MINERAL INVENTORY SYSTEMS
TRAINING HANDBOOK

Compiled by L.D. Jones

OPEN FILE 1994-20
Development and Management of Computerized Mineral Inventory Systems, using MINFILE as an Example
Forward

In November, 1993, the Geological Survey Branch of the Ministry of Energy, Mines and Resources offered a two-week training course to two geologists from the Mineral Resources Department in Tanzania. The purpose of the course was to provide guidelines on the organization, development and management of mineral resource data using personal computers. The course included talks on systematic database development and used MINFILE and other databases as practical models for managing resources.

The intent of this publication is to document most of the notes and overheads used in the course. It will be of interest to those planning and developing mineral inventory and other earth science related database systems.

MINFILE is a comprehensive, computerized mineral inventory of over 11,400 metallic, industrial mineral and coal occurrences in British Columbia. The information is used for geoscience research, mineral exploration, prospecting, land-use management and other applications requiring data for managing mineral resources. The MINFILE system was a pioneer of computerized mineral inventories. It began in the 1970s and now, after over two decades of research, development, and practical usage, is a stable, powerful, easy-to-use, mineral inventory system for IBM PCs and compatibles. The design of MINFILE, the depth of geological data, and the ability to distribute digital data to clients ensures its continued applicability, data-integrity and system-flexibility.

Through licensing agreements, the Province of British Columbia offers the MINFILE system for sale. This proven system can easily be customized to immediately capture data in other localities. Participating agencies could also use MINFILE as a model to design a new system or enhance an existing inventory system. Either way, savings, both in time and cost, would be realized in designing, developing and testing the resulting system. For further information on licensing or training contact Larry Jones, MINFILE Project or Gib McArthur, Manager, Geoscience Information Section, Geological Survey Branch, 5th Floor, 1810 Blanshard Street, Victoria B.C., V8V 1X4; phone (604) 952 0382; fax (604) 952-0381.

Some of the course material is based on a training course on Computerized Databases in Mineral Exploration and Development, which took place in Lusaka, Zambia in May 1993, sponsored by the International Atomic Energy Agency (IAEA) and the Government of Zambia. The course was a follow-up on previous work with the IAEA in Vienna in 1990 and 1991, which resulted in a 200-page technical document titled: "Guidelines for the Organization and Management of Earth Science Data on a Personal Computer." The document is aimed at providing government organizations in developing countries with guidelines in the organization, management and preservation of earth science data.

As coordinator of the course, I acknowledge the assistance from Ministry staff including Gib McArthur, Vic Preto, Cindy McPeek, George Owsiacki, Dorthe Jakobsen, Kim Stone, Don Porter, Laura de Groot, Allan Wilcox, Sherri Proceviat, Sharon Ferris, Eric Grunsky, Ward Kilby, Bill McMillan, Dave Grieve, Dave Lefebure, Steve Sibbick, and Brian Grant.

Larry Jones
Senior Geologist
MINFILE Project
Geological Survey Branch
Development and Management of Computerized Mineral Inventory Systems, using MINFILE as an Example
15 - 26 November 1993, Victoria, B.C., Canada

OUTLINE:

Course Introduction and Outline
The Role of the Geological Survey Branch (GSB)
Overview of Geological Survey Branch Databases
Geology and Mineral Resources of B.C.
The Strategy and Philosophy in Mineral Resources Databases
Guidelines to Database Systems
Mineral Deposit Databases
MINFILE Project Management
  Concept, designing, planning (budget, staff)
  Database Design and Data Dictionary
  System Testing and Quality Assurance
  Database Administration and Maintenance (documentation and manuals)
  Data Acquisition and Processing Procedures (coding procedures)
Training and Client Support
Marketing and Distribution of Data
New Technology and Future Planning
Designing and Producing Computer Generated Products for Users
Mineral Titles
Mineral Exploration Databases
Earth Science Information Databases (ARIS example)
Using the MINFILE System:
  Basic Disk and File Management Techniques (DOS and dBase)
  Installing MINFILE
  Searching, Reporting, Data Entry, Data Transfer and Utilities
Data Integration, Mineral Potential and GIS Applications

Branch Tours

Myra Falls Mine Visit
# Development and Management of Computerized Mineral Inventory Systems, using MINFILE as an Example

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# Development and Management of Computerized Mineral Inventory Systems, using MINFILE as an Example
15 - 26 November 1993, Victoria, B.C., Canada

## FINAL PROGRAM

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Province of British Columbia 

Geological Survey Branch
15. **Mineral Titles:** J. Chan, K. Stone, D. Porter  
   - LUNCH -  
   10:30 - 12:00

16. **New Technology and Future Planning:** L. Jones  
   13:30 - 14:00

17. **Designing and Producing Computer Generated Products for Users:** L. Jones, G. Owsiacki  
   - COFFEE BREAK -  
   14:00 - 15:00

18. **The QuikMap Mapping System:** G. Owsiacki, L. Jones  
   - Discussions -  
   15:30 - 16:30
   16:30 - 17:00

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**Thursday, 18 November**

- Discussions -

19. **Data Modelling Concepts:** L. de Groot, L. Jones  
   - COFFEE BREAK -  
   09:00 - 09:15
   09:15 - 10:30

20. **Data Modelling Practical (Host Rock Hierarchy):** L. Jones, L. de Groot  
   - LUNCH -  
   11:00 - 12:00

21. **Data Modelling Practical, continued:**  
   L. Jones, L. de Groot, G. Owsiacki  
   - Discussions -  
   13:30 - 16:30
   16:30 - 17:00

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**Friday, 19 November**

- Discussions -

22. **Mineral Exploration Databases:** L. Jones  
   - Geological Database System (GBS-GDS), COALFILE Database  
   - Regional Geochemistry Survey (RGS) Database  
   - COFFEE BREAK -  
   09:00 - 09:15
   09:15 - 10:15

23. **Earth Science Information Databases**  
   - Their Elements and Functions: L. Jones  
   - Assessment Report (ARIS) Database: A. Wilcox, L. de Groot  
   - LUNCH -  
   10:45 - 12:00

24. **Bibliography Database Demonstration**  
   - ARIS Database, CDS-ISIS, GEOSCANN: A. Wilcox  
   - ARIS Maps: S. Proceviat  
   13:30 - 15:00

25. **GeoHighlight Talks:**  
   - Exploration Highlights in B.C., Tom Schoeter  
   - Geology and Mineral Potential of Tanzania, P. Ndondo, A. Ishegize  
   **Geological Survey Branch Slide Show,** Oak Bay Beach Hotel  
   15:00 - 17:00

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**Sunday, 21 November**

Drive to Campbell River  
Accommodation at Discovery Coast Inn  
12:00 - 18:00

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**Monday, 22 November**

26. **Myra Falls Mine Tour,** S. Juras (Westmin)  
   Drive to Victoria  
   09:00 - 15:00
   15:00 - 20:00
Tuesday, 23 November

27. **Computer Program Demonstrations**
   - Bedrock, COALFILE, Metadata File: ARISTRAN, ATLAS,
   - MINERAL, UDEPO, GSB-GDS, NEWPET, RGS, Help Desk, Pro-Cite
   - LUNCH

28. **Tour of Ministry Activities**
   - Information Resource Centre (Georef Search)
   - Discussions

Time:
09:00 - 12:00
13:30 - 15:00
15:00 - 16:00

Wednesday, 24 November

- Discussions

29. **Workshop on Using the MINFILE System:** D. Jakobsen, G. Owsiacki

30. **Basic Disk and File Management Techniques** (DOS and dBase)

31. **Introduction to MINFILE**
   - LUNCH

32. **Installing MINFILE/pc**

33. **Searching, Reporting, Data Entry, Data Transfer and Utilities**
   - Discussions

Time:
09:00 - 09:15
09:15 - 12:00
13:30 - 14:00
14:00 - 16:30
16:30 - 17:00

Thursday, 25 November

34. **MINFILE Workshop** continued
   - LUNCH

35. **Data Integration, Mineral Potential and GIS Applications:**
   - W. Kilby
   - COFFEE BREAK

36. **Tour of Ministry Activities**
   - Mineral Potential Project: E. Grunsky, P. Desjardins, J. Cunningham
   - Scientific Review: B. Grant

Time:
09:00 - 12:00
13:30 - 15:00
15:30 - 16:30

Friday, 26 November

37. **Tour of Ministry Activities**
   - Mapping Section: B. McMillan
   - COFFEE BREAK

38. **Tour of Ministry Activities**
   - Economic Geology Section: D. Lefebvre, D. Grieve
   - LUNCH

39. **Tour of Ministry Activities**
   - Environmental Geology Section: S. Sibbick

40. **Wrap-up**

Time:
09:00 - 10:00
10:30 - 12:00
13:30 - 14:30
14:30 - 17:00
Development and Management of Computerized Mineral Inventory Systems, using MINFILE as an Example

Larry Jones, Coordinator

Notes from a Training Course held in Victoria, B.C., 15 - 26 November 1993
Introduction

Participants:

Tanzania Mineral Development

Coordinator:

Geological Survey Branch
- Larry D. Jones

Contributors:

- Gib McArthur
- Vic Preto
- Cindy McPeek
- George Owsiacki
- Dorthe Jakobsen
- Janice Chan
- Laura de Groot
- Allan Wilcox
- Eric Grunsky
- Ward Kilby
Introduction

Purpose

✓ provide guidelines on the organization development and management of mineral inventory systems
✓ systematic database development
✓ mineral resource data
✓ use of personal computers
✓ MINFILE example
Introduction

Course Outline

Course Introduction and Outline
The Role of the Geological Survey Branch (GSB)
Overview of Geological Survey Branch Databases
Geology and Mineral Resources of B.C.
The Strategy and Philosophy in Mineral Resources Databases
Guidelines to Database Systems
Mineral Deposit Databases
MINFILE Project Management
Mineral Titles
Mineral Exploration Databases
Earth Science Information Databases (ARIS example)
Using the MINFILE System:
Data Integration, Mineral Potential and GIS Applications

Branch Tours

Myra Falls Mine Visit
Introduction

Course Materials

✓ Course Binder
  - lecture notes
  - handouts

✓ MINFILE Manuals
  - Coding Manual
  - User's Manual
  - Workshop Notes

✓ Government Publications
  - Style Guide
  - Introduction to Prospecting
  - NTS Location & Author Index
  - Mineral Market Update
  - B.C. Exploration & Development Highlights
  - Ore Deposits, Tectonics and Metallogeny
  - Other publications

✓ Diskettes
  - MINFILE/pc
  - Sample Data
  - Various programs and utilities
Introduction

Lusaka Workshop

Place & date

Participants
- 20 participants from Geological Surveys of 13 Countries in Africa

Technical Document (TECDOC)
- Guidelines for the Organization & Management of Earth Science Data on Personal Computers

Consultants
- Larry D. Jones, B.C. Geological Survey
- Caj R. Kortman, Geol. Surv. of Finland
- Maksimilijan Pecnik, IAEA
- Dr. Richard B. Taylor, USGS
Lusaka Workshop

Course Content

- Mineral Exploration & Development in Africa
- Geology & Mineral Resources of Zambia
- Computers in Geological Studies & Mineral Exploration
- Exploration & Development Strategy & Planning
- Strategy & Philosophy in Mineral Resources Databases
- Computer Hardware & Software
- Guidelines to Database Systems
- Geoscience Databases
- Earth Science Information Databases
- Mineral Deposit Database
- Exploration Databases
IAEA-TECDOC-... in press

Guidelines for the organization and management of earth science data on a personal computer

INTERNATIONAL ATOMIC ENERGY AGENCY  IAEA
ABSTRACT

The understanding of database systems for the organization, management and presentation of earth science data is a major challenge for geological organizations. The management of digital data sets includes the systematic collection, storing, retrieving, transforming and displaying of data. The IBM-PC and compatibles are considered the most suitable, either as temporary or permanent, solutions for the creation of an information system. The dBASE-compatible, Lotus 1-2-3-compatible and ISO-ASCII files are recommended formats for data storage. Database design includes the understanding of data modelling, format standardization, data specifications and types, and data access methods. Geoscience information systems comprise several thematic databases, starting with the master database, which contains information about other databases, such as those handling bibliographies, mapping indexes, mineral deposit information, and exploration information. Most of these subject databases follow a multi-level model. Well designed databases are potentially valuable for integration into more sophisticated and enhanced information systems at a later date when such are required and available. Organizations may benefit by modelling after simple to complex examples of solutions to database management systems in the planning and developing of database systems to meet their needs.

FOREWORD

The International Atomic Energy Agency has long had an interest in providing manuals and guidebooks to assist workers in the most effective use of uranium exploration techniques and methods. Little has yet been done to assist the management of the earth science information needed for exploration or that produced by exploration activities. During the last several decades, the worldwide search for uranium has generated vast amounts of valuable data. The recent decline in uranium exploration has increased the risk of the loss of this data. The IAEA has produced this document to encourage the preservation of data in digital form so that they will still be available when needed in the future.

To address this need the IAEA convened meetings of consultants in October 1990 and September 1991. The three consultants, Larry D. Jones of the British Columbia Geological Survey, Canada, Caj R. Kortman of the Geological Survey of Finland, Richard B. Taylor of the United States Geological Survey, and IAEA staff member Maksimilijan Pecnik, brought their experience in the organization and management of many kinds of earth science information to this need. The capabilities of microcomputers belonging to the IBM-compatible family, using widely available software, were recommended for these tasks. Discussions and examples are provided to assist small organizations in setting up data systems. This volume provides the tangible results of these meeting.
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UNITED STATES DEPARTMENT OF THE INTERIOR  
GEOLOGICAL SURVEY  

SYSTEM 8. GSMAP, GSMEDIT, GSMUTIL, GSPOST, GSDIG AND OTHER PROGRAMS VERSION 8,  
FOR THE IBM PC AND COMPATIBLE MICROCOMPUTERS, TO ASSIST WORKERS IN THE  
EARTH SCIENCES  

by  
Gary I. Selner and Richard B. Taylor  

Open-File Report  
92-217  

DISCLAIMER  

Although program tests have been made, no guarantee (expressed or implied) is made by the authors or the U.S. Geological Survey regarding program correctness, accuracy, or proper execution on all computer systems. Any use of trade names is for descriptive purposes only and does not imply endorsement by the U.S. Geological Survey. This report and has not been reviewed for conformity with the U.S. Geological Survey editorial standards.  

Denver, Colorado  
February, 1992
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UNIVERSAL DECIMAL CLASSIFICATION (UDC); International Medium Edition, English Text, Part 1; Systematic Table, British Standards Institute, (1985) 495 p.

Overview of Geological Survey Branch Databases

OUTLINE:

Introduction

B.C. Geological Survey Databases
  ARIS
  COALFILE
  BEDROCK
  MINFILE
  PROPERTY FILE
  GSB-GDS
  RGS

Integration of Databases - Mineral Potential Maps

System Plan Development - Example

Summary

Lecture by: L. Jones
15 November 1993

References: TECDOC Section 4.2, Annex 6.1
Geological Survey Branch

Mandate

The Geological Survey Branch of the Ministry of Energy, Mines and Petroleum Resources is charged with providing the geological inventory required to develop British Columbia's mineral resources, to improve government's stewardship of our mineral endowment, and to help manage and protect Crown lands.

The Branch's mandate is to:

Assemble, maintain, and market a comprehensive geoscience database for B.C. to provide a sound base for

1. exploration & development of the province's mineral resources;
2. planning & resource management decisions by governments; and,
3. public information on geological resources and hazards.
Geological Survey Branch

Hardware
Computers: IBM compatibles (586s, 486s, 386s)
           Macintosh
           Notebooks
           SPARC 10 Work Stations
Printers:  HP LaserJet, Dot Matrix
Plotter:   HP 650 Colour, HP Draftmaster
Digitizers: Kurta
Slide Makers: Matrix Procolor
Flatbed Scanner: Disks, Tapes, CD ROM

Software
Operation Systems: Dos, Workgroup for Windows, UNIX
Word Processing: Word for Windows, Ventura
Spreadsheets: Excel, Lotus, Quattro Pro
Databases:     dBASE, FoxPro, Friendly Finder, R&R
Communications: Dynacomm, Sethost, (network to VAX)
                E-Mail, INTERNET
Graphics:      CorelDRAW, Harvard Graphics,
                Power Point
Mapping/GIS:   AutoCad, Terrasoft, QuikMap
Custom software: eg MINFILE/pc, ARIS, Field Data
British Columbia Geological Survey Geoscience Databases

Assessment Report Indexing System  
Acronym: ARIS

ARIS is a relational database that is an index and an administrative tracking system to the Geological Survey Branch's Mineral Assessment Report Library of more than 22,000 reports. Approximately 1000 new reports are added annually. The database is used to display the distribution of exploration and development activity and for research and mineral potential projects. A group of fields for each Assessment Report are extracted in 8 ASCII files from the VAX mainframe to diskettes. This data may be used on the PC within database management and small mapping projects using QUIKMap software.

Host computer: VAX Mainframe; PC  
Data model: Entity-relationship  
Data size: 22000 records; 70 MB  
Operating system: VMS; DOS  
DBMS: SUPRA; ASCII; dBase  
Number of files: 15  
Fields per record (maximum/average): 60/40.

COALFILE  
Acronym: COALFILE

COALFILE contains summarized coal assessment reports dating from 1900, submitted by exploration companies in compliance with the Coal Act. The data is organized in six related files - Explore, Comment, Map, Trench, Bulk and Borehole. There is a 3-year confidential period for coal exploration assessment reports and only non-confidential data is publicly available. Distribution policy and administration of the database is currently being established.

Host computer: PC  
Data model: Relational  
Data size: 8025 records; 3 MB  
Operating system: DOS  
DBMS: dBase  
Number of files: 6  
Fields per record (maximum/average): 171/78.

NTS Bibliographic Index  
Acronym: BEDROCK

Bibliography of BC Geological Survey publications, including author, title, type of publication and map area. The data file is used to publish a map location and author index.

Host computer: PC  
Data model: Flat-File  
Data size: 2800 records; 10 MB  
Operating system: DOS  
DBMS: dBase  
Number of files: 1  
Fields per record (maximum/average): 5/5.

