a letter code assigned to each geologist (column 5) and a number (columns 6-8). Outcrop locations are determined on air photos which are designated by flight and photo numbers respectively, (columns 9-16). The name of the geologist, date and project number are indicated in columns 17-29. The following sections describe the outcrop location by longitude and latitude (columns 30-41), the dimension, and orientation (columns 42-52). A possible correlation of the lithologies comprising the outcrop with a standard section (columns 53-59) is indicated if the relationship is known.

Lithology. The upper part of this section (card 1) makes provision for recording five lithologies (columns 9-18), relative amounts of each (columns 19-28), colour (columns 29-43), contact relationships between various lithologies (columns 44-48), grain size (49-53) and texture (54-63). Presence of deformational effects is indicated by placing the number "1" in the appropriate column (64-68).

The central part of this section indicates the relative amounts of minerals and rock fragments for various rock types (card 2 – columns 9-80 and card 3 – columns 9-11). The lower part of this section (card 3) indicates rock alteration (columns 12-26), metallic minerals and mode of occurrence (columns 27-56). Additional information about these are usually given in the notes (cards 8 and 9).

Structure. This section is divided into two parts: a) Planar structures and b) Linear structures.

In the sub-section on planar structures, the blocks near the top of each column (card 3 – columns 57-67) indicate the presence (referred to by the number "1") and/or nature (indicated by a letter) of various types of planar structures. Below these, provision has been made to indicate strike (card 4 – columns 9-41), dip angles and directions (columns 42-74) and relative ages of various structures which are indicated by

numbers (card 5 – columns 12-19). Faults are recorded in a similar fashion (card 5 – columns 20-35), but, in addition, pitches of striations and sense of movement are indicated (columns 36-43). Joints have been classified into three categories (Fig. 2) and provision has been made for five sets (Fig. 1). In addition to attitudes (card 6 – columns 9-43), the intensity has been indicated in joints per meter (columns 44-53).

Linear structures (Fig. 2 shows a classification of intersection and mineral lineations) are recorded on card 6 – columns 54-74. The geometry (card 7 – columns 9-14) and attitudes (columns 15-47) of folds have been indicated in the next section. Allowance has been made for three groups of folds which can usually be recognized in most polydeformed rocks of the region (columns 48-50). At any particular locale, effects of all types of deformation may not be present, and therefore, where evidence of sequence is lacking the folds have been classified on the basis of style alone.

The remainder of card 7 describes various types of samples collected (columns 51-55), sample preparations (columns 56-60), formational name (columns 61-62), age (columns 63-64) and presence of additional

data is indicated in column 65. Cards 8 and 9 are entirely used for additional field notes.

Data Retrieval

A computer program has been written to store and retrieve geologic and related data. Print out of data is designed to facilitate comparison and manipulation. The following flow chart illustrates the sequence of punched cards in a typical retrieving operation (Fig. 2).

The main program is capable of both full print out or retrieval of part of the data. Figure 3 shows the specification cards in sequence for retrieval purposes.

Acronyms used to construct word codes for the required specifications are described in the following pages.

Description of Retrieval Specification Cards

The retrieval specification card (R.S. Card 1) following the \$GO card shows:

- 1) Type of data required, 2) Location parameter, 3) Lithological parameter, 4) Type of output required for structural data (punch out or print out).

Retrieval specification Card 1 (R.S. Card 1) is shown in Figure 4.

Some examples of the use of R.S. Card 1 are:

- a) STRU, COBO, ROTY, POPL.
Punched output of planar structures (POPL) is required for a rock type (ROTY) (ROTY specified on R.S. Card 4) within certain co-ordinate boundaries (COBO) (COBO specified in R.S. Card 3).
- b) NOTE, PACK, ROTY
Printed output is required for all notes (NOTE) on a particular rock type (ROTY) in the entire data package (PACK). The rock type is specified in R.S. Card 4.

Some examples of R.S. Card 2 are:

- a) PLST, CLSC, 3, A, C, B.
Three types (3, A, C, B) of cleavages (CLSC) are requested under planar structures (PLST). When types are specified by only one letter or one number, the type symbols are placed in columns 13, 16, and 19 (See Figure 5). Print out will be generated even though one of these types is present.