B.C. MINFILE  
Acronym: MINFILE

MINFILE contains over 11,000 metallic, industrial mineral and coal occurrences for B.C. Each of these occurrences contain 84 data elements describing mineral deposits in terms of geography, geology and economics. The database is used by government, industry and academia for resource management, land-use planning, exploration and research. MINFILE/pc, Version 3.0, a menu-driven data-entry, search and report program for IBM-compatible computers, accesses the database. An exploration and development module is currently in development.
PROPERTY FILE

PROPERTY FILE is a library of research material on the mineral occurrences contained in the MINFILE database. The FILE contains news clippings, field notes, company prospectuses, and historical maps, photographs and documents. The FILE is used by government, industry and academia for research. The public has access to view these paper files.

Geological Field and Analytical Data
(Geological Database System)  

A dBase relational database contains locations for stations in UTM coordinates, structural measurements, alteration codes, mineralization, rock type and map unit, lists of fossils, age dates, geochemistry and isotopic data. Areas have been mapped at 1:50 000 scale since 1986. Data is not being marketed; available as flat ASCII files on request by interested users.

B.C. METAL  

BCMETERAL is the historical metal production database for British Columbia. It contains mine location and name, and metal production since 1888. BCMETERAL is a proto-type software, written in FoxBase, that allows query by name, location (NTS and Mining Division), year of operation, and metal type produced. Total production for any mine, year or Division may be calculated.

Regional Geochemical Survey  

RGS database contains multi-element analytical determinations, sample location information, bedrock associations and field observations of over 38,000 stream sediment and water samples in British Columbia. The database is used for exploration and development activities; geochemical, metallogenic and environment studies; and mineral potential, resource management and land-use projects. Digital data are stored in standard ASCII format.
ARIS
A Mineral Assessment Report Database for the Public

Geological Survey Branch
ARIS History

- 1947 1st Assessment Report
- 1981 IBM 3760 Mark IV
- 1984 NTS mini computer
- 1987 ARIS design starts
- 1987 VAX 780/8650
- 1988 ARIS production
- 1990 20 000th Assessment Report

BaTA Forum 1992
Geological Survey Branch
ARIS

- RELATIONAL DATABASE
- ENTITY/RELATIONSHIP MODEL
- 4TH GENERATION LANGUAGE
- 1200 NEW REPORTS ANNUALLY
- 22 000 REPORTS/RECORDS

BaTA Forum 1992

---

Geological Survey Integrated Data Base
Master File Maintenance

01 > General Data
02 > Names (Author Owner Operator)
03 > Geological Summary
04 > Keywords
05 > Work Data
06 > Approval Data
07 > Amend/Reject Data
X > Exits System

Option Number :
Assessment Report Number:

BaTA Forum 1992
MINFILE is ...

A powerful mineral inventory and exploration database for British Columbia

Mineral Deposit Information at YOUR Fingertips!
The MINFILE database has information on...

1. 11 368 metallic mineral, industrial mineral and coal occurrences

2. Showings to major producing mines

3. Location BC

4. Mineralogy and alteration

5. Geology and host rock

6. Assays, reserves and production

7. References and publications
MINERAL OCCURRENCES IN B.C.

B.C. Geological Survey Branch
MINFILE AT A GLANCE

DATABASE
Total occurrences: 11,368 records
Size of database: 68 Mb
Area covered (B.C.): 950,000 square kilometres
Map areas (1:250K scale): ~90 Maps
Data format: 69 entity-relational ASCII files
Per cent data released: 75%

PRODUCT OUTPUT
Mineral location maps: 1:250,000; 1:100,000 scales
Data diskettes (1.2 Mb): 1 for each map area
MINFILE/pc program: Data Entry-Search-Report
Paper printouts: Indexes and complete reports
Open Files: Commodity reports

CLIENTS
Users of MINFILE/pc: 536 clients
Mailing list for MINFILE: 950 clients
Types of clients: Governments, Industry, Public
List of interested clients: Canada, U.S.A., Australia,
New Zealand, England, Europe, China, Japan, Vietnam, Africa

January 1994
HISTORY OF MINFILE

YEAR
1967 CARD SYSTEM (BCDM)
1973 MINDEP (UBC)
1976 MINFILE (GSB)
1984 REDESIGN VAX
1987 MINFILE/pc V1.0
1988 MINFILE/pc V2.0
1989 MINFILE/pc V2.13
1990 DATA ENTRY PROGRAM DEVELOPMENT
1991 MINFILE/pc V3.0
1992 IMPROVEMENTS AND USER'S MANUAL
1993 EXPLORATION ACTIVITY PROGRAM DEVELOPMENT
1994 PROJECTED RELEASE MINFILE/pc V4.0

NUMBER OF OCCURRENCES (THOUSANDS)

January 1994
MINFILE products...

1. 1:250,000 NTS area data diskettes ($5/disk)
2. Paper printouts ($5-$50)
3. Mineral inventory maps by NTS area ($5)
4. Coding manual, custom searches, MINFILE/pc and User's manual (FREE)
5. Provincial MINFILE location index ($5)
6. Open Files: Major Industrial Mineral Deposits, Major Deposits in B.C. ($10)
7. Complete digital dataset of the Province ($75)
8. Complete set of 1992 MINFILE maps for the Province on microfiche ($10)
MINERAL INVENTORY MAPS
UPGRADES

- Topographic Base
- Geological Base
- Sorted Index Reports: Commodities, Name, Nts
- Plot by Status
- Computer Plotting
- Inserts
Mineral Potential Project

BaTA Forum 1992
Mineral Potential Project
Mission

The Mineral Potential Project of the Geological Survey Branch is a component of the multi-ministry Corporate Resource Inventory Initiative (CRII). Government agencies responsible for resource inventories will establish current inventories of the major land based resources of the province in digital form which is readily accessible for inclusion in the land use decision making process.

The Mineral Potential Project will evaluate the mineral potential of BC. The order in which the province is evaluated will be on a priority basis. The term 'mineral' is used in its broadest sense and includes solid, liquid and gaseous commodities found in the earth's crust which have value. Commodities included in this initiative will be metals, industrial minerals, coal, oil and gas.

BaTA Forum 1992
FIGURE 2

Mineral Potential Project
Project Components

- Data integration and analysis
  - Known commodity inventory
  - Preliminary data maps
    - Tract definition
    - Tract confidence
  - Data layers storage maintenance release
  - Deposit type selection
  - Depository occurrence probability
  - Simulators
  - Unknown commodity inventory
  - Known and unknown commodity in ground
  - Map production multiple themes

- MINERAL DEPOSIT MODELS
  - Placer
  - Coal
  - Industrial Minerals
  - Oil and Gas

- TRANSLATORS
  - Gross in Place Value
  - Employment Potential
  - Provincial Revenue
  - Exploration Activity
  - Other
  - Digital Maps Maintenance and Release

- FINAL REPORT
  - Maps
  - Multiple Themes
  - Methodology
    - Geology
    - Data
    - Assumptions
  - Social Economic
    - General
    - Impact
    - Statement

Source: W. Kilby, Geological Survey Branch
Geological Survey Branch
Geographical Information System (GIS)

Objectives:
- Resource Management
- Mineral Potential Maps
- Multi-sourced Data Integration
- Land Information Infrastructure

Data Integration:
Polygonal Data:
- contours
- geology
- land use
- claim maps
- mineral potential

Linear Data:
- streams
- faults

Point Data:
- structural attributes
- RGS sample data
- MINFILE location
- ARIS location
- TRIM point data
Figure 2. Data sources for a Geoscience Information System using GIS technology. Numbers in brackets indicate number of records in files.
# Geological Survey Branch

## GEOSCIENCE DATABASE DIRECTORY

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARIS</td>
<td>B.C. Assessment Report Indexing System</td>
</tr>
<tr>
<td>BEDROCK</td>
<td>B.C. Bedrock Geology, 1:50 000 (Geological Database System)</td>
</tr>
<tr>
<td>BIBLIOGRAPHY</td>
<td>B.C. GSB Bibliographic Index</td>
</tr>
<tr>
<td>COALFILE</td>
<td>B.C. COALFILE</td>
</tr>
<tr>
<td>MINFILE</td>
<td>B.C. MINFILE</td>
</tr>
<tr>
<td>MINPOT</td>
<td>B.C. Mineral Potential</td>
</tr>
<tr>
<td>PROFILES</td>
<td>B.C. Mineral Deposit Profiles</td>
</tr>
<tr>
<td>PROPERTY FILE</td>
<td>B.C. PROPERTY FILE</td>
</tr>
<tr>
<td>RGS</td>
<td>B.C. Regional Geochemical Survey</td>
</tr>
<tr>
<td>SURFICIAL</td>
<td>B.C. Surficial Geology, 1:50 000</td>
</tr>
</tbody>
</table>
B.C. Assessment Report Indexing System


Description: ARIS is a relational database that is an index and an administrative tracking system to the Geological Survey Branch's Mineral Assessment Report Library of more than 23,000 reports, dating from 1947. About 1000 new reports are added annually. The database is used to display distribution of exploration and development activity, and for research and mineral potential projects.

Keywords: Assessment reports, Bibliography, Mineral deposits
Owner, operator, location, Work done, exploration results

Location: BC
Coverage: All BC; Not uniform 48° min - 60° max; 114° min - 140° max
Notes: Scales: 1:20 000 to 1:250 000
Geographical references: Lat./Long.; UTMs
Map projections: Mercator; Polyconic; Universal Transverse Mercator (UTM)
Data form: Digital, Hard copy form: Map; Text

Positional accuracy: Positional resolution:
Dimensionality: F (depth and/or height measurement used?)
Time span: Date began: 1947 Date end: Continues Last revised: 1994
Data quality: Encoded for areas only Data set status: Operational
Access: Restricted User base: All
Host Computer: VAX 6650 (Mainframe); PC Operating system: VMS; DOS

Data structure (model): Entity-relationship
DBMS used: SUPRA (Cincom); ASCII; dBASE files
GIS software: QUIKMap; AutoCAD; GIS
Output formats: Point Data Flat File; ASCII and .DBF relational files
Output media: Floppy Disk; Paper; Accessible online; Comfiche, Microfiche
Document status: Partial

Notes: A group of fields for each Assessment Report are extracted in 8 ASCII files from the VAX to diskettes. This data may be used on the PC within database management and small mapping projects using QUIKMap software. ARIS disks are $35.00. Five volumes of index maps are $35.00 each. The complete library of 23,000 reports on fiche is $17,000.00.

Data custodian: Laura de Groot
ARIS Database Manager, Geoscience Information Section
Geological Survey Branch
BC Ministry of Energy, Mines and Petroleum Resources
5th Fl. 1810 Blanshard St., Victoria, B.C., V8W 1X4
Phone: (604)952-0387 Fax: (604)952-0381

Scientific contact: Talis E. Kalins
Mineral Inventory Geologist, Assessment Reports
Geological Survey Branch
BC Ministry of Energy, Mines and Petroleum Resources
5th Fl. 1810 Blanshard St., Victoria, B.C., V8W 1X4
Phone: (604)952-0385 Fax: (604)952-0381

Completed by: Laura de Groot, ARIS Database Manager
Phone: (604)952-0387 Fax: (604)952-0381

Questionnaire completed: 09/20/89 (mm/dd/yy) Data entered: 01/19/94
B.C. Bedrock Geology, 1:50 000 (Geological Database System)  


Description: A dBase relational database contains locations for stations in UTM coordinates, structural measurements, alteration codes, mineralization, rock type and map unit, lists of fossils, age dates, geochemistry and isotopic data. Areas have been mapped at 1:50 000 scale since 1986.

Keywords: Structural & regional geology, Rock types and alteration, Mineralization, Fossils, Geochemistry and isotopic data

Location: BC

Coverage: All BC; Uniform in areas 48° min - 60° max; 114° min - 140° max

Notes: Approximately 90 1:50 000 scale sheets have been mapped.

Geographical references: UTM

Map projections: Universal Transverse Mercator (UTM)

Data form: Digital

Hard copy form: Open File Maps

Positional accuracy: ± 3m

Dimensionality: T (depth and/or height measurement used?)

Date began: 1986

Date end: Continues

Last revised: 1993

Data quality: Not encoded but could be obtained

Data set status: Under development

User base: All

Host Computer: PC; Notebook Computer

Operating system: DOS

Data structure (model): Relational

DBMS used: GSB-GDS; dBASE files

GIS software: QUIKMap; AutoCAD; GIS

Output formats: Point Data Flat File; ASCII and .DBF relational files

Output media: Floppy Disk; Paper; Open File Maps

Document status: Partial

Notes: Data is not being marketed. Available as flat ASCII files on request by interested users (user supplies diskettes).

Data custodian: Don Maclntyre

Head, Mapping Unit

Geological Survey Branch

BC Ministry of Energy, Mines and Petroleum Resources

5th Fl. 1810 Blanshard St., Victoria, B.C., V8V 1X4

Phone: (604) 952-0440

Fax: (604) 952-0381

Scientific contact: D.G. Maclntyre

Head, Mapping Unit

Geological Survey Branch

BC Ministry of Energy, Mines and Petroleum Resources

5th Fl. 1810 Blanshard St., Victoria, B.C., V8V 1X4

Phone: (604) 952-0440

Fax: (604) 952-0381

Completed by: D.G. Maclntyre, Head, Mapping Unit

Phone: (604) 952-0440

Fax: (604) 952-0381

Questionnaire completed: 10/06/89 (mm/dd/yy)

Data entered: 11/20/89
# B.C. GSB Bibliographic Index


**Description:** Bibliography of BC Geological Survey publications, including author, title, type of publication, NTS map areas and keywords.

**Keywords:** Geoscience information

<table>
<thead>
<tr>
<th>Author</th>
<th>Bibliography; map</th>
<th>Location; NTS area</th>
</tr>
</thead>
<tbody>
<tr>
<td>BC</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Location:** BC

**Coverage:** All BC; Not uniform

**Notes:** 48° min - 60° max; 114° min - 140° max

**Map areas:** 82, 92, 102, 93, 103, 94, 104, 114

**Scales:** 1:50 000 to 1:2 000 000

**Geographical references:** NTS Map sheets

**Map projections:** Mercator; Lambert Conformal; Polyconic; Stereographic; Universal Transverse Mercator (UTM)

**Data form:** Digital

**Hard copy form:** Paper

**Positional accuracy:**

**Dimensionality:** F (depth and/or height measurement used?)

**Time span:** Date began: 1874

**Data quality:** Unknown

**Access:** Open to the Public

**Date end:** Continues

**Last revised:** 1994

**User base:** Academia; Government; Industry

**Host Computer:** PC

**Operating system:** DOS

**Data structure (model):** Relational

**Set size:** 10 MB

**DBMS used:** dBASE files

**Files:** 3

**GIS software:** No

**Records:** 2809

**Output formats:** ASCII, .DBF, .XLS

**Fields:** 57

**Output media:** Floppy Disk; Paper (Information Circular)

**Average fields:** 35

**Document status:** Not available

**Notes:** The data file is used to publish a map location and author index.

A diskette ($5.00) is available as Open File 1994-13, Digital Bibliographic Index of B.C. Geological Survey Branch Publications 1874-1993.

**Data custodian:** Brian Grant

Scientific Editor, Scientific Review Office
Geological Survey Branch
BC Ministry of Energy, Mines and Petroleum Resources
4th Fl. 1810 Blanshard St., Victoria, B.C., V8V 1X4
Phone: (604)952-0454 Fax: (604)952-0451

**Scientific contact:** Brian Grant

Scientific Editor, Scientific Review Office
Geological Survey Branch
BC Ministry of Energy, Mines and Petroleum Resources
4th Fl. 1810 Blanshard St., Victoria, B.C., V8V 1X4
Phone: (604)952-0454 Fax: (604)952-0451

**Completed by:** Brian Grant, Scientific Editor
Phone: (604)952-0454 Fax: (604)952-0451

**Completed by:** Brian Grant, Scientific Editor
Phone: (604)952-0454 Fax: (604)952-0451

**Questionnaire completed:** 01/18/94 (mm/dd/yy)

**Data entered:** 01/18/94
**GEOSCIENCE DATABASE DIRECTORY**

Geological Survey Branch
Ministry of Energy, Mines and Petroleum Resources
Province of British Columbia, Canada

**B.C. COALFILE**

**COALFILE**

**Organization:** BC Ministry of Energy, Mines and Petroleum Resources, Geological Survey Branch, Geoscience Information Section

**Description:** COALFILE is a index of over 800 coal assessment reports dating from before 1900. The reports are submitted by exploration companies in compliance with the Coal Act. COALFILE also functions as a statistical record of exploration activity.

The data are organized in 5 related files: Borehole, Bulk, Comment, Explore, Map and Trench.

**Keywords:** Coal Assessment Reports, Borehole data, Map Information, Exploration data, Trench, adit or pit data

**Location:** BC

**Coverage:** All BC; Not uniform

**Notes:**

**Map areas:** 82, 92, 102, 93, 103, 94, 104, 114

**Geographical references:** UTM

**Map projections:** Universal Transverse Mercator (UTM)

**Data form:** Digital

**Hard copy form:** Text

**Positional accuracy:** ±2-3 m for Boreholes

**Dimensionality:** T (depth and/or height measurement used?)

**Time span:** Date began: <1900

**Data quality:** Not encoded but could be obtained

**Access:** Open to the Public

**Host Computer:** PC

**Operating system:** DOS

**Data structure (model):** Relational

**DBMS used:** dBASE files

**GIS software:** No

**Output formats:** Point Data Flat File; ASCII and .DBF relational files

**Output media:** Floppy Disk; Paper

**Document status:** Partial

**Notes:** Data file (fields/records): Borehole (46/8025); Bulk (28/454); Comment (9/608); Explore (447/773); Map (39/852); and Trench (31/323). COALFILE products include paper copy ($10.00), fiche ($5.00) and disks on request.

The Coal Assessment Report library of 800 reports is available on microfiche (7000 fiche) for $4500.00.

**Data custodian:** Alex Matheson
Project Geologist, Economic Geology Section
Geological Survey Branch
BC Ministry of Energy, Mines and Petroleum Resources
5th Fl. 1610 Blanshard St., Victoria, B.C., V8V 1X4
Phone: (604)952-0420 Fax: (604)952-0381

**Scientific contact:** Alex Matheson
Project Geologist, Economic Geology Section
Geological Survey Branch
BC Ministry of Energy, Mines and Petroleum Resources
5th Fl. 1610 Blanshard St., Victoria, B.C., V8V 1X4
Phone: (604)952-0420 Fax: (604)952-0381

**Completed by:** Dave Grieve, Coal Unit Head, Economic Geology Section
Phone: (604)952-0416 Fax: (604)952-0381

**Questionnaire completed:** 01/18/94 (mm/dd/yy) **Data entered:** 01/18/94
B.C. MINFILE


Description: MINFILE contains over 11,350 metallic, industrial mineral and coal occurrences for B.C. Each of these occurrences contain 84 data elements describing mineral deposits in terms of geography, geology and economics. The database is used by government, industry and academia for resource management, land-use planning, exploration and research.

Keywords: Metallic & Industrial minerals Location, geology, rock types Bibliography Reserves, production Mineral deposits

Location: BC

Coverage: All BC; Not uniform 48° min - 60° max; 114° min - 140° max

Notes: About 85% of the data have been coded; 75% of the data or 73 of the 105 (1:100 000 and 1:250 000 scales) map areas have been released.

Map areas: 82, 92, 93, 94, 103, 104, 114

Geographical references: Lat./Long.; UTM;

Map projections: Universal Transverse Mercator (UTM); NAD 27

Data form: Digital Hard copy form: Reports and Maps

Positional accuracy: 500 meters Positional resolution: 500 meters

Dimensionality: T (depth and/or height measurement used?)

Date span: Date began: 1967 Date end: Continues Last revised: 1994

Data quality: Encoded with each data value Data set status: Under development

Access: Open to the Public

Host Computer: PC Operating system: DOS

Data structure (model): Entity-Relationship

DBMS used: Entity-Relationship

GIS software: Entity-Relationship

Output formats: Point Data Flat File; ASCII and .DBF relational files

Document status: Complete

Notes: MINFILE/pc, Version 3.0, a menu-driven data-entry, search and report program for IBM-compatible computers, accesses the database. An exploration and development module is currently in development. MINFILE data are available as printouts, hardcopy maps (101 maps are on file at $10.00) and disks (complete data is on 15 disk at $75.00).

Data custodian: Cindy McPeek

MINFILE Database Manager, Geoscience Information Section
Geological Survey Branch
BC Ministry of Energy, Mines and Petroleum Resources
5th Fl. 1810 Blanshard St., Victoria, B.C., V8V 1X4
Phone: (604)952-0387 Fax: (604)952-0381

Scientific contact: Larry Jones

Senior Geologist - MINFILE
Geological Survey Branch
BC Ministry of Energy, Mines and Petroleum Resources
5th Fl. 1810 Blanshard St., Victoria, B.C., V8V 1X4
Phone: (604)952-0386 Fax: (604)952-0381

Completed by: Larry Jones, Senior Geologist - MINFILE
Phone: (604)952-0386 Fax: (604)952-0381

Questionnaire completed: 01/18/94 (mm/dd/yy) Data entered: 01/18/94
**GEO SCIENCE DATABASE DIRECTORY**

Geological Survey Branch  
Ministry of Energy, Mines and Petroleum Resources  
Province of British Columbia, Canada

**B.C. Mineral Potential**

**MINPOT**

**Organization:**  

**Description:**  
A series of geological map compilations, at a 1:250 000 scale, in digital (.dxf) format. These accurate geological base maps are useful to researchers and mineral exploration personnel who are working with computer systems.

**Keywords:**  
Geological contacts and units  
Structural features

**Location:**  
BC

**Coverage:**  
All BC; Uniform in areas  
48° min - 60° max ; 114° min - 140° max

**Notes:**  
41 of the 88 map areas (1:250 000 scale) have been released.

**Map areas:**  
82, 83, 92, 93, 102, 103, 104  
Scales: 1:250 000

**Geographical references:**  
NTS

**Map projections:**  
Universal Transverse Mercator (UTM)

**Data form:**  
Digital  
Hard copy form: Map; Text

**Positional accuracy:**  
1:100 000

**Dimensionality:**  
F (depth and/or height measurement used?)

**Time span:**  
Date began: 1992  
Date end: Continues

**Data quality:**  
Not encoded but could be obtained  
Data set status: Operational

**Access:**  
Open to the Public  
User base: Academia; Government; Industry

**Host Computer:**  
PC  
Operating system: DOS

**Data structure (model):**  
Line/Polygonal  
Set size:

**DBMS used:**  
AutoCAD  
Files: Records 59-123

**GIS software:**  
AutoCAD; Terrasoft  
Fields: 68

**Output formats:**  
AutoCad data exchange format (.DXF)  
Average fields: 60

**Output media:**  
Floppy Disk; Maps

**Document status:**  
Partial

**Notes:**  
The digital files comprise:  
- Polylines of geological contacts and structural features; polygons of geological units; labels for geological units; NTS 1:50 000 map sheet grid reference lines; geological legend as a text file; metadata descriptor file.
- Open File packages ($25.00) contain disks, map, legend and notes. Each package contains 8 to 11 NTS map areas.

**Data custodian:**  
Ward Kilby  
Manager, Mineral Potential Project  
Geological Survey Branch  
BC Ministry of Energy, Mines and Petroleum Resources  
5th Fl. 1810 Blanshard St., Victoria, B.C., V8V 1X4  
Phone: (604)952-0422  
Fax: (604)952-0381

**Scientific contact:**  
Eric Grunsky  
Project Geologist, Mineral Potential Project  
Geological Survey Branch  
BC Ministry of Energy, Mines and Petroleum Resources  
5th Fl. 1810 Blanshard St., Victoria, B.C., V8V 1X4  
Phone: (604)952-0424  
Fax: (604)952-0381

**Completed by:**  
Larry Jones, Senior Geologist - MINFILE  
Phone: (604)952-0386  
Fax: (604)952-0381

**Questionnaire completed:** 01/20/94 (mm/dd/yy)  
**Data entered:** 01/20/94
### B.C. Mineral Deposit Profiles

**Organization:** BC Ministry of Energy, Mines and Petroleum Resources, Geological Survey Branch, Economic Geology Section

**Description:** The Mineral Deposit Profiles database is a table of deposit types and standard descriptions found in British Columbia. Global and B.C. examples are given.

**Keywords:** Mineral deposits, Deposit types, Deposit models

<table>
<thead>
<tr>
<th>Location: BC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coverage: All BC; Not uniform 48° min - 60° max; 114° min - 140° max</td>
</tr>
<tr>
<td>Notes: 90 Deposit Profiles exist for B.C.</td>
</tr>
<tr>
<td>Map areas: Scales:</td>
</tr>
<tr>
<td>Geographical references: N/A</td>
</tr>
<tr>
<td>Map projections: N/A</td>
</tr>
<tr>
<td>Data form: Digital</td>
</tr>
<tr>
<td>Hard copy form: Text</td>
</tr>
<tr>
<td>Positional accuracy: N/A</td>
</tr>
<tr>
<td>Positional resolution: N/A</td>
</tr>
<tr>
<td>Dimensionality: F (depth and/or height measurement used?)</td>
</tr>
<tr>
<td>Time span: Date began: 1992</td>
</tr>
<tr>
<td>Date end: Continues</td>
</tr>
<tr>
<td>Data set status: Under development</td>
</tr>
<tr>
<td>Access: Internal use</td>
</tr>
<tr>
<td>User base: Academia; Government; Industry</td>
</tr>
<tr>
<td>Host Computer: PC</td>
</tr>
<tr>
<td>Operating system: DOS/Windows</td>
</tr>
<tr>
<td>Data structure (model): Flat-file</td>
</tr>
<tr>
<td>DBMS used: Excel and Word for Windows</td>
</tr>
<tr>
<td>GIS software: ASCII and worksheet</td>
</tr>
<tr>
<td>Output formats: Floppy Disk; paper</td>
</tr>
<tr>
<td>Output media: Partial</td>
</tr>
<tr>
<td>Document status:</td>
</tr>
<tr>
<td>Notes: The file is currently being developed and is only available for internal users.</td>
</tr>
</tbody>
</table>

**Data custodian:** Dave Lefebvre
Manager, Economic Geology Section
Geological Survey Branch
BC Ministry of Energy, Mines and Petroleum Resources
5th Fl. 1810 Blanshard St., Victoria, B.C., V8V 1X4
Phone: (604)952-0404 Fax: (604)952-0381

**Scientific contact:** Dave Lefebvre
Manager, Economic Geology Section
Geological Survey Branch
BC Ministry of Energy, Mines and Petroleum Resources
5th Fl. 1810 Blanshard St., Victoria, B.C., V8V 1X4
Phone: (604)952-0404 Fax: (604)952-0381

**Completed by:** Larry Jones, Senior Geologist - MINFILE
Phone: (604)952-0386 Fax: (604)952-0381

**Questionnaire completed:** 01/20/94 (mm/dd/yy) **Data entered:** 01/20/94
PROPERTY FILE


Description: PROPERTY FILE is a library of research material on the approximate 11,000 mineral occurrences contained in the MINFILE database. The FILE contains news clippings, field notes, company prospectuses, and historical maps, photographs and documents. The FILE is used by government, industry and academia for research.

Keywords: Metallic & Industrial minerals, Bibliography, Mineral deposits, Geology, sketch maps, Drill logs

Location: BC

Coverage: All BC; Not uniform

Notes: 48° min - 60° max; 114° min - 140° max

Map areas: 82, 92, 93, 94, 103, 104, 114

Geographical references: Lat./Long.; UTM's

Map projections: Various projections

Data form: Paper

Hard copy form: Reports and Maps

Positional accuracy: F (depth and/or height measurement used?)

Dimensionality: Continues

Date began: 1940s

Date end: Last revised: 1993

Data quality: Unknown

Data set status: Operational

Access: Open to the Public

User base: All

Host Computer: none

Operating system:

Data structure (model): None

DBMS used: None

GIS software:

Output formats: None

Output media: Paper, Maps

Document status: Partial

Notes: The public has access to view these paper files.

Data custodian: Dorthe Jakobsen
Research Geologist, Geoscience Information Section
Geological Survey Branch
BC Ministry of Energy, Mines and Petroleum Resources
5th Fl. 1810 B. C. Ministry of Energy, Mines and Petroleum Resources
5th Fl. 1810 B.C. Ministry of Energy, Mines and Petroleum Resources
Victoria, B.C., V8V 1X4
Phone: (604)952-0388 Fax: (604)952-0381

Scientific contact: Dorthe Jakobsen
Research Geologist, Geoscience Information Section
Geological Survey Branch
BC Ministry of Energy, Mines and Petroleum Resources
5th Fl. 1810 B. C. Ministry of Energy, Mines and Petroleum Resources
5th Fl. 1810 B.C. Ministry of Energy, Mines and Petroleum Resources
Victoria, B.C., V8V 1X4
Phone: (604)952-0388 Fax: (604)952-0381

Completed by: Larry Jones, Senior Geologist - MINFILE
Phone: (604)952-0386 Fax: (604)952-0381

Questionnaire completed: 09/21/89 (mm/dd/yy)

Data entered: 08/25/93
**GEOSCIENCE DATABASE DIRECTORY**

**Organization:** BC Ministry of Energy, Mines and Petroleum Resources, Geological Survey Branch, Environmental Geology Section

**Description:** 
RGS database contains multi-element analytical determinations, sample location information, bedrock associations and field observations of over 40,000 stream sediment and water samples in British Columbia. Used for exploration and development activities; geochemical, metallicogic and environment studies; and resource management projects.

**Keywords:** Geochemistry; moss mat seds.  
Sediment & water - stream, lake  
Elemental values;  
Location; stream parameters  
Rock types; formation  

**Location:** BC  

**Coverage:** All BC; Uniform in areas 48° min - 60° max; 114° min - 140° max  
**Notes:** 46 of the 88 map areas (1:250 000 scale) have been released.

**Map areas:** 82, 83, 92, 93, 102, 103, 104  
**Scales:** 1:250 000  

**Geographical references:** UTMs  
**Map projections:** Universal Transverse Mercator (UTM); NAD 27

**Data form:** Digital  
**Hard copy form:** Map; Text

**Positional accuracy:** 1:50 000  
**Positional resolution:**  
**Dimensionality:** T (depth and/or height measurement used?)  
**Time span:** Date began: 1975  
**Data quality:** Not encoded but could be obtained  
**Access:** Open to the Public

**Host Computer:** PC  
**Operating system:** DOS

**Data structure (model):** Flat-File  
**DBMS used:** ASCII; dBASE files  
**GIS software:** QUIKMap; AutoCAD; GIS  
**Output formats:** Point Data Flat File  
**Output media:** Floppy Disk; Paper  
**Document status:** Complete  
**Set size:** 10 MB  
**Files:** 1  
**Records:** 40 000  
**Fields:** 80  
**Average fields:** 80

**Notes:** Digital data are stored in standard ASCII format.

**Data custodian:** Wayne Jackaman  
Research Officer  
Geological Survey Branch  
BC Ministry of Energy, Mines and Petroleum Resources  
5th Fl. 1810 Blanshard St., Victoria, B.C., V8V 1X4  
Phone: (604) 952-0398  
Fax: (604) 952-0381

**Scientific contact:** Paul Matysek  
Manager, Environmental Geology Section  
Geological Survey Branch  
BC Ministry of Energy, Mines and Petroleum Resources  
5th Fl. 1810 Blanshard St., Victoria, B.C., V8V 1X4  
Phone: (604) 952-0394  
Fax: (604) 952-0381

**Completed by:** Wayne Jackaman, Research Officer  
Phone: (604) 952-0398  
Fax: (604) 952-0381

**Completed by:** Wayne Jackaman, Research Officer  
Phone: (604) 952-0398  
Fax: (604) 952-0381

**Completed by:** Wayne Jackaman, Research Officer  
Phone: (604) 952-0398  
Fax: (604) 952-0381

**Completed by:** Wayne Jackaman, Research Officer  
Phone: (604) 952-0398  
Fax: (604) 952-0381

**Questionnaire completed:** 01/19/94 (mm/dd/yy)  
**Data entered:** 01/19/94
B.C. Surficial Geology, 1:50 000

**Organization:**
BC Ministry of Energy, Mines and Petroleum Resources, Geological Survey Branch, Environmental Geology Section

**Description:**
Surficial Geology maps are currently released in hard copy.

**Keywords:**

**Location:** BC

**Coverage:** 48° min - 60° max; 114° min - 140° max

**Notes:**

**Geographical references:**

**Map projections:** Universal Transverse Mercator (UTM)

**Scales:**

**Data form:** Paper

**Hard copy form:** Map

**Data structure (model):**

**DBMS used:**

**GIS software:**

**Output formats:** Maps

**Output media:**

**Document status:** Partial

**Notes:**

**Data custodian:** Paul Matysek
Manager, Environmental Geology Section
Geological Survey Branch
BC Ministry of Energy, Mines and Petroleum Resources
5th Fl. 1810 Blanshard St., Victoria, B.C., V8V 1X4
Phone: (604)952-0394 Fax: (604)952-0381

**Scientific contact:** Peter Bobrowsky
Quaternary Geologist, Environmental Geology Section
Geological Survey Branch
BC Ministry of Energy, Mines and Petroleum Resources
5th Fl. 1810 Blanshard St., Victoria, B.C., V8V 1X4
Phone: (604)952-0395 Fax: (604)952-0381

**Completed by:** Larry Jones, Senior Geologist - MINFILE
Phone: (604)952-0386 Fax: (604)952-0381

**Questionnaire completed:** 01/19/94 (mm/dd/yy)

**Data entered:** 01/19/94
1993-94
Computer Systems Plan
Geological Survey Branch

Contents:

Executive Summary
1. Introduction
2. Objectives of the Branch Computer System Plan
3. System Plan Highlights of 1992-93
   3.1. Hardware and software upgrades
        Mineral Potential Mapping Project (MPMP)
   3.3. District Geology Database and
        MINFOE system development
   3.4. Network planning and remote communication
   3.5. Assessment Report management
   3.6. Highlights within Branch sections
4. Identification of Key Issues for 1993-94
   4.1. Network strategy and implementation
   4.2. Hardware and software upgrades and training
   4.3. Operation and maintenance of existing systems
   4.4. Specific and new initiatives
5. Recommended Strategy and Priorities
6. Conclusion
7. Appendices
8. Other Key Documents

Prepared by:
Geosystems Advisory Group (L. Jones, Chair)

April 28, 1993
### PERSONAL COMPUTER
**Hardware Strategy Matrix**

<table>
<thead>
<tr>
<th>Hardware Component</th>
<th>Current Norm</th>
<th>Recommended Configuration</th>
<th>Longterm Direction</th>
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<tbody>
<tr>
<td></td>
<td>DOS 80386</td>
<td>APPLE 80030</td>
<td></td>
</tr>
<tr>
<td>Central Processing Unit</td>
<td>80386</td>
<td>68030</td>
<td></td>
</tr>
<tr>
<td>CPU Memory</td>
<td>1 megabyte</td>
<td>1 megabyte</td>
<td>4 megabytes</td>
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<td></td>
<td></td>
<td></td>
<td>8 megabytes</td>
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<tr>
<td>Monitor / Display</td>
<td>EGA</td>
<td>HiRes Mono</td>
<td>VGA</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>HiRes Color</td>
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<tr>
<td>Backup</td>
<td>Floppy</td>
<td>Floppy</td>
<td>Shared Tape</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Shared Tape</td>
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<tr>
<td>High Speed Disk Storage</td>
<td>40 megabytes</td>
<td>40 megabytes</td>
<td>80 megabytes</td>
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<td>Low Speed Diskette Stor</td>
<td>1 x 5.25</td>
<td>1 x 3.5</td>
<td>1 x 3.5</td>
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<td>Med. Speed - Compact Disc</td>
<td>1.5 gigabyte</td>
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<td>Networks</td>
<td>DNET</td>
<td>AppleLink</td>
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<tr>
<td>Mouse...etc</td>
<td>Yes</td>
<td>Yes</td>
<td>Scripting Device</td>
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<td>Printer</td>
<td>Deskjet</td>
<td>Personal Laser</td>
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<td></td>
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<tr>
<td>Energy Consumption</td>
<td>900 watts</td>
<td>1700 watts</td>
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<tr>
<td>Cooling Requirements</td>
<td>1800 BTU's</td>
<td>1400 BTU's</td>
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</tr>
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### PERSONAL COMPUTER
**Software Strategy Matrix**