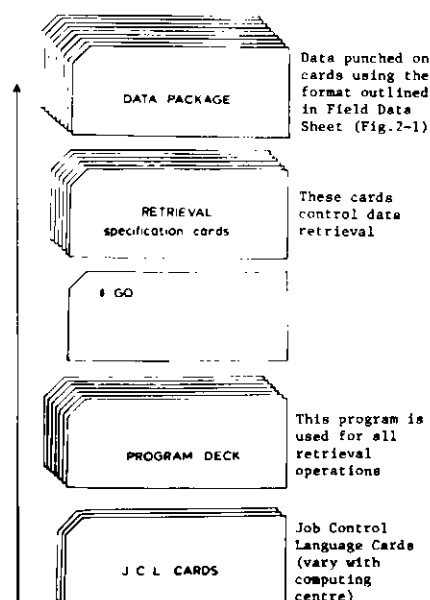


Figure 2
Typical Retrieval Operation Deck.

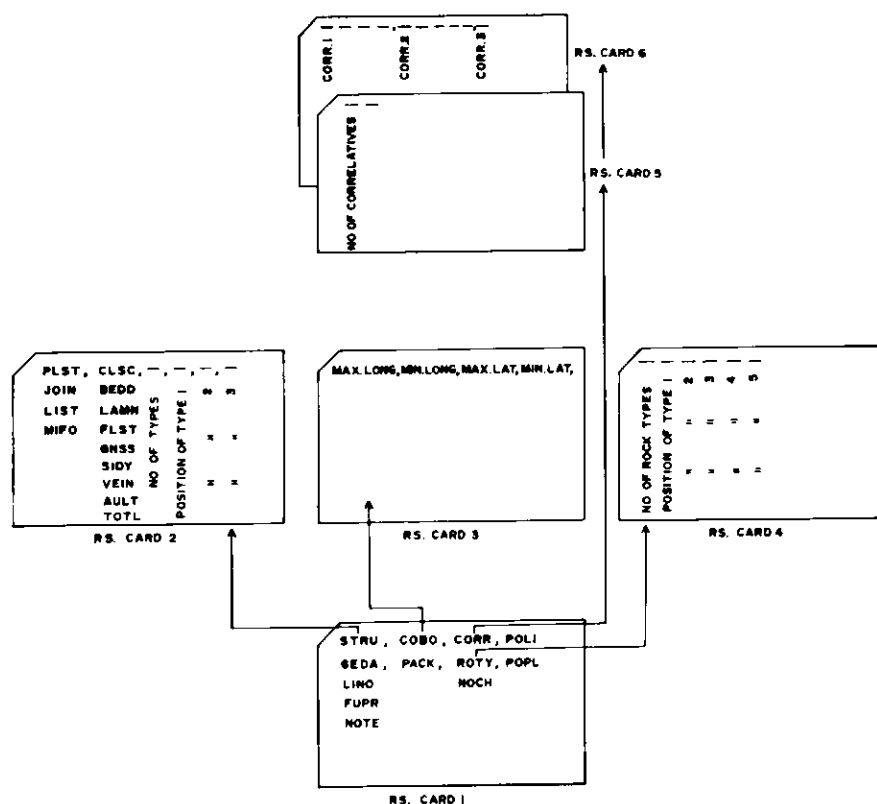


Figure 3
Retrieval Specification Cards.

TYPE OF OUTPUT	CODE	LOCATION PARAM	CODE	LITHOLOGICAL PARAM.	CODE	OUTPUT OPTION(Structure)	CODE
FULL PRINTOUT	FUPR	Coordinate bound- aries	COBO	Rock type (S)	ROTY	Punched output for planar structure	POPL
GENERAL DATA	GEDA	Package (data package)	PACK	Correlative (S)	CORR	Punched output for linear structure	POLI
LITHOLOGY AND NOTES	LINO			No check required	NOCH		
STRUCTURES	STRU					Result in printout of data	(Blank)
NOTES	NOTE						

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
F	U	P	R		C	O	B	O		C	O	R	R		P	O	P	L
G	E	D	A		P	A	C	K		R	O	T	Y		P	O	L	I
L	I	N	O							N	O	C	H					
S	T	R	U												b	b	b	b
M	O	T	E															

Figure 4
Retrieval Specification Card 1.
(b = blank space).

- b) LIST, TOTL, 3, 01, 04, 06
A total (TOTL) check is requested for three types (3, 01, 04, 06) of linear structures (LIST).
- c) MIFO, TOTL, 3, 1, 2, 3
A total (TOTL) check is made for three types (3, 1, 2, 3) of minor folds (MIFO).

The use of R.S. Card 3 is shown in Figure 6. The code COBO, representing co-ordinate boundaries, restricts the computer to a part of the data deck within certain geographic boundaries indicated by maximum and minimum latitudes and longitudes. The computer can also be requested to read through the entire

data package by using the acronym PACK in R.S. Card 1. In this case, the use of a COBO specification card (R.S. Card 3) is unnecessary.

Figure 7 illustrates the use of R.S. Card 4 which specifies only rock types (ROTL). When no check is required for any particular rock type the acronym NOCH is used in R.S. Card 1. This eliminates the use of card 4 as shown in Figure 4.