<table>
<thead>
<tr>
<th>Business Function</th>
<th>% Use</th>
<th>Currently Used</th>
<th>1 to 2 Year Strategy</th>
<th>3 to 5 Year Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating System</td>
<td>93%</td>
<td>DOS 3.3</td>
<td>DOS 5.0/Windows</td>
<td>UNIX/XWindows (Open Systems)</td>
</tr>
<tr>
<td></td>
<td>5%</td>
<td>DOS 3.3/Windows</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2%</td>
<td>MacIntosh 6.x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Word Processing</td>
<td>95%</td>
<td>MSWord 5.0+</td>
<td>Word for Windows</td>
<td>Word / UNIX</td>
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<tr>
<td></td>
<td>5%</td>
<td>Word for Windows</td>
<td></td>
<td></td>
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<tr>
<td>Spreadsheet</td>
<td>80%</td>
<td>Lotus</td>
<td>Excel</td>
<td>Excel / UNIX</td>
</tr>
<tr>
<td></td>
<td>12%</td>
<td>Excel</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5%</td>
<td>L.P.S.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2%</td>
<td>Supercalc</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1%</td>
<td>Quatro</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Database</td>
<td>40%</td>
<td>FoxBase/FoxPro</td>
<td>OMNIS</td>
<td>OMNIS/UNIX</td>
</tr>
<tr>
<td></td>
<td>55%</td>
<td>DBase III/V++</td>
<td></td>
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<tr>
<td></td>
<td>5%</td>
<td>Symphony</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Communications</td>
<td>85%</td>
<td>Set Host</td>
<td>Pathworks</td>
<td>Pathworks / UNIX</td>
</tr>
<tr>
<td>- Mini/Mainframe</td>
<td>5%</td>
<td>Telex</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3%</td>
<td>Mobius</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3%</td>
<td>Mac 240/241</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2%</td>
<td>Procomm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Enh. Term. Em.</td>
<td>3%</td>
<td>Mac 240/241</td>
<td>DynaComm Mac 241</td>
<td>Pathworks / UNIX</td>
</tr>
<tr>
<td>- File Transfer</td>
<td>90%</td>
<td>Kermit</td>
<td>Pathworks</td>
<td>Pathworks / UNIX</td>
</tr>
<tr>
<td></td>
<td>6%</td>
<td>Mobius</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2%</td>
<td>FT Term</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Graphics</td>
<td>90%</td>
<td>Harvard</td>
<td>PowerPoint</td>
<td>PowerPoint / UNIX</td>
</tr>
<tr>
<td>- Presentation</td>
<td></td>
<td>Powerpoint Impressionist</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Charting</td>
<td>90%</td>
<td>Harvard</td>
<td>Excel</td>
<td>Excel / UNIX</td>
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<tr>
<td></td>
<td></td>
<td>Lotus Excel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Mapping/GIS</td>
<td>60%</td>
<td>AutoCAD Quickmap</td>
<td>Application Driving</td>
<td>UNIX standard platform</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TerraSoft (GIS)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Geology & Mineral Resources of British Columbia

OUTLINE:

Introduction
Tectonic Belts
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Lecture by: V. Preto
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References: Geological Survey Branch Publications:
Paper 1991-4
Mineral Market Update, July 1993
Open File 1992-1
Information Circular 1993-1

Province of British Columbia  *  Geological Survey Branch
MINERAL RESOURCES OF BRITISH COLUMBIA,
AN OVERVIEW

SLIDES NOAA # 16, 19, 20.

B.C. is strategically located on the Pacific Ring of Fire, so called because of the great concentration of earthquakes of magnitude 5.5 or greater which ring the Pacific Ocean. This is a ring of active volcanoes, due to active plate subduction which goes on all around this ocean. Such activity over geologic time has been the reason for B.C.'s geological framework and its world class mineral endowment.

The province exactly straddles the North American Cordillera, from the boundary of the Pacific Plate on the west, where subduction is active and mineral deposits are being formed, to the craton on the east. The American Cordillera is the backbone of the Americas, and throughout its length, from Bering Strait on the north to Cape Horn on the south, a distance of some 20,000 kilometres is richly endowed with minerals. B.C.'s rocks, as most cordilleran rocks, are relatively young when compared to shield areas of the world. Most are palaeozoic and younger, but in the central and eastern parts of the province we do have precambrian Hadrynian and Helikian rocks which host significant mineral deposits.

SLIDE Tectonic Belts

From the Pacific Ocean to the Plains B.C. is divided into five Tectonic Belts and at least seven distinct mountain chains across its southern part.

SLIDE Metals distribution by belts

The distribution of metals is controlled by these belts with the Insular Belt containing mostly Fe, Cu, Zn, Au, and Ni, the Coast Belt some Cu, Au, and Ni, the Intermontane Belt Mo, Cu, Au, Sn, and Hg, the Omineca Belt mostly Ag, Zn, Au, Pb, Sn, W, and U, and the Eastern Belt being the least mineralized with only some Zn, Pb, and Ag. Most of our coal, as will be seen in another slide, occurs in the great coal basins of the north and south Eastern Belt, with lesser amounts in the Intermontane and Insular belts.

SLIDE Mineral Deposit Types by belts.

This metal distribution is also reflected in the distribution of metallic mineral deposits types, with most skarns and magmatic deposits occurring in the Insular Belt, most massive sulphide deposits in the Coast and Insular belts, most porphyry deposits in the Intermontane Belt and only some in the Coast and Insular belts, most vein and stratiform deposits in the Omineca Belt and only a sprinkling of these last two types of deposits in the Eastern Belt.
Let us now look at the size and type of the province's mineral output.

OVERHEAD Value of mineral output, '91 and '92.

Mining is B.C.'s second largest industry after timber production. Some will argue that now Tourism is #2, and this may be so, particularly in terms of the number of people employed. The fact is, however, that every year B.C. produces 2.5 to more than 3 billion dollars worth of coal, metals and a growing number of industrial minerals and structural materials. This industry provides well paying direct jobs to more than 20,000 men and women, and an additional 25,000 to 30,000 related jobs in the supply, service and support sectors. The average salary in our mines is in excess of $60,000 /yr with considerably higher salaries for certain jobs.

The table shows that our two most important products are copper and coal, with first place being traded between the two depending on world prices. Gold comes third with a total yearly production of roughly 500,000 ounces. Zinc is fourth. Mo, Ag, and Pb are well back on the list. An increasingly important group of products is structural materials, mostly cement and sand & gravel, and a variety of industrial minerals including gypsum, silica, barite, dimension stone, and many others.

OVERHEAD Operating Mines, 1993

These products come from 15 metal mines, 8 coal mines, 7 industrial minerals mines and a great number of sand & gravel pits throughout the province.

Let us first look at coal.

OVERHEAD Coal Basins

Our most important coal basins are in the Eastern Belt, unfortunately a long distance from tide water. Transportation to the ports of Vancouver and Prince Rupert is provided by our two major railways, Canadian National in the north and Canadian Pacific in the south. Most of the eastern coals are Upper Jurassic to Lower Cretaceous, high quality metallurgical coals, but some which are of lesser quality for coke making, mostly because oxidized, are sold as thermal coals.

The Intermontane Belt coal basins are soft Tertiary coals in the south and extreme north, with two large basins of Cretaceous hard thermal coals, one of which, the Klappan Basin, contains huge deposits of anthracite. There is no production from these basins at this time.

Insular coals are all Cretaceous and thermal, with one producing mine, Quinsam, at the north end of Comox Basin.
OVERHEAD Metallurgical and thermal coal production, 91&92.

Coal production is dominated by metallurgical coal largely exported to Japanese steel mills. The drop in production in the second half of '92 was due to operating problems at some of the largest mines in the southeast coalfields. Thermal coal is a distant second to metallurgical coal in terms of output.

OVERHEAD Metallurgical and thermal coal production, 92&93.

'93 is shaping up to be very similar to '92 with an anticipated output of 14.5-15 million tonnes metallurgical coal and 2-2.5 million tonnes thermal coal.

SLIDES
Six slides showing that our coal mines are large open pit operations.

Let us now turn to the metal sector.

OVERHEAD Value of mineral output,"91&'92.

Copper is the most important metal product, with gold second and Zn,Mo,Ag,and Pb following in that order.

OVERHEAD Tectonic Belts and Prospective Areas.

The bulk of our copper production comes from our large Cu-Mo and Cu-Au porphyry deposits, most of which occur in the Intermontane Belt, with some notable exceptions in the Coast and Insular belts. Current gold production is also significantly related to these deposits. Most of the Zn-Ag-Pb deposits are in the Omineca and Eastern belts and in the Coast and Insular belts.

OVERHEAD Producing Mines.

Our largest mine is Highland Valley Copper, roughly tenth on a world scale. This is a huge and highly efficient mine mill complex which treats 136,000 tonnes of ore per day but also mines an equal amount of waste, for a total of 275,000 tonnes of rock mined every day. Full production at Highland Valley began at the nearby Bethlehem mine in 1963 and will continue into the next century. Past production and current reserves at Highland Valley Copper are in excess of 1200 million tonnes grading 0.4 % Cu and 0.01% Mo, with moderate gold and silver values. Other major porphyry copper deposits that are being mined are Gibraltar and Endako, both Cu-Mo, and the Cu-Au deposits at Island Copper, Afton and Copper Mountain.
SLIDES

Three slides to show the size of the highland Valley copper operation.

SLIDE Porphyry Deposit types

There are two classes of porphyry deposits in B.C. Those associated with calc-alkaline intrusive rocks and those associated with alkalic intrusive. The alkalic deposits be smaller than the calc-alkaline ones, but of higher copper grade and always gold rich.

SLIDE Porphyry Cu-Au deposits in B.C.

All alkalic porphyries contain significant gold while only some of the calc-alkaline ones do.

SLIDE Three slides showing porphyry models

The main reason for this difference in gold content is not in the chemistry of the host intrusive rock, alkalic vs. calc-alkaline. It is in the depth of formation. Calc-alkaline porphyries come in two major types. Deeper seated plutonic porphyries, like Highland Valley Copper, are very large masses of intrusive rock which were hydrothermally altered and mineralized entirely within a larger pluton and at a depth of about 5 kilometres below the surface. These are gold poor. Shallow seated calc-alkaline deposits formed within or around high level, subvolcanic plugs at depths of one to two kilometres from the surface are gold rich. Alteration and mineralization involve both the intrusion and the sedimentary or volcanic host rocks. The same can be said about alkalic deposits. These are all shallow to subvolcanic in setting, all gold rich, and very complex due to the great number of dykes, plugs and breccia pipes that cut the usually volcanic host rocks.

SLIDE Porphyry Deposit from Chile

In Chile, where the mountains are higher and barren of vegetation, thus affording clearer cross-sections through ore systems, one can actually see in one mountain side the transition between the porphyry system below and the overlying epithermal gold zone in the hosting volcanic and sedimentary rocks.

SLIDE Cordilleran Epithermal Model

In a model such as this, the shallower gold rich porphyries would fit directly below the level of Transitional and Epithermal precious metal systems.
SLIDE  Strato Volcano Model.

Stratovolcanoes were the main building block of Cordilleran Island Arches. In the model of such a system the shallow, gold rich porphyries would fit directly below the cone, at the base of which one would find Transitional and Epithermal systems.

SLIDE  Ore Production.

The age of these large producers is Late Triassic to Lower Jurassic. Others, none of which are currently in production, are as young as Early Tertiary. This diagram essentially reflects the age distribution of these deposits, which dominate the provincial metal output.

SLIDE  Two slides - Gold Production

Gold is the second most important metal produced in the province. From the beginning of record keeping much of the gold production has come from traditional mesothermal veins, skarns and volcanogenic massive sulphide deposits, with comparatively less from porphyries. This simply because no porphyry deposits were ever mined in B.C. prior to 1962, except for Copper Mountain which at the time was not recognized as a porphyry. If we look at gold production in more recent years, one can then readily see how porphyries dominate the field.

OVERHEAD  Lode Gold Production and Reserves

The reserve picture is almost identical, with porphyries holding the largest reserve. Mesothermal veins, which were the most important source of gold earlier in the century continue as an important reserve and source, as do massive sulphides and a newly recognized type of deposit called Transitionals. These are deposits which are bulk mineable or contain compact, higher grade, strongly structurally controlled ore zones and were formed at shallow depths between the porphyry environment and that of epithermal systems.

OVERHEAD  Operating Mines, 1993

SLIDE  Example of mesothermal vein.

The most important producers of this type earlier in the century were the Bralorne Camp at 4 million ounces and the Rossland Camp at 3 million ounces. The Snip mine, a small but very profitable underground operation in the northwest part of the province, today produces well in excess of 100,000 ounces per year.

SLIDE  Mesothermal veins genetic model

Using the strato volcano model, mesothermal veins fit at the base of the cone.
SLIDE  Gold at Snip

A good deal of the gold at Snip is recovered directly from jigs and shaking tables with the rest coming from a bulk concentrate.

SLIDE  Golden Bear

This is a view of the Golden Bear mine, similar but also somewhat different from classic mesothermal veins. The view shows the good vertical continuity that is one important characteristic of this type of veins.

SLIDE  Transitional Deposits Model.

Using the strato volcano model, Transitional Deposits fit high, above mesothermal veins.

SLIDE  View of Red Mountain

This is an example of a transitional deposit that is under active exploration at this time. This project had in excess of $7.5 million spent on it, the largest single exploration project in B.C. in 1993. This work has indicated a resource of about 2 million ounces of gold, highlighting the importance of this type of deposit.

SLIDE  AGB vein specimen, Lawyers Mine.

This is a sample of amethyst gold breccia vein material from the Lawyers Mine, a small Au-Ag producer now closed. This mine started operation at 500 tonnes per day in December, 1988 with reserves of 1,938,000 tonnes grading 6.72 gpt Au and 243 gpt Ag. It closed late in 1992.

SLIDE  Tillicum High Grade

This is a specimen of extremely high grade ore from a small gold skarn known as Tillicum Mountain. There is more than $6,000 worth of gold, or 15-16 ounces in this 63 lb specimen.

SLIDE  Afton mine pit.

This is an alkalic Cu-Au porphyry. This pit is now extinguished. It produced 31 million tonnes of ore grading 1% Cu and slightly over 0.5 gpt Au. The orebody is clearly visible in the photograph, and continues at depth beyond the deepest drill holes. This deeper ore may some day be mined by underground methods.

SLIDE  View of Afton from the air.
SLIDE  Galore Creek.

This is another alkalic Cu-Au porphyry deposit. Located in a very rugged and remote area. Not a mine yet. Reserves are 125 million tonnes grading 1.06% Cu and 0.5 gpt Au.

OVERHEAD  Value of mineral production, '91&'92.

Zn, Mo, Ag and Pb are the next most important metallic products.

OVERHEAD  Tectonic Belts and Prospective Areas.

Mo comes from Cu-Mo porphyries in the Intermontane Belt. Zn, Ag and Pb come mainly from two types of deposits: polymetallic volcanogenic massive sulphides in the Insular and Coast belts and clastic hosted massive sulphides in the Omineca and Eastern belts.


Major producers of Zn, Ag, and Pb are the Sullivan, Myra Falls and Goldstream mines, all massive sulphide deposits.

SLIDE  Tectonic environment, massive sulphide deposits.

This diagram models the environment of formation of various types of massive sulphide deposits as related to subduction. Outboard at the oceanic rift where new ocean floor is formed, Cyprus type deposits are formed by black smokers like this (forward, then back up). Farther inboard, in sedimentary or volcanic basins, Besshi type deposits like the Goldstream are formed. Further in with high angle faulting and acid volcanic rocks, Volcanogenic Massive Sulphide deposits like Myra Falls occur. Further in yet, in areas of rifted crust clastic hosted massive sulphides like the great Sullivan deposit and carbonate hosted deposits occur.

SLIDE  Volcanogenic Massive Sulphide Model

This model shows a heat source, high angle extensional faulting, a basement of mafic volcanics and sediments, and domes of acid volcanics with associated massive sulphides lenses. Myra Falls is an excellent example of this type. As other B.C. deposits of this type it is palaeozoic in age. Past production and current reserves from several distinct ore lenses total approximately 28.7 million tonnes grading 2% Cu, 6.4% Zn, 0.6% Pb, 2.2 gpt Au and 54 gpt Ag. Major company sustaining world class deposits are of this type, like the great Kidd Creek deposit at Timmins, Ontario. Typically there are several ore lenses at one or two distinct stratigraphic levels.
SLIDE  Proterozoic Metallogeny, Sullivan area.

This slide shows the setting of the great Sullivan deposit, a clastic hosted massive sulphide deposit. It shows a sedimentary basin rifted by extensional growth faults, and the location of mineral deposits close to these faults.

SLIDE  Cross-section of basin.

A cross-section more clearly shows the growth faults and how the mineral deposits relate to them.

SLIDE  Cross-section Sullivan Deposit

This slide shows a section of the deposit, its source or root, its stratabound nature and resulting great lateral continuity. Sullivan is a major world class company sustaining deposit. It has been in continuous production since the turn of the century. Its discovery was the main stimulus for the settling of the southeastern part of our province. It also started a major company, Consolidated Mining And Smelting, now known the world over as Cominco. The trail Smelter was built to treat Sullivan ore and the southern rail line was built to transport ore and coal from the nearby coalfields to the smelter. The city of Kimberley was built at the minesite and to this day depends primarily on the mine for its existence. Sullivan past production and current reserves total more than 150 million tonnes grading 5.55% Zn, 5.8% Pb and 63 gpt Ag.

CONCLUSION.

British Columbia has a wonderful mineral endowment largely due to its strategic location across the American Cordillera, the 20,000 km long backbone of the Americas.

SLIDE  The country is rugged. The geology is complex and engineering and transportation problems are very challenging, but the prizes are there to be found. This is why mining is B.C. second most important industry.

SLIDE  Gold crystal.


#  #  #  #  #
Figure 4

Tectonic Belts and Prospective Areas
### B.C. MINERAL PRODUCTION 1992 - 1993

<table>
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<tr>
<th></th>
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<th>Value</th>
<th>1993 (E)</th>
<th>Value</th>
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<td>119 313 000</td>
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(E)=Estimate
MAJOR OPERATING MINES IN BRITISH COLUMBIA
1992 AND 1993

Mines operating during 1992 or 1993 are shown above.
- Names are as of the year reported
LEGEND

Kitimat Smelter                      Coalfield
Trail Smelter                        
Ridley Island (Prince Rupert) Port
Point Roberts / Vancouver Port
Railroads
Highways / Exploration Roads

Figure 6
Coalfields in British Columbia
## B.C. CLEAN COAL SOLD AND USED
### 1980 - 1993

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<th>Year</th>
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<td>Value $</td>
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<td>783 176 000</td>
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(E) = Estimate
MARKETS FOR METALLURGICAL COAL
1992

- Japan 61%
- Korea 14%
- Europe 12%
- U.S.A. 4%
- Other 5%

B.C. Metallurgical Coal Sales
By Destination

<table>
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<tr>
<th>Thousand Tonnes</th>
<th>% of Total Sales</th>
<th>Thousand Tonnes</th>
<th>% of Total Sales</th>
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<td>9,376</td>
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<td>Turkey</td>
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<tr>
<td>Korea</td>
<td>2,185</td>
<td>14.2%</td>
<td>Belgium</td>
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<tr>
<td>Taiwan</td>
<td>660</td>
<td>4.3%</td>
<td>Egypt</td>
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<tr>
<td>U.K.</td>
<td>641</td>
<td>4.2%</td>
<td>Canada</td>
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<td>U.S.A.</td>
<td>560</td>
<td>3.6%</td>
<td>Pakistan</td>
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<tr>
<td>Portugal</td>
<td>154</td>
<td>1.0%</td>
<td>Total Sales</td>
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<tr>
<td>Brazil</td>
<td>350</td>
<td>2.3%</td>
<td>To Other B.C. Producers</td>
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<tr>
<td>France</td>
<td>276</td>
<td>1.8%</td>
<td>Adjustments/Purchases</td>
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<tr>
<td>Netherlands</td>
<td>274</td>
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<td>Spain</td>
<td>267</td>
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<td>Used at mines</td>
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<tr>
<td>Italy</td>
<td>89</td>
<td>0.6%</td>
<td></td>
</tr>
<tr>
<td>Denmark</td>
<td>72</td>
<td>0.5%</td>
<td></td>
</tr>
<tr>
<td>COMPANY NAME</td>
<td>PROJECT NAME</td>
<td>COMMODITY</td>
<td>ESTIMATED TONNES (000s)</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>--------------</td>
<td>-----------</td>
<td>-------------------------</td>
</tr>
<tr>
<td>Taseko Mines Ltd.</td>
<td>Fish Lake</td>
<td>Cu, Au</td>
<td>1 080 000</td>
</tr>
<tr>
<td>El Condor Resources Ltd.</td>
<td>Kemess South</td>
<td>Cu, Au</td>
<td>207 000</td>
</tr>
<tr>
<td>St Philips Resources Inc.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jordex Resources Inc.</td>
<td>Expo/Hushamu</td>
<td>Cu, Au, Mo</td>
<td>173 260</td>
</tr>
<tr>
<td>Imperial Metals Corp.</td>
<td>Mount Polley</td>
<td>Cu, Au</td>
<td>49 000</td>
</tr>
<tr>
<td>Gibraltar Mines Ltd.</td>
<td>Gibraltar North</td>
<td>Cu</td>
<td>50 000+</td>
</tr>
<tr>
<td>CMP Resources Ltd.</td>
<td>Q R</td>
<td>Au</td>
<td>1 200</td>
</tr>
<tr>
<td>Placer Dome Inc.</td>
<td>Mount Milligan</td>
<td>Cu, Au</td>
<td>284 000</td>
</tr>
</tbody>
</table>

**Porphyry Deposits**

<table>
<thead>
<tr>
<th>COMPANY NAME</th>
<th>PROJECT NAME</th>
<th>COMMODITY</th>
<th>ESTIMATED TONNES (000s)</th>
<th>ESTIMATED GRADE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Westmin Resources Ltd.</td>
<td>Battle Zone/Myra Falls</td>
<td>Cu, Pb, Zn, Ag, Au</td>
<td>3 018</td>
<td>2.9% Cu, 0.4% Pb, 14.0% Zn, 24.0 g/t Ag, 1.0 g/t Au</td>
</tr>
<tr>
<td>Geddes Resources Ltd.</td>
<td>Windy Craggy</td>
<td>Cu, Au, Ag, Co</td>
<td>297 440</td>
<td>1.38% Cu, 0.2 g/t Au, 3.83 g/t Ag, 0.069% Co</td>
</tr>
<tr>
<td>Curragh Resources Ltd.</td>
<td>Stronsay</td>
<td>Pb, Zn, Ag</td>
<td>22 080</td>
<td>2.8% Pb, 9.4% Zn, 60 g/t Ag</td>
</tr>
<tr>
<td>Homestake Canada Ltd.</td>
<td>Eskay Creek 21B</td>
<td>Au, Ag</td>
<td>1 190</td>
<td>59.41 g/t Au, 2659.3 g/t Ag</td>
</tr>
<tr>
<td>Redfern Resources Ltd.</td>
<td>Tulsequah Chief</td>
<td>Cu, Pb, Zn, Au, Ag</td>
<td>7 800</td>
<td>1.6% Cu, 1.18% Pb, 6.47% Zn, 2.74 g/t Au, 109.72 g/t Ag</td>
</tr>
</tbody>
</table>

**Massive Sulphide Deposits**

<table>
<thead>
<tr>
<th>COMPANY NAME</th>
<th>PROJECT NAME</th>
<th>COMMODITY</th>
<th>ESTIMATED TONNES (000s)</th>
<th>ESTIMATED GRADE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equity Silver Mines Ltd.</td>
<td>North Waterline Zone</td>
<td>Cu, Au, Ag</td>
<td>750</td>
<td>0.68% Cu, 209 g/t Ag</td>
</tr>
<tr>
<td>Cheni Gold Mines Ltd.</td>
<td>Mets</td>
<td>Au</td>
<td>53.5</td>
<td>11.62 g/t Au</td>
</tr>
<tr>
<td>Golden Rule Resources Ltd.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manson Creek Resources Ltd.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canarc Resources Corp.</td>
<td>Polaris-Taku</td>
<td>Au</td>
<td>2 590</td>
<td>14.74 g/t Au</td>
</tr>
<tr>
<td>Suntac Minerals Corp.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Newhawk Gold Mines Ltd.</td>
<td>Brucejack Lake</td>
<td>Au, Ag</td>
<td>749.3</td>
<td>15.43 g/t Au, 647.2 g/t Ag</td>
</tr>
<tr>
<td>Granduc Gold Mines Ltd.</td>
<td>(Brucside) (West Zone)</td>
<td>Au</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fairfield Minerals Ltd.</td>
<td>Elk</td>
<td>Au</td>
<td>308.4</td>
<td>22.18 g/t Au, 24.68 g/t Ag</td>
</tr>
</tbody>
</table>

**Transitional & Vein Deposits**

<table>
<thead>
<tr>
<th>COMPANION NAME</th>
<th>PROJECT NAME</th>
<th>COMMODITY</th>
<th>ESTIMATED TONNES (000s)</th>
<th>ESTIMATED GRADE</th>
</tr>
</thead>
</table>

Table A

Advanced Exploration / Development Projects

Copper
<table>
<thead>
<tr>
<th>COMPANY NAME</th>
<th>PROJECT NAME</th>
<th>COMMODITY</th>
<th>ESTIMATED TONNES (000s)</th>
<th>ESTIMATED GRADE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Placer Dome Inc.</td>
<td>Kerr</td>
<td>Cu, Au</td>
<td>126 000</td>
<td>0.62% Cu, 0.274 g/t Au</td>
</tr>
<tr>
<td>Placer Dome Inc.</td>
<td>Sulphurets Gold (Sulphide)</td>
<td>Au, Cu</td>
<td>18 000</td>
<td>0.35% Cu, 0.823 g/t Au</td>
</tr>
<tr>
<td>New Canamin Res. Ltd.</td>
<td>Huckleberry</td>
<td>Cu, Au</td>
<td>78 000</td>
<td>0.401% Cu, 0.025% MoS2</td>
</tr>
<tr>
<td>El Condor Res. Ltd.</td>
<td>Kness North</td>
<td>Cu, Au</td>
<td>116 109</td>
<td>0.19% Cu, 0.377 g/t Au</td>
</tr>
<tr>
<td>Placer Dome Inc.</td>
<td>Shear</td>
<td>Cu, Au</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Yellowack Res. Ltd.</td>
<td>Katie</td>
<td>Cu, Au</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Crew Natural Res. Ltd.</td>
<td>Red Dog</td>
<td>Cu, Au, Mo</td>
<td>25 000</td>
<td>0.35% Cu, 0.44g/t Au, 0.006% Mo</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MASSIVE SULPHIDE DEPOSITS</th>
<th>COMINCO LTD.</th>
<th>Par</th>
<th>Pb, Zn, Ag, Ba</th>
<th>n/a</th>
<th>n/a</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teck Explorations Ltd.</td>
<td>MGM/Bend</td>
<td>Zn, Pb, Ag</td>
<td>n/a</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>Kokanee Explorations Ltd., Chapleau Res. Ltd., Barkor Res. Inc.</td>
<td>Fors</td>
<td>Ag, Pb, Zn</td>
<td>n/a</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>Kokanee Explorations Ltd., Legion Res. Ltd.</td>
<td>Leg</td>
<td>Zn, Ag, Ba</td>
<td>n/a</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>Minnova Inc. International Curator Res. Ltd.</td>
<td>Seneca</td>
<td>Zn, Cu, Au, Ag</td>
<td>533</td>
<td>0.91% Cu, 0.22% Pb, 7.06% Zn, 66.8 g/t Ag, 1.44 g/t Au</td>
<td></td>
</tr>
<tr>
<td>Westmin Resources Ltd.</td>
<td>Thelwood Valley (Myra Falls)</td>
<td>Cu, Pb, Zn, Ag, Au</td>
<td>n/a</td>
<td>n/a</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TRANSITIONAL &amp; VEIN DEPOSITS</th>
<th>Lac Minerals Ltd.</th>
<th>Red Mountain (Marc Zone)</th>
<th>Au</th>
<th>840</th>
<th>12.68 g/t Au</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gold Fields Canadian Mining Ltd.</td>
<td>Nizi</td>
<td>Au, Ag</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Minnova Inc.</td>
<td>Wolf</td>
<td>Au</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
</tbody>
</table>

Table B
Exploration Highlight Projects

Copper
**B.C. Lode Gold Production (1890-1990)**

by Deposit Type

Total Production 683.4 Tonnes

---

**1991 B.C. Lode Gold Reserves**

by Deposit Type

Total Reserves 1813 Tonnes

---

*Figure 5*

Lode Gold Production and Reserves
Strategy and Philosophy in Mineral Resources Databases

OUTLINE:

Introduction
Why, How, When, Where, What, Who
The Mineral Exploration and Development Cycle
Organization of Earth Science Data
Master Database - Data Dictionary
System Planning - System Cycle
An Approach to Integrated Data Management
Summary

Lecture by: L. Jones
15 November 1993

References: TECDOC Section 4.1, 4.2, Figure 3.
Green, Bill, 1991, Exploration with a Computer.
Strategy and Philosophy in Mineral Resources Databases

REASONING:

Some Whats:

- Mineral resources are unevenly distributed throughout the earth's crust.
- Most countries enjoy some mineral endowment.
- Many have a mining history dating back hundreds of years.

Some Whys:

- Few countries have a well-organized, comprehensive and easily accessible source of historic mining and geological data relating to the nature and distribution of their mineral resources.
- Such information is the starting point in the search for new orebodies.
- Readily accessible databases are essential for effective management of the existing resource and invaluable tools in the search for new orebodies.
- Add to the country's resource base.
- Stimulates mineral exploration leading to discovery of new mineral deposits.
- Development of new mines.
- Contributes to the creation of new wealth by developers, workforce, and public treasury (profits, wages, and taxes).
- Well maintained databases attracts investment.

Some Hows:

- Effective management of mineral resources requires a knowledge of the nature of the resources to be managed, their dimensions, where they are located, their current status, and many other factors.
- Earth Science Databases - compile and update this information.
- These databases must be accessible to all potential users.
- Organization should develop responsible resource management policies.
The Mineral Exploration and Development Cycle

PHILOSOPHY OF MINERAL EXPLORATION PROGRAMS:

- Mineral exploration and mine development ventures involve a high level of financial risk.
- Information gathered at each stage of a project leads to increased confidence of discovering and developing an orebody.
- If the data gathered at each stage of a project is accurate and complete lower risk factors are involved.

STAGES OF MINERAL EXPLORATION PROGRAMS:

- First stage of exploration is the choice of area, which is generally based on analysis of available geoscience data from general surveys and previous exploration effort.
- Ready access to this type of information will simplify the task and greatly increase success.
- Subsequent stages include geophysical and geochemical surveys, detailed geological mapping and drilling and underground work.
- Costs increase at each stage, as do the spin-off economic benefits.
- Information generated must provide the justification for continuing to the next stage.
- Final stage - ore reserves exhausted and mine closes.
- Portion of the profits will be allocated to the search for new orebodies and the exploration and development cycle will be repeated.

MINERAL EXPLORATION PROGRAM OBSERVATIONS AND STRATEGY:

- Detailed geological information will be collected during the life of the operation.
- These data are invaluable in the search for new orebodies in the same district and in other areas with similar geological setting.
- Data are often lost if the project is abandoned.
- Drill core and logs, assays, geophysical results, geological maps, mine plans and engineering reports may be buried in private files or may even be lost or destroyed.
- If the information is stored in a database where it can be readily retrieved and analyzed, it may lead to fresh insights and new ideas that rekindle interest in the project.
- New geological concepts, availability of new technology, commodity price increases, or improved transportation may reactivate old mining areas.
- Easy access to historical and current geoscientific data, which is gathered at great expense and sometimes is not reproducible, benefits new investors, which in turn will stimulate and promote mining exploration in an area.
Figure 1

MINERAL INVENTORY DATABASE

Area Selection

Research

Ownership Data

Land Acquisition

Fees Licenses

Production

Production Statistics

Ore Reserve Data

Geoscience Data

Mine Development

Exploration Property Maintenance

Wages Product for Sale Goods & Services Taxes & Royalties

Wages Goods & Services Fees Taxes
Organization of Earth Science Data

- Information comprising a geoscience information system starts with a repository-type database referred to as the **master database**.
- Database subjects or **themes** describe the handling of earth science information such as bibliographies; mapping indexes (geological, geophysical and geochemical); air photography indexes; and drill hole indexes; mineral deposit information; and exploration information (drill hole, geophysical, geochemical, and field data).
- Selection of appropriate databases and their content are based on the **objectives** of an organization.
- Examples of objectives would be to **collect and store data** on the various themes; provide essential **linkages** to other databases and other levels within the same data theme; facilitate the production of various **reports and maps**; or provide an aid in **planning** future exploration programs.
- Most subject databases follow a **multi-level model**, beginning with the first-level database, which provides a **basic orientation** to the database theme.
- A second- or third-level database provides more **detailed information** on the subject data.
INDEX OF GEOSCIENCE MAPPING

FIRST-LEVEL DATA

- Listing of sources
- Name and address
- Coverage and scales
- Data form

SECOND-LEVEL DATA

- Rock units
- Field observations
- Sample locations
- Kind of data (geophysical surveys)
- Boundaries of map coverage
- Date
Table 9 - Example of first-level mineral deposit data.

Structure for database: C:\MINDEP\MINDEP1.DBF
Number of data records: 300
Date of last update: 07/07/91

<table>
<thead>
<tr>
<th>FIELD</th>
<th>FIELD NAME</th>
<th>TYPE</th>
<th>WIDTH</th>
<th>DEC</th>
<th>SAMPLE DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ID_NO</td>
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<td>10</td>
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<td>2</td>
<td>DPST_NM</td>
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<td>30</td>
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<td>DOMINION REEF</td>
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<td>3</td>
<td>STATUS_C</td>
<td>Character</td>
<td>4</td>
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<td>Character</td>
<td>2</td>
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<td>UR</td>
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<td>5</td>
<td>CMDTY2_C</td>
<td>Character</td>
<td>2</td>
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<tr>
<td>6</td>
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<td>7</td>
<td>LAT</td>
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<td>8</td>
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</tr>
<tr>
<td>9</td>
<td>DPTYPE_C</td>
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<td>REF1</td>
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<td>4</td>
<td></td>
<td>0012</td>
</tr>
<tr>
<td>11</td>
<td>REF2</td>
<td>Character</td>
<td>4</td>
<td></td>
<td>0066</td>
</tr>
<tr>
<td>12</td>
<td>REF3</td>
<td>Character</td>
<td>4</td>
<td></td>
<td>0109</td>
</tr>
<tr>
<td>13</td>
<td>CMNT1_T</td>
<td>Character</td>
<td>70</td>
<td></td>
<td>Quartzite overlying oligomictic quartz-pebble conglomerate.</td>
</tr>
<tr>
<td>14</td>
<td>GEOL_NM</td>
<td>Character</td>
<td>4</td>
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<td>LDJ</td>
</tr>
<tr>
<td>15</td>
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<td>Character</td>
<td>8</td>
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<td>070791</td>
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<td><strong>Total</strong></td>
<td><strong>Total</strong></td>
<td><strong>Total</strong></td>
<td><strong>Total</strong></td>
<td><strong>Total</strong></td>
<td><strong>Total</strong></td>
</tr>
</tbody>
</table>

Table 10 - Example of second-level mineral deposit data.