In order to specify correlatives (CORR), R.S. Card 5 and R.S. Card 6 (Figure 8) are used in place of R.S. Card 4. A maximum of 10 correlatives may be specified.

Examples of Retrieval Operations

Data from the Field Sheet (Fig. 1) was used to generate these results. The examples (Table II) show the sequence of retrieval specification cards and the printed/punched result.

Conclusions

Our computer oriented method of geologic data collection, storage and retrieval has the following advantages over conventional methods:

- 1) It provides for accurate collection of all pertinent geologic field data.
- 2) Subjectivity of standard geologic observations is greatly reduced, while provision for additional notes and sketches allows for sufficient flexibility of the system.
- 3) Training of new geologists and senior students has been greatly accelerated as a result of this system.
- 4) Editing and correlation of geologic data collected by large numbers of observers is greatly facilitated.
- 5) Punched output of various types of geologic data can be produced rapidly for any part of the area or specified geologic parameter. This greatly accelerates final processing of structural and lithologic data.
- 6) Mineral exploration geologists can rapidly search our data file for mineral occurrences, alteration zones, rock assemblages and structures favorable for deposition of metallic minerals.

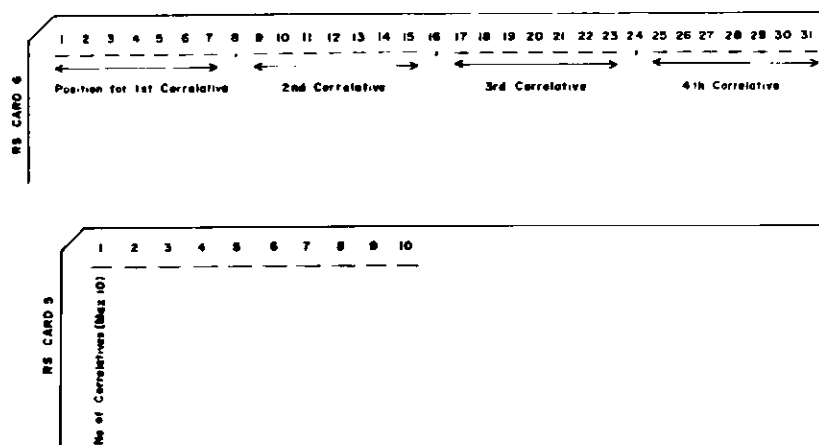


Figure 8
Retrieval Specification Card 5 and 6
(CORR).

Table II

EXAMPLE 1	
No. of RS Cards Required	LINO,PACK,NOCH
1	
O/C NO P28B027	LONG 654840 LAT 452207
LITHOLOGY	
ROCK TYPE	RT ST SN DB GT
PCT	10 30 40 5 15
COLOUR	MRT MRM GGM GND GGM
FURTHER DESCR	B B B K I
GRAIN SIZE	M F V F M
TEXTURE PRIM	19 09 08 04 01
TEXTURE DEFOR	1 1 1
MINERAL PCT	VF4 QZ5 FP2 MU2
AND/OR	FU1 QT4 MX8 FK2
ROCK TYPE PCT	MX4 RL1 FP4
IF DETRITAL	QZ1 QZ2
ALTERATION PR	
METALLIZATION	HD HV FD
AND	
DESCRIPTION	
NOTES	
G THE GRANITE IS INTRUDED BY THE DIABASE. THE RHYOLITE	
TUFF HAS A WEAK BUTAXITIC FOLIATION WHICH HAS BEEN RECORDED UNDER FLOW	
STRUCTURE	
TERMINATION	

EXAMPLE 2	
No. of RS Cards Required	Q270014
5	01
	654845,654835,452230,452200
	PLST,CLSC,2,A,B
	STRU,CORO,CORR
STRUC P LOC C NO 2 TYPE(S) A B	
1	
4	
3	
COORDINATE BOUNDARIES LONG 654845 654835 LAT 452230 452200	
NO3 1 CORR(S) Q270014,	
O/C NO P28B027 LONG 654840 LAT 452207	
PLANAR STRUCTURE	
INFO	BED LAM FLS CLE OR SCH GNE VEL VE2 SI OR DY
STRIKE	1 1 1 A C B 0 0 A A
DIP	13 49 139 32 112 134 0 0 175 132 0
TOPS	60° 40N 47S 71N 80S 30N 80S 83S
REL AGE	U K K 1 2 3 0 0 1 1 0
INFO	FA1 FA2
STRIKE	1 1
DIP	95 178
REL AGE	205 50N
STRI P1	1 2
SENSE	075 80N
	D D
TERMINATION	