Structure for database: C:\MINDEP\MINDEP2.DBF
Number of data records: 300
Date of last update: 07/07/91

<table>
<thead>
<tr>
<th>FIELD</th>
<th>FIELD NAME</th>
<th>TYPE</th>
<th>WIDTH</th>
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<th>SAMPLE DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ID_NO</td>
<td>Character</td>
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<td></td>
<td>TVL-013</td>
</tr>
<tr>
<td>2</td>
<td>HOST_NM</td>
<td>Character</td>
<td>30</td>
<td></td>
<td>DOMINION REEF</td>
</tr>
<tr>
<td>3</td>
<td>HOST_AGE</td>
<td>Character</td>
<td>4</td>
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<td>ARCH</td>
</tr>
<tr>
<td>4</td>
<td>LITH1_C</td>
<td>Character</td>
<td>4</td>
<td></td>
<td>CGLM</td>
</tr>
<tr>
<td>5</td>
<td>LITH2_C</td>
<td>Character</td>
<td>4</td>
<td></td>
<td>QRTZ</td>
</tr>
<tr>
<td>6</td>
<td>LITH3_C</td>
<td>Character</td>
<td>4</td>
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<tr>
<td>7</td>
<td>MIN1_C</td>
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<td>8</td>
<td>MIN2_C</td>
<td>Character</td>
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<td>BASIN</td>
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<tr>
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<td>Character</td>
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</tr>
<tr>
<td>10</td>
<td>SETTING</td>
<td>Character</td>
<td>1</td>
<td></td>
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<td>11</td>
<td>SIZE</td>
<td>Character</td>
<td>20</td>
<td></td>
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</tr>
<tr>
<td>12</td>
<td>CMNT2_T</td>
<td>Character</td>
<td>70</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>Total</strong></td>
<td><strong>Total</strong></td>
<td><strong>Total</strong></td>
<td><strong>Total</strong></td>
<td><strong>Total</strong></td>
</tr>
</tbody>
</table>
# DATABASE DIRECTORY

<table>
<thead>
<tr>
<th>Name of data set</th>
<th>Acronym</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Responsible organization</td>
<td></td>
</tr>
<tr>
<td>• Purpose and description</td>
<td></td>
</tr>
<tr>
<td>• Keywords</td>
<td></td>
</tr>
</tbody>
</table>

**Location**

| • Lat. min - Lat. max; Long. min - Long max |         |
| • Coverage |         |
| • Scales |         |

**Data form**

| • Positional Accuracy |         |
| • Time span |         |
| • Data quality and access |         |
| • User Base |         |

**Host computer**

| • Operating system |         |
| • Data Structure |         |
| • Set size |         |
| • "GIS" Software DBMS used |         |
| • Output formats and Output media |         |

**Data Custodian/Manager**

**Scientific Contact**
System Planning

SYSTEM CYCLE:

- Establish business objectives and desired output.
- Scope document, user-requirements, fitting analysis (content and system).
- Detailing the proposal, with an action plan and resources required.
- Budgeting and project team selection.
- User-needs analysis and design details.
- Project schedule and detailed implementation plan.
- Develop universal tables, establish regional flexibility.
- Chose application development software and acceptable user-interface.
- Produce a PC-based application.
- System testing and documentation.
- User acceptance and evaluation.
- Marketing, distribution, training and support.
Figure 4.1 The System Life Cycle
CHALLENGE:

- grow with the changes in user-need and technology
  - information strategy
  - minimum cost and effort

MESSAGES:

- Technology alone cannot solve business problems.
- Need people and business strategy.
- Technology is important, but how it is used is the key to success.
System Planning

DATA AND SYSTEM GOALS:

- Quick and easy access to data.
- Detailed, high quality information.
- Data available in a wide variety of forms, such as custom and standard reports, and digital files for incorporation into other programs.
- Systematic management of data elements to improve data integrity and validity.
- An established methodology for the distribution of data.
- Allow the database to grow with increased requirements.
- Efficient and flexible model.
- Establish common data formats and system capabilities.
- Define links to geographical information systems.
- Implement a modern user-interface based on the latest technology.
- Standardize tables and definitions (e.g. commodities and work types).
- A versatile data dictionary will permit customized data content.
Figure 2
LIMITATIONS

- Incomplete or inaccurate reporting
- Reporting and recording bias
- Data structure knowledge required
- Data delivery and updating
- Costs & technological barriers

SOLUTIONS

- Research / Interpretation
- Ranking / Combining commodities
- Educate / Documentation
- Planning / Staff support
- Technology / Innovations

GSB
An Approach to
Integrated Data Management

- Challenges
- Data Issues - Data Models
- Technology Management Issues
- Procedure
- Database Components
Diagram 1: A proposed Reference Model of Geomatics
An Approach to Integrated Data Management

CHALLENGES:

- Successfully integrate the various databases and mapping systems in a way that facilitates exchange of data for broader purposes.
- Maintain information in a manner which promotes data integrity and rapid retrieval.

DATA ISSUES - DATA MODELS:

- Originally recorded on paper.
- Transferred into digitally based systems.
- Data model must be constructed that provides the organizational layout of the data.
- Must serve the needs of the business application that surrounds the data.
- Many databases evolve in which model construction is minimal.
- Ad hoc database construction which occurred as technology developed.

TECHNOLOGY MANAGEMENT ISSUES:

- Development and maintenance of data requires human resources.
- Local and central responsibility of systems.
- Database managers and administrators.
- Routine and specialized maintenance - backups, programming.
- Inconsistencies, errors, corruption of data, and eventual abandonment of the databases and applications will result.
- Focus on future developments and planned migration strategies.
- Data static if it is collected and managed in a consistent framework.
- Data considered to be dynamic (changing in its nature, structure, and application) if collected and evolved over time.
- Requires a strategy that will work towards keeping data relevant and manageable.

PROCEDURE:

- Establish business case and plan strategy.
- Coordinate implementation with the custodians of the databases.
- Review and recommend, where necessary, upgrading of databases.
- Manage and coordinate the exchange of data.

DATABASE COMPONENTS:

- Data model
- Administration
- Project staffing
- Documentation
- Database directory
Guidelines to Database Systems

OUTLINE:

Introduction
Definitions
Data Models
Database System Design
Standards
Database Administration
Database Documentation

Lecture by: L. Jones
15 November 1993

References: TECDOC Section 3
### Table 1. Some Common Computer Acronyms.

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>4GL</td>
<td>Fourth-Generation Language</td>
</tr>
<tr>
<td>AI</td>
<td>Artificial Intelligence</td>
</tr>
<tr>
<td>CAD</td>
<td>Computer-Aided Design</td>
</tr>
<tr>
<td>CASE</td>
<td>Computer-Aided Systems Engineering</td>
</tr>
<tr>
<td>CD-ROM</td>
<td>Compact-Disk Read-Only Memory</td>
</tr>
<tr>
<td>DBMS</td>
<td>Database Management System</td>
</tr>
<tr>
<td>DOS</td>
<td>Disk Operating System</td>
</tr>
<tr>
<td>GIS</td>
<td>Geographic Information System</td>
</tr>
<tr>
<td>GUI</td>
<td>Graphical User Interface</td>
</tr>
<tr>
<td>kb</td>
<td>Kilobyte, 1 thousand bytes of data</td>
</tr>
<tr>
<td>LAN</td>
<td>Local Area Network</td>
</tr>
<tr>
<td>Mb</td>
<td>Megabyte, 1 million bytes of data</td>
</tr>
<tr>
<td>PC</td>
<td>Personal Computer</td>
</tr>
<tr>
<td>RAM</td>
<td>Random Access Memory</td>
</tr>
<tr>
<td>QBE</td>
<td>Query by Example</td>
</tr>
<tr>
<td>SQL</td>
<td>Structured Query Language</td>
</tr>
<tr>
<td>WORM</td>
<td>Write-Once Read-Many optical disk drives</td>
</tr>
</tbody>
</table>
Definitions

- **database** is an organized set of related data that is drawn together to fit defined needs

- **database management system (DBMS)** consists of a database and a set of programs to access the database. It provides a structured environment that is both convenient and efficient to use in storing, accessing and reporting data

- **database file** contains data with a particular theme

- **record** all the data for a particular entry

- **field** is an item of information within a record

- **database structure** defines a database file

- **database key** uniquely identifies the sites of each record

- **data dictionary** contains details of the structure of the database, definitions of the contents of each field and listings of acceptable entries for fields of explicit content

- **external interface** is defined as the mechanism in which the user captures or enters the data

- **data model** describes data and a set of operations used to manipulate that data
### FILES

**LOCATION.DBF**

<table>
<thead>
<tr>
<th>MIN_DEP_NO</th>
<th>LOCATION</th>
<th>STR_NAME</th>
</tr>
</thead>
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<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**GEOLOGY.DBF**

<table>
<thead>
<tr>
<th>STR_NAME</th>
<th>ROCK_TYPE</th>
</tr>
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<tbody>
<tr>
<td></td>
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<td></td>
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</table>

**DRILL_HOLE.DBF**

<table>
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<tr>
<th>MIN_DEP_NO</th>
<th>DRILL_H_NO</th>
<th>COMM_NAME</th>
<th>COMM_AM</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# DATABASE DIRECTORY

<table>
<thead>
<tr>
<th>Name of data set</th>
<th>Acronym</th>
</tr>
</thead>
<tbody>
<tr>
<td>Responsible organization</td>
<td></td>
</tr>
<tr>
<td>Purpose and description</td>
<td></td>
</tr>
<tr>
<td>Keywords</td>
<td></td>
</tr>
</tbody>
</table>

**Location**

- Lat. min - Lat. max; Long. min - Long. max
- Coverage
- Scales

**Data form**

- Positional Accuracy
- Time span
- Data quality and access
- User Base

**Host computer**

- Operating system
- Data Structure
- Set size
- "GIS" Software DBMS used
- Output formats and Output media

**Data Custodian/Manager**

**Scientific Contact**
MINFILE No: 093B 001
Deposit Name: Layers
Deposit Status: Past Producer
Commodities:
- Building Stone
- Aggregate
Location:
- NTS Map: 093B
- Latitude: 52 13 54
- Longitude: 122 16 18
- UTM Zone: 10
- Easting: 5786837
- Northing: 549743
File: MINF0000.BMP
DATABASE MODELS

A notation for describing data and a set of operations used to manipulate that data

Hierarchical

- tree-structured diagram
- record replication

Flat-File

- spreadsheet style
- single table
- simplicity and portability

Relational

- data in multiple files
- complex data management
- discrete and manageable units
- flexible; easily modified

Entity-Relationship

- entity is a distinct object
- relationship is an association among several entities
- primary key is assigned to each entity
- increased data integrity
- easier future modification
- enhanced performance capabilities
INDEX OF GEOSCIENCE MAPPING

FIRST-LEVEL DATA

- Listing of sources
- Name and address
- Coverage and scales
- Data form

SECOND-LEVEL DATA

- Rock units
- Field observations
- Sample locations
- Kind of data (geophysical surveys)
- Boundaries of map coverage
- Date
INDEX OF AIR PHOTOGRAPHY

FIRST-LEVEL DATA

- Listing of sources
- Name and address

SECOND-LEVEL DATA

- Agency code
- Date of coverage
- Scale of photography
- Focal length of lens
- Type of film
- Cloud cover

INDEX OF DRILL HOLES

FIRST-LEVEL DATA

- Listing of sources
- Name and address
- Project, identification number

SECOND-LEVEL DATA

- Location, bearing
- Inclination
- Total length
- Locations of drill core, log and report
Format Specification for Regional Geochemical Survey Data

The following describes the data format for recorded field observations and analytical data, with an explanation of the codes for the field observations.

<table>
<thead>
<tr>
<th>FIELD</th>
<th>DESCRIPTION</th>
<th>COLUMNS</th>
<th>TYPE</th>
<th>LENGTH</th>
<th>EXAMPLE</th>
</tr>
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<tbody>
<tr>
<td>01</td>
<td>NTS Map-Sheet</td>
<td>001-006</td>
<td>A</td>
<td>6</td>
<td>104N16</td>
</tr>
<tr>
<td>02</td>
<td>ID (Year,Crew,Number)</td>
<td>007-012</td>
<td>N</td>
<td>6</td>
<td>841102</td>
</tr>
<tr>
<td>03</td>
<td>UTM Zone</td>
<td>013-014</td>
<td>N</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>04</td>
<td>UTM East (Metres)</td>
<td>015-020</td>
<td>N</td>
<td>6</td>
<td>544654</td>
</tr>
<tr>
<td>05</td>
<td>UTM North (Metres)</td>
<td>021-027</td>
<td>N</td>
<td>7</td>
<td>5911939</td>
</tr>
<tr>
<td>06</td>
<td>Elevation (Metres)</td>
<td>028-031</td>
<td>N</td>
<td>4</td>
<td>1500</td>
</tr>
<tr>
<td>07</td>
<td>Sample Material</td>
<td>032</td>
<td>N</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>08</td>
<td>Replicate Status</td>
<td>033-034</td>
<td>N</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>09</td>
<td>Formation</td>
<td>035-038</td>
<td>A</td>
<td>4</td>
<td>JJBv</td>
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<td>Rock Type</td>
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<td>12</td>
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<td>Stream Order</td>
<td>046</td>
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<td>1</td>
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<td>14</td>
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<td>047</td>
<td>N</td>
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<td>2</td>
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<td>15</td>
<td>Physiography</td>
<td>048</td>
<td>N</td>
<td>1</td>
<td>3</td>
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<td>16</td>
<td>Drainage Pattern</td>
<td>049</td>
<td>N</td>
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<td>2</td>
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<td>17</td>
<td>Contamination</td>
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<td>N</td>
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<td>3</td>
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<td>18</td>
<td>Stream Width (metres)</td>
<td>051-054</td>
<td>N</td>
<td>4 (1)</td>
<td>10.5</td>
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<tr>
<td>19</td>
<td>Stream Depth (cm)</td>
<td>055-057</td>
<td>N</td>
<td>3</td>
<td>220</td>
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<tr>
<td>20</td>
<td>Stream Flow Rate</td>
<td>058</td>
<td>N</td>
<td>1</td>
<td>1</td>
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<tr>
<td>21</td>
<td>Water Colour</td>
<td>059</td>
<td>N</td>
<td>1</td>
<td>3</td>
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<td>22</td>
<td>Bank Type</td>
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<td>N</td>
<td>1</td>
<td>3</td>
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<td>23</td>
<td>Bank Precipitate</td>
<td>061</td>
<td>N</td>
<td>1</td>
<td>2</td>
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<td>24</td>
<td>Sediment Composition</td>
<td>062-064</td>
<td>N</td>
<td>3</td>
<td>111</td>
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<tr>
<td>25</td>
<td>Sediment Colour</td>
<td>065</td>
<td>N</td>
<td>1</td>
<td>5</td>
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<tr>
<td>26</td>
<td>Sediment Precipitate</td>
<td>066</td>
<td>N</td>
<td>1</td>
<td>2</td>
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<td>27</td>
<td>Channel Bed Type</td>
<td>067</td>
<td>N</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>28</td>
<td>Channel Pattern</td>
<td>068</td>
<td>N</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>29</td>
<td>Moss-mat Position</td>
<td>069-071</td>
<td>N</td>
<td>3 (1)</td>
<td>2.5</td>
</tr>
<tr>
<td>30</td>
<td>Moss-mat Colour</td>
<td>072</td>
<td>N</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>31</td>
<td>Moss-mat Health</td>
<td>073</td>
<td>N</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>32</td>
<td>Moss-mat Host</td>
<td>074</td>
<td>N</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>33</td>
<td>Thickness of Moss-mat</td>
<td>075</td>
<td>N</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>34</td>
<td>Blanks</td>
<td>076-080</td>
<td>N</td>
<td>5</td>
<td>?</td>
</tr>
<tr>
<td>35</td>
<td>pH of stream waters</td>
<td>081-085</td>
<td>N</td>
<td>5 (1)</td>
<td>7.0</td>
</tr>
<tr>
<td>36</td>
<td>Uranium in waters (ppb)</td>
<td>086-090</td>
<td>N</td>
<td>5 (2)</td>
<td>0.12</td>
</tr>
<tr>
<td>37</td>
<td>Fluorine in waters (ppb)</td>
<td>091-095</td>
<td>N</td>
<td>5</td>
<td>34</td>
</tr>
<tr>
<td>38</td>
<td>Zinc (ppm)</td>
<td>096-100</td>
<td>N</td>
<td>5</td>
<td>47</td>
</tr>
<tr>
<td>39</td>
<td>Copper (ppm)</td>
<td>101-105</td>
<td>N</td>
<td>5</td>
<td>79</td>
</tr>
<tr>
<td>40</td>
<td>Lead (ppm)</td>
<td>106-110</td>
<td>N</td>
<td>5</td>
<td>12</td>
</tr>
<tr>
<td>41</td>
<td>Nickel (ppm)</td>
<td>111-115</td>
<td>N</td>
<td>5</td>
<td>26</td>
</tr>
</tbody>
</table>
NORMALIZATION

To divide data into logical groupings in separate data files.

Example of unnormalized and normalized data structures

**Unnormalized** (single database file)

- MINERAL DEPOSIT NUMBER
- LOCATION
- STRATIGRAPHIC NAME
- ROCK TYPE
- DRILL HOLE NO
- COMMODITY NAME
- COMMODITY AMOUNT

**Normalized** (three database files)

- MINERAL DEPOSIT NUMBER
  - LOCATION
  - STRATIGRAPHIC NAME
- STRATIGRAPHIC NAME
  - ROCK TYPE
- MINERAL DEPOSIT NUMBER
  - DRILL HOLE NO
  - COMMODITY NAME
  - COMMODITY AMOUNT

**Offers:**

- easy future modification
- efficient performance
- data integrity
- minimize redundancy
MINFILE ENTITY RELATIONSHIP DATA MODEL

Mineral Deposits
- Longitude / Latitude
- UTM
- Elevation
- Location accuracy
- Deposit size
- Deposit attitude
- Name; CANMINDEX
- Date coded / revised
- Field checked
- Coded by
- Open pit / underground

Entity - Relationship

Exploration Model

Inventory Model

* New to Version 4.0
PART of 'E-R' MODEL

MINERAL DEPOSITS

ARE PRESENT

R-relationship

COMMODITIES

E-entity
CODE TABLE EXAMPLES

COMMODITY CODES

Copper CU

MINERAL CODES

Azurite AZRT

ROCK CODES

Gabbro GBBR

ALTERATION CODE

Sericitic SERI
**MINFILE**

**IDENTIFICATION**

MINFILE NO. 093L.053
NAT'L. MINERAL INV. NO. 093L3 Mo1

NAME(S): 1. LUCKY SHIP

STATUS: □ SHOWing □ PROSpect □ DEVELOped PROSpect □ PRODUCer □ PAst PRODUCer

LOCATION:

NTS MAP: 093L03W
BC MAP: 
MINING DIVISION: OMIN Ominesis
UTM ZONE: 9
NORTHING: 5987098 EASTING: 599776
LATITUDE: °
LONGITUDE: °
ELEVATION: 1082 (metres)
LOCATION CERTAINTY: □ within 500 m □ within 1 km □ within 5 km

Comment on Identity: Centre of mineralized zone (Minister of Mines Annual Report 1965, Figure 13)

**MINERAL OCCURRENCE**

COMMODITIES: Mo

MINERALOGY:

SIGNIFICANT Minerals: MLBD CLEP SLP R GLEN
Comment: Minor chalcopyrite, sphalerite and galena are reported in separate localities.
ASSOCIATED Minerals: ARTZ
Comment: 
ALTERATION Minerals: PYRT CARB KSPA TALC
Comment: 
ALTERATION Type: SILI PYRT CARB KSPA TALC

**DEPOSIT CHARACTER:** 02

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
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<tbody>
<tr>
<td>01</td>
<td>Vein</td>
</tr>
<tr>
<td>02</td>
<td>Podiform</td>
</tr>
<tr>
<td>11</td>
<td>Discordant</td>
</tr>
<tr>
<td>01</td>
<td>Replacement</td>
</tr>
<tr>
<td>05</td>
<td>Epigenetic</td>
</tr>
<tr>
<td>07</td>
<td>Skarn</td>
</tr>
<tr>
<td>08</td>
<td>Clastrome</td>
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<td>Unknown</td>
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**DEPOSIT CLASSIFICATION:** 09

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<tr>
<td>07</td>
<td>Stockwork</td>
</tr>
<tr>
<td>07</td>
<td>Layered</td>
</tr>
<tr>
<td>11</td>
<td>Massive</td>
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<tr>
<td>01</td>
<td>Migmatic</td>
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<tr>
<td>03</td>
<td>Hydrothermal</td>
</tr>
<tr>
<td>07</td>
<td>Pegmatitic</td>
</tr>
<tr>
<td>03</td>
<td>Epithermal</td>
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<td>03</td>
<td>Volcanogenic</td>
</tr>
<tr>
<td>03</td>
<td>Residual</td>
</tr>
<tr>
<td>02</td>
<td>Pegmatitic</td>
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<td>01</td>
<td>Precipitate</td>
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<td>Porphyry</td>
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<tr>
<td>03</td>
<td>Chlorite</td>
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<tr>
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<td>Metamorphic</td>
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**AGE OF MINERALIZATION:** 124 Eocene

**MATERIAL DATED:**

**DATING METHOD:**

**SHAPE OF DEPOSIT:**

<table>
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</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Regular</td>
</tr>
<tr>
<td>2</td>
<td>Tabular</td>
</tr>
<tr>
<td>3</td>
<td>Cylindrical</td>
</tr>
<tr>
<td>4</td>
<td>Bladed</td>
</tr>
<tr>
<td>5</td>
<td>Irregular</td>
</tr>
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</table>

**SHAPE MODIFIER:**

<table>
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<th>Description</th>
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<tbody>
<tr>
<td>1</td>
<td>Folded</td>
</tr>
<tr>
<td>2</td>
<td>Faulted</td>
</tr>
<tr>
<td>3</td>
<td>Fractured</td>
</tr>
<tr>
<td>4</td>
<td>Sheared</td>
</tr>
<tr>
<td>5</td>
<td>Other</td>
</tr>
</tbody>
</table>

**DEPOSIT DIMENSION:** X X (metres)

**ATTITUDE:** STRIKE/DIP TREND/PLOUNGE

**DATE CODED:** Y M D CODED BY LLD

**FIELD CHECKED:** □ YES □ NO

**REVISED BY:** LLD

**YES □ NO**

HS 536
Database System Design

⇒ Base on an organization's business objectives, functions and processes, and its available resources.

⇒ Conduct a system study to help identify requirements for users and implement a process to achieve efficient access to, and manipulation of, data.

⇒ Use a data classification hierarchy to described data according to subject area and group.

⇒ Good design techniques will include data modeling, data flow diagrams and normalization.
Figure 4.1 The System Life Cycle
TECHNOLOGY STUDY

Table of Contents

I. INTRODUCTION 1-

II. SUMMARY OF CURRENT ENVIRONMENT 2-

1. Overview
2. Existing Applications Environment
3. Existing Technical Environment
4. Organization Standards and Policies
5. Operational Organization
6. Evaluation of Existing System

III. REQUIREMENTS 3-

1. Overview
2. Application Requirements
3. Data Requirements
4. System Usage Requirements
5. External Interfaces
6. Operational Requirements
7. Environmental Requirements

IV. ALTERNATIVES COST BENEFIT ANALYSIS 4-

1. Executive Summary
2. Introduction
3. Alternatives
4. Preferred Architecture
5. Conversion Strategy

V. SYSTEM BLUEPRINT 5-

1. Architecture Definition
2. Implementation Strategy
3. Appendices
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<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0 Ministry Overview</td>
<td>2</td>
</tr>
<tr>
<td>2.0 Situation Overview/Objectives</td>
<td>6</td>
</tr>
<tr>
<td>3.0 Hardware and Software Environment</td>
<td>7</td>
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<tr>
<td>4.0 Requirements/Specifications</td>
<td>8</td>
</tr>
<tr>
<td>5.0 Vendor Response</td>
<td>13</td>
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<tr>
<td>6.0 Pricing</td>
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<td>7.0 Project Management</td>
<td>16</td>
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<tr>
<td>8.0 Proposal Evaluation</td>
<td>17</td>
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</table>
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<td>Revised Hardware, Software and Communication Requirements</td>
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1. Identification

DENT4010
MINFILE / pc
Data Entry
04/27/90
13:12
Ministry of Energy, Mines and Petroleum Resources

--- Identification ---

MINFILE No. : XXXXXXXXXX
NMI No. : XXXXXXXXXXXXXXXX
Status : XXXXXXXXXXXXXXXX
Names: XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
Mining Method:
Open Pit: X
Underground: X

--- Location ---

NTS Maps': XXXXXXX
BC Maps : XXXXXXX
Latitude : XX XX XX
Longitude : XXXXX
Elevation : XXXX metres
Mining Divisions : XXXXXXXXXXXXXX
UTM Zone : XX
Northing : XXXXXX
Easting : XXXXXX
Location Certainty : XXXXXXXXXXXXXX

Comments

XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

Date Coded : XX/XX/XX
Coded by : XXXX
Field Checked: X
Date Revised : XX/XX/XX
Revised by: XXXX
Field Checked: X
Deposits : XXXXXX

2. Mineral Occurrence

DENT4020
MINFILE / pc
Data Entry
04/27/90
13:20
Ministry of Energy, Mines and Petroleum Resources

--- Mineral Occurrence ---

MINFILE No. : XXXXXXXXXX
Name : XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

Commodities : XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
MINERALS: DEPOSIT

Significant : XXXXXXXXXXXXXXXXXXXXXXXX
Characteristics: XXXXXXXXXXXXXXXXXXXXXXXXXXX
Associated : XXXXXXXXXXXXXXXXXXXXXXXX
Classifications: XXXXXXXXXXXXXXXXXXXX
Alteration : XXXXXXXXXXXXXXXXXXXXXXXX
Shape : XXXXXXXXXXXXXX
Alterat'n Type: XXXXXXXXXXXXXX
Modifiers : XXXXXXXXXXXXXXXXXXXX
AGE
Mineralization: XXXXXXXXXXXXXXXXXXXXXX
Trend/Plunge : XXX/XX
Isotopic : XXXXXXXXXXXXXXXXXXXXXXXX
Material Dated: XXXXXXXXXXXXXXXXXXXXXXXXXXX
Method: XXXXXXXXXXXXXXXXXXXXXXXX
COMMENTS: XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

Deposits: XXXXXX
MINFILE DETAILED DESIGN DOCUMENT

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# Project Change Request

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Conventions and Standards

GENERAL

⇒ Acquisitions for business objectives

HARDWARE AND SOFTWARE

⇒ IBM-compatible PC

⇒ Store data in ASCII (American Standard Communication Information Interchange) format.

⇒ Lotus 1-2-3 (.WK1) and dBASE (.DBF) formats are recommended.
COMPUTER HARDWARE AND SOFTWARE GENERAL

- Custom development of programs is expensive.

- Recommend purchase of existing application packages, such as spreadsheets, word processors, database systems, statistical packages and GIS programs is.

- Concentrate on the integration and implementation of these applications.

- Benefits include improved functionality and reduced costs for maintenance and support of custom-built software.

- Establish business objectives before selecting computing environment.

- Evaluate software requirements first, before hardware selection, to avoid incompatibilities.

- Consider availability of support and local expertise; training requirements; standards compliance; and the size and growth requirements of the database.
Hardware

- IBM-compatible PC systems (80486 processor) recommended.
- 640-kilobyte random access memory (RAM), with at least four megabytes of extended memory.
- Large hard disk (200 megabytes).
- Parallel port for a printer; two serial ports for plotter and digitizer.
- VGA graphics system.
- Peripheral devices: laser printer; digitizer (capable of sending data as an ASCII string); plotter (HPGL).
- Mass storage devices for large data sets and system backup.
- UPS (uninterrupted power supply) recommended in areas of erratic power supply.
Software

- Operating systems: **DOS and MS Windows**.

- Word-processing systems: capable of working in, or exporting a simple **ASCII** file (ASCII characters 33-127), without control characters.

- Spreadsheet format: **Lotus 1-2-3 (.WK1)** format.

- Database management systems (DBMS): .DBF format of **dBASE** has become a *de facto* standard.

- Other **supporting software** packages: report writers; file compression utilities.

- **Custom development**: if funds are available; may make the organization's work process more efficient; documentation of the developed product is very important.
DATABASE ADMINISTRATION

Objective to maintain a standard, structured and secure database.

**CONCERNS**

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<th>Data acquisition</th>
<th>- collecting, managing and modifying data</th>
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<td>Data integrity</td>
<td>- detect errors; provide logic and range checks</td>
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<tr>
<td>Data currency</td>
<td>- data values are reconfirmed or updated within an appropriate time period</td>
</tr>
<tr>
<td>Data access control</td>
<td>- granting of permission for the creation, retrieval, use, modification and disposal of data.</td>
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<tr>
<td>Data custodianship</td>
<td>- designation of a functional responsibility for the creation, integrity and maintenance of data</td>
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<td>Data links</td>
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DATABASE LIMITS
AND SOLUTIONS...

PROBLEM:
Data structure knowledge is required for proper interpretation of data

SOLUTION:
Education of users and accurate documentation

DATABASE LIMITS
AND SOLUTIONS...

PROBLEM:
Data delivery and updating involves tremendous amount of time

SOLUTION:
Project planning and staff support
DATABASE PROJECT STAFFING

QUALIFICATIONS

1. Understanding of computerized database concepts, model and design.

2. Understanding of geoscience data acquisition, data elements and their relationships.

3. Ability to design computerized databases using widely available database management systems.

4. Ability to access and to retrieve the data in the database in order to transfer the data to other application programs to gain additional capabilities (statistical packages, GIS and others).
DATABASE DOCUMENTATION

Important for instruction and reference by users and subsequent program developers.

COMPONENTS OF DOCUMENT PLANNING

- user-needs analysis
- purpose, scope and contents of documentation
- document specification
- work plan
- organization (menu hierarchy, topic or function)

TYPES OF DOCUMENTS

- training documents (user manuals, tutorials and quick reference cards)
- reference documents (technical programmer notes)
- marketing documents (descriptive brochures)
Mineral Deposit Databases

OUTLINE:

Introduction

Data Codes, Structure and Elements

USGS Example

MINFILE Example
  • What is MINFILE
  • Brief History
  • Data Model
  • User Examples
  • MINFILE/pc
  • Products and Distribution

Summary

Lecture by: L. Jones
15 November 1993

References: TECDOC Section 4.4, Annex 6.4
Computer-based files on mineral deposits: Guidelines and recommended standards for data content

A report by the Mineral Deposits Working Committee, National Advisory Committee on Research in the Geological Sciences


1978
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TABLE 1. Schematic relationship between natural, conceptual, physical and electronic data structures. This report focuses on conceptual data structures.
Mineral Deposit Databases

GENERAL

- A mineral deposit database is an organized inventory of data related to mineral occurrences.
- A relational data model is functional, flexible and expandable.
- Use in a multi-level approach.
- Use standard codes.
- Rank multiple entries, such as the commodity, mineralogy and lithology fields, in decreasing order of importance.
Multi-Level Approach

FIRST-LEVEL DATA ELEMENTS:

- Deposit identification number
- Deposit name
- Commodities or minerals present
- Point location, map area
- Administrative jurisdiction
- Geologic setting
- Current status or stage of development
- Deposit type
- Commodity economics
- Brief geological descriptions
- Primary references
- Name of the collector and date of input

*these are the recommended minimum data elements*
Example of first-level mineral deposit data.

Structure for database:  C:\MINDEP\MINDEP1.DBF
Number of data records:  300
Date of last update:  07/07/91

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** Total **  163
Multi-Level Approach

SECOND-LEVEL DATA ELEMENTS:

- Host rocks in terms of name, age, lithology and relationship to the economic minerals
- Size of deposit
- Regional structural-tectonic setting
- Economic, gangue and alteration minerals
- Reserves
Example of second-level mineral deposit data.

Structure for database: `C:\MINDEP\MINDEP2.DBF`
Number of data records: 300
Date of last update: 07/07/91

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** Total ** 179
Multi-Level Approach

THIRD-LEVEL DATA ELEMENTS:

- Elevation & location accuracy
- Alteration type
- Deposit details
- Metamorphic type and grade
- Stratigraphic name and age
- Isotopic age, material dated and dating method
- Ore reserve category, year of calculation, quantity, grade and reference
- Year of production, ore mined, ore milled, quantity and reference
Example of third-level mineral deposit data.

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<tr>
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<tr>
<td>DEPSIZEW</td>
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</table>
Mineral Deposit Databases

DATA CODES (ENTITIES OR TABLES)

- Keep the database small.
- Reduce errors on input.
- Help to speed up queries on the database.
- Provide the user with classification guidelines and choices.
- May be easily redefined, modified or expanded.
- Chose codes with meaning and flexibility.
- Use standard codes based on controlled vocabularies and global frequencies, such as commodities, rocks, mineral names and stratigraphic units.
## MINFILE CODING FORM

### SUMMARY

#### MINERALOGY

<table>
<thead>
<tr>
<th>COMMON MINERALS</th>
<th>CODE</th>
<th>ALTERATION TYPE (Assemblages)</th>
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</thead>
<tbody>
<tr>
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<td>Propylitic</td>
<td>PPLC</td>
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</tr>
<tr>
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#### GANGUE

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<td>Biotite</td>
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<tr>
<td>Dolomite</td>
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<tr>
<td>Feldspar</td>
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### ALTERATION

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</table>
# Code Table Example

**FILE NAME: STATUS_C**

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<th>DESCRIPTION</th>
<th>EXPLANATION</th>
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<td>Showing</td>
<td>A showing or occurrence with identified mineralization.</td>
</tr>
<tr>
<td>PROS</td>
<td>Prospect</td>
<td>A showing with development and unknown resources.</td>
</tr>
<tr>
<td>DEPR</td>
<td>Developed prospect</td>
<td>A prospect pending an economic evaluation.</td>
</tr>
<tr>
<td>ECDP</td>
<td>Economic deposit</td>
<td>A developed prospect with recoverable ore.</td>
</tr>
<tr>
<td>MINE</td>
<td>Active mine</td>
<td>A producing mine.</td>
</tr>
<tr>
<td>MINR</td>
<td>Inactive mine</td>
<td>An inactive mine with resources remaining.</td>
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<tr>
<td>MIND</td>
<td>Depleted mine</td>
<td>A mined-out or depleted ore deposit.</td>
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<tr>
<td>Deposit Character Search</td>
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<tr>
<td>--------------------------</td>
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<td>06 Podiform</td>
<td>11 Discordant</td>
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<tr>
<td>02 Stockwork</td>
<td>07 Layered</td>
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<td>03 Breccia</td>
<td>08 Stratabound</td>
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All of: and and and and and must be present

AND

At least 1 of: or or or or or must be present

Complete the above Boolean expression ...

| Deposits : 11144 |

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</tbody>
</table>

All of: and and and and and must be present

AND

At least 1 of: or or or or or must be present

Complete the above Boolean expression ...

<p>| Deposits : 11144 |</p>
<table>
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# DEPOSIT TYPES

Geological Survey Branch Mineral Deposit Profiles

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<td>Refractory shale</td>
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ORGANIZATION OF MINERAL DEPOSIT DATA

Mineral Deposits

Identification
  - Location
  - Name
  - Status
  - References
  - Commodity

Geological Setting
  - Host rock
  - Stratigraphy
  - Age

Deposit Geology
  - Deposit type
  - Mineralization
  - Ore minerals
  - Gangue minerals
  - Alteration

Economics
  - Mining method
  - Size
  - Grade
  - Production
  - Reserves
Mineral Deposit Databases

USES

- An inexpensive research tool by industry, academic researchers and government.

- Selection of areas for exploration or research projects.

- Assists in the analysis of the distribution of geology, metallogeny and mineral deposits.

- Mineral deposit distribution plots help select prospective areas for mineral potential.

- Land-use planning and mineral resource management.

- Data may be integrated into geographical information systems (GIS).
Mineral Deposit Databases

USGS EXAMPLE:
MRDS - Mineral Resource Data System Contents

- Record Number and Type
- Information Source
- Reporter and Affiliation, and Entry Date
- Site Type, Name and Synonyms
- Country, State, County and District/Area
- Primary Quadrangle and Scale
- Latitude And Longitude
- Commodities
- Production
- Deposit Type and Code
- Host Rock Name and Lithology
- Host Rock and Mineralization Age
- Tectonic Setting
- Associated Igneous Rock and Age
- Ore Minerals and Controls
- Non-Ore Mineralogy
- Deposit Description
- Comments
- Key Words
- References
MRDS - MINERAL RESOURCE DATA SYSTEM

Reference


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<td>REF_5</td>
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MRDS - MINERAL RESOURCE DATA SYSTEM

Database Descriptions of Fields
- or what goes into each blank in the form -

RECORD NUMBER:
The entry in this required field is generated automatically by the computer. Each record in a file is numbered starting with one; the working file numbers continuously increase in order of entry. (This number belongs to the computer - the PC - it does not go to the national MRDS system.)

WORKING FILE NUMBER (WF_NUMBER): The entry in this field is for the convenience of the compiler of the database; any number can be used (0-99999); it is best used as a sequential entry when several different MRDS databases are being compiled. It is not a required field. (This number belongs to the compiler.)

MRDS NUMBER (MRDS_NO): Enter the MRDS number if one has been assigned to the deposit; otherwise, leave blank. (This number belongs to the national MRDS system.)

CMR NUMBER (CMR_NO): Enter the CMR record number if one has been assigned to the deposit; otherwise, leave blank. (This number belongs to CMR - it does not go to the national MRDS system.)

RECORD TYPE (REC_TYPE): This is a two character code describing the type of record. The first character is an S if the record contains site specific information (describes a single mine, prospect, etc.). The first character is an A if the record contains information describing an area (a mineralized area, mining district, etc.). The second character is an M for metallic deposits, an N for nonmetallic deposits, or a B for deposits that contain both metallic and non-metallic commodities. (Only the M, N, or B goes to the national MRDS system.)

\[\begin{align*}
S &\quad site \\
A &\quad area \\
M &\quad metallic \\
N &\quad nonmetallic \\
B &\quad both\ metallic\ and\ nonmetallic
\end{align*}\]

ENTRY DATE (ENTRY_DATE): The date the data is entered into the database. Enter two digits for month (06), two for date (03), and two for year (85). Change date after editing only for substantive changes, especially if new information has been added.

INFORMATION SOURCE (INFO_SRCE): A one character code used to describe the primary type of information which was used to create the record. The codes are:

\[\begin{align*}
1 &\quad Published\ literature \\
2 &\quad Unpublished\ report,\ memo,\ file,\ etc. \\
3 &\quad Field\ observation \\
4 &\quad MRDS \\
5 &\quad Personal\ communication
\end{align*}\]

REPORTER (REPORTER): Enter the name (preferably last name, first name, middle initial) of the person responsible for the contents of the record. If an assistant is doing the actual data entry, he or she should enter his supervisor's name in this field. The purpose of this field is to provide users with a contact for further information about this particular record.

REPORTER AFFILIATION (REPORT_AFF): Enter the name of the organization for which the reporter works. Organization names may be abbreviated if the abbreviation is unique and easily recognizable (USGS, BLM, etc.).

SITE TYPE (SITE_NAME): Enter the most well known, or most recent name of the deposit, occurrence, district, or area. If the name is unknown, enter as unidentified occurrence. This is a required field.

SYNONYMS (SYNONYMS): Enter other names by which the site has been known. If more than one name is entered, separate names with commas. For district or area records, names of important mines in the district should be entered here.

SITE TYPE (SITE_TYPE): Enter type of site or area being described by this record as a one character code from the following list:

\[\begin{align*}
M &\quad Mine \\
P &\quad Prospect \\
C &\quad Claim \\
O &\quad Occurrence \\
A &\quad Mineralized\ area \\
D &\quad Mining\ district
\end{align*}\]

DISTRICT/AREA (DIST_AREA): Enter the best known or most recent name of the mining district or mineralized area which contains the site being described, or the name of the district or area for an area record.

COUNTY (COUNTY): Enter in full the county name in which the deposit is located. If the deposit is located in more than one county, separate the names with commas. Do not enter the word "county" as part of the name.
Enter the two character, U.S. Postal Service abbreviation for the name of the state in which the deposit is located. If a district or area is located in more than one state, enter the code for the state in which most of the area is located.

Enter the name, or abbreviation for the name (e.g. US) of the country in which the deposit is located.

Enter the name of the lo x 2o quadrangle in which the deposit is located. In the case of district or area records, enter the name of the lo x 2o quadrangle in which most of the district or area is located. Do not enter the word "quadrangle" as part of the name.

Enter the name of the quadrangle used to determine the accurate coordinates of the site location, or the boundary of the mining district or area. Normally, this will be the name of a 1:24,000 or 1:62,500 scale quadrangle. Do not enter the word "quadrangle" as part of the name.

Enter the denominator of the fractional scale of the primary quadrangle (24000, not 1:24,000).

Enter the latitude of the site being described to the nearest second. The format is: \( dd \) mm ssN
\( dd = \) degrees \( \quad mm = \) minutes \( \quad ss = \) seconds
Normally, this information is obtained by digitizing from the primary quadrangle named above. This is a required field.

Enter the longitude of the site being described to the nearest second. The format is: \( dd \) mm ssW.
Normally, this information is obtained by digitizing from the primary quadrangle named above. This is a required field.

Enter a list separated by commas of the known commodities at the site being described. Use the correct chemical symbols for elements (Au, Ag, Pb, etc.) and short descriptive "codes" for other minerals and materials. The list below is that of the national MRDS system; please use it, as it will facilitate search, and feed directly into the main system. If possible, list the commodities in decreasing order of importance.

### Commodity Codes

**ALM** Alum
**AL1** Bauxite
**AL2** Aluminum (from other sources)
**AL3** Alunite
**AMB** Amber
**GYP** Anhydrite, gypsum
**ASB** Asbestos
**VOL** Ash, volcanic
**BRI** Brines, saline materials
**MG** Brucite as well as magnesium
**CAR** Carbonates
**CER** Cement rock, natural
**CLY** Clay, general
**CLI** Bentonite
**CL2** Fuller's earth
**CL3** Kaolin (includes high alumina clay)
**CL4** Ball clay
**CL5** Fire clay (refractory)
**CL6** Bloating materials (clay, shale, etc.)
**CL7** Brick clay (common)
**COR** Conodont
**DIA** Diamond
**DIT** Diatomite
**DOL** Dolomite, general
**DOL1** Ultra pure dolomite, CaCO3 + MgCO3 >97%
**DOL2** High magnesium dolomite, 97% > CaCO3 MgCO3 >95%
**EMY** Emery
**EVA** Evaporates, see also brine, halite
**FLD** Feldspar
**GAR** Garnet
**GEM** Gem stones
**GLA** Glauconite
**GRF** Graphite
**GYP** Gypsum, anhydrite
**HAL** Halite

**HAG** Heavy aggregate
**KYN** Kyantite, sillimanite, andalusite, dumortierite
**LAT** Laterite
**LST** Limestone, general
**LST1** Limestone, CaCO3 >97%
**LST2** Limestone, 97% > CaCO3 >95%
**LWA** Light weight aggregate
**MGS** Magnesite
**MBL** Marble
**MIC** Mica, general
**MIC1** Sheet mica
**MIC2** Scrap mica
**MIC3** Flake mica
**MPG** Mineral pigments
**MON** Monazite
**OLV** Olivine
**P** Phosphorus or phosphate
**PEA** Peat
**PER** Perlite
**PGM** Platinum group metals
**PUM** Pumice
**PYR** Pyrite
**PYRI** Pyrrhotite
**PYF** Pyrophyllite
**QTZ** Quartz
**REE** Rare earth elements
**REF** Refractory materials
**BRI** Salines, brines
**SAP** Saponite
**SIL** Silica
**TLC** Talc, serpentine, soapstone
**VRM** Vermiculite
**WOL** Wollastonite
**ZEO** Zeolites
PRODUCTION (PRODUCTION): A one character field which indicates whether production has been known to occur. Codes are as follows:

- Y known production
- N known to have not produced
- ? production history unknown

PRODUCTION INFORMATION (PROD_INFO): Enter into this text field information about the production history of the deposit, if any. Include known dates of production, commodities produced, and data on tonnage and/or grade of ore produced.

DEPOSIT TYPE (DEPOS_TYPE): Enter a concise label, or labels that you would attach to the type of deposit being described by this record (epithermal vein, massive sulfide, Mississippi Valley, placer, etc.).

DEPOSIT TYPE CODE (DEPOS_CODE): Enter the code number from the following list which best describes the deposit. If several deposit types are present, enter the code numbers describing them in order of importance; separate these code numbers with commas. These code numbers provide a structured entry to facilitate sorting by deposit type. This entry will not be transmitted to the main MRDS file.

**Deposit type code**

10. Placer deposits
   10.2 Modern
      10.21 Alluvial, including beach, strand line
      10.22 Marine
   10.4 Fossil
      10.41 Alluvial
      10.42 Marine, including beach, strand line
      10.47 Quartz-Pebble conglomerate (Au. U. Th. Rand)

12. Residual deposits
   12.2 Resistate (mechanical)
      12.22 Barite (Missouri)
   12.4 Chemical (concentrations, alteration minerals)
      12.42 Clays
      12.44 Bauxite
      12.46 Iron (including "bog iron, manganese",)
      12.48 Vermiculite
      12.49 Nickel (Riddle, OR)

14. Supergene base and precious metals

20. Organic-rich sedimentary deposits
   20.2 Peat
   20.6 Shale (metal-rich)
      20.62 Metal-rich black shale

22. Syngenetic sedimentary deposits
   22.2 Clays
      22.25 Lithium clays
   22.3 Shales (bloating, light-weight aggregate)
      22.34 Carbonate rocks
      22.42 Limestone
      22.44 Dolomite
      22.46 Nacrite
      22.6 Phosphorite
      22.8 Evaporite
      22.82 Gypsum-anhydride-sulfur
      22.84 Saline minerals
      22.86 Saline brines

24. Iron formation

26. Sedimentary manganese
   26.2 Bedded (Kalabari field)
   26.4 Nodules

28. Sedimentary (bedded) barite

30. Syngenetic massive (and disseminated) sulfides
   30.2 Sedimentary (Rammelsberg)
   30.4 Iron formation, sulfide bearing
   30.6 Volcanic-hosted
      30.61 Ophiolite assemblage (Cyprus)
      30.63 Pelitic to intermediate (Kuroko)
   30.8 Metamorphosed syngenetic sulfide deposits
      30.81 Zn-Cu (Sedalia type)
      30.83 W-Cu (Firefly type)

36. Diagenetic sedimentary deposits
   36.2 Clays
   36.4 Zeolites
      36.42 Saline lake (closed system)
      36.44 Altered tuffs (open system)
   36.6 Fluorite (Rome, OR)
36.8 metals in sedimentary rocks
40.  Epigenetic sedimentary-hosted deposits
   40.2 sandstone-hosted metals
   40.22 sandstone uranium, vanadium, silver
   40.24 sandstone-hosted "Mississippi Valley" (Leipsvall, Sweden)
   40.4 sandstone. shale-hosted metals
   40.42 copper (Kupferschiefer)
   40.44 molybdenum (SD Baglands)
   40.6 carbonate-hosted metals
   40.62 "Mississippi Valley", base metals, cobalt
   40.64 Dolomitic Cu-Co (Zaire Cu)
50.  Geothermal energy
   50.2 Steam
   50.4 Hot water (only)
52.  Hot spring deposits
   52.1 carbonates (travertine)
   52.2 clays
   52.3 metals
   52.33 sedimentary rock-hosted
   52.35 volcanic-hosted
55.  Hydrothermal (volcanic-subvolcanic)
   55.1 veins
   55.2 stockworks
   55.3 breccia pipes
   55.4 mantos
   55.5 disseminated
   55.55 volcanic Cu (Keweenaw, MI)
   55.6 unconformity-vein (uranium)
57.  Contact metamorphic
   57.1 Cu (Pb-Zn-Au-Ag-Mo, Carr Fork, UT)
   57.2 Zn-Pb (Ag-Cu-W, Ban Ban, Australia)
   57.5 W (Mo-Zn-Cu, Pine Creek, CA)
   57.6 Sn (W-F-Be, Lost River, Ak)
   57.7 Fe (Cu-Co-Au, Daitguiri, Cuba)
   57.8 Nonmetals
   57.81 magnesite (magnesite, brucite, Gabbs, NV)
   57.83 marble
58.  Porphyry
   58.1 Cu
   58.3 Cu-Mo (Au)
   58.4 Au
   58.5 Mo (W)
   58.7 Sn
59.  Greisen
   59.1 disseminated
   59.3 veins
   59.5 pegmatite-greisen veins
60.  Volcanic-plutonic rocks
   60.1 pumice and perlite
66.  Migmatic segregations, granitic plutons
   66.1 pegmatites
67.  Migmatic segregations, mafic-ultramafic plutons
   67.1 sulfide (immiscible melts)
   67.11 podlike (Sudbury)
   67.13 layered, interstitial (Bushfeldt Pt)
   67.3 cumulates
   67.31 stratiform chromite
   67.32 disseminated chromite
   67.34 Podiform
   67.6 intrusive
   67.61 magnetite, chromite, ilmenite
   67.7 extrusive
   67.71 magnetite (lava)
68.  Migmatic differentiates, undersaturated plutons (syenite-ultramafic complexes)
   68.5 intrusive
   68.51 carbonatite
   68.7 extrusive
   68.71 carbonate (lava)
69.  Kimberlite pipes (diamond pipes)
   69.1 alnoite (diamond-bearing, Kimberly, Australia)
70.  Meta-ultramafic
   70.1 asbestos
   70.3 serpentine
75.  Regional metamorphic
   75.2 aluminosilicate minerals
   75.3 marble
Commodities that should not be entered in MRDS file:

| Oil and gas | Sand and gravel (common aggregates) | Dimension stone | Coal |

HOST ROCK LITHOLOGY (HR_LITH): Enter a concise description of the lithology of the rock which forms the principal host for the deposit.

HOST ROCK NAME (FORM_HR): Enter the formal name of the unit which forms the principal host for the deposit.

HOST ROCK AGE (AGE_HR): Enter the abbreviation for the most specific geologic age of the rock which forms the principal host for the deposit. A range of ages may be entered separated by a hyphen (Cret-Tert).

| Con | Cenozoic | Pal | Paleozoic |
| Quat | Quaternary | Perm | Permian |
| Holocene | Penn | Penn | Pennsylvanian |
| Pleis | Pleistocene | Carb | Carboniferous |
| Tert | Tertiary | Miss | Mississippian |
| Neo | Neogene | Dev | Devonian |
| Paleol | Paleogene | Sil | Silurian |
| Plio | Pliocene | Ord | Ordovician |
| Mio | Miocene | Camb | Cambrian |
| Oligol | Oligocene | Prec | Precambrian |
| Eoc | Eocene | Prot | Proterozoic |
| Paleol | Paleocene | Arch | Archean |
| Mes | Mesozoic | E | Early |
| Cret | Cretaceous | M | Middle |
| Jur | Jurassic | L | Late |
| Tri | Triassic |

MINERALIZATION AGE (AGE_MINER): Enter the abbreviation for the most specific geologic age of the mineralization of the deposit. Use the same abbreviations used for the age of the host rock. A range of ages may be entered separated by a hyphen (Cret-Tert). If the mineralization has been dated radiometrically, include that information in the "Deposit Description" field.

TECTONIC SETTING (TECTON_SET): Enter a brief description of the tectonic setting of the site or area at the time the deposit was formed.

ASSOCIATED IGNEOUS ROCK (AS_IG_LITH): Enter a brief description of any igneous rock genetically associated with the mineralization. Include the formal name, if any, and the lithology.

ASSOCIATED IGNEOUS ROCK AGE (AGE_AS_IG): Enter the abbreviation for the most specific geologic age of the genetically associated igneous rock. Use the same abbreviations used for the age of the host rock. A range of ages may be entered separated by a hyphen (Cret-Tert). If the associated igneous rock has been dated radiometrically, include that information in the "Deposit Description" field.

ORE MINERALS (ORE_MINER): Enter the complete name of all ore minerals known to occur at the site being described. If possible, list in decreasing order of importance.

NON-ORE MINERALOGY (N_ORE_MIN): Enter into this text field a complete (as possible), but brief description of the alteration, gangue, and other non-ore mineralogy associated with the mineralization at this site.

ORE CONTROLS (ORE_CNTRLS): Enter into this text field a description of the factors controlling mineralization, including structural, stratigraphic, chemical, or any other type of control.

DEPOSIT DESCRIPTION (DEPOS_DESC): Enter into this text field a general description of the deposit being described. Also include any other information concerning this deposit or area that does not seem to fit in another field.

COMMENTS (COMMENTS): This is a general purpose text field which can be used for information which does not fit any other field. This is a good place to put speculations (as opposed to facts entered into other fields) concerning deposit origin, etc.

KEY WORDS (KEY_WORDS): This is a key word field available for free use; it will not be transferred to MRDS or to the CMR file.

NOTES (NOTES): This is a memo field available for notes, comments, that are not to be transferred to MRDS or to the CMR file.

REFERENCES (REF_1...): Five numeric reference fields are furnished. Each reference should be entered into the Reference file, numbered in order of entry. These references must be in standard Survey format, and must be complete. Each reference will be assigned a number and be entered only once. A number from the reference file should be entered into the numeric reference field of the MRDS file. Up to five references may be entered into a single deposit record, one in each field.
MINFILE AT A GLANCE

DATABASE
- Total occurrences: 11,368 records
- Size of database: 68 Mb
- Area covered (B.C.): 950,000 square kilometres
- Map areas (1:250K scale): ~90 Maps
- Data format: 69 entity-relational ASCII files
- Per cent data released: 75%

PRODUCT OUTPUT
- Mineral location maps: 1:250,000; 1:100,000 scales
- Data diskettes (1.2 Mb): 1 for each map area
- MINFILE/pc program: Data Entry-Search-Report
- Paper printouts: Indexes and complete reports
- Open Files: Commodity reports
- Major deposits

CLIENTS
- Users of MINFILE/pc: 536 clients
- Mailing list for MINFILE: 950 clients
- Types of clients: Governments, Industry, Public

January 1994
Summary of B.C. MINFILE

OVERVIEW OF MINFILE:

- MINFILE is the British Columbia Geological Survey’s mineral inventory database management system.
- Contains information on over 11 000 metallic, industrial mineral and coal occurrences (showings to major producing mines).
- MINFILE/pc, a menu-driven data-entry, search and report program for IBM-compatible microcomputers, accesses the database.
- Data elements are organized with a set of codes (entities), within a relational database design (entity-relationship model).
- The MINFILE system helps provide solutions in mineral exploration, land-use planning and mineral resource management.
- MINFILE information may be used in other programs such as word processors, plotted using computer-aided mapping systems, and integrated with conventional geographical information systems.
- The database contains 69 files, with 96 fields and 84 data elements.
- 86 maps (1:250,000 or 1:100,000 scale) cover 950 000 square kilometres.

MINFILE DATA:

- Location
- Commodity
- Mineralogy and alteration
- Geological setting
- Lithology and host-rock name and age
- Deposit class and character
- Assays, reserves and production, and reserves
- Textual geological description (capsule geology)
- Bibliography, citing information sources for the occurrence
Summary of B.C. MINFILE (cont)

THE MINFILE/pc PROGRAM:

- 12 menu-driven **searches** on a variety of exploration and geological parameters.
- 12 high quality **reports** on the search results.
- **Data-entry** has a pull-down and pop-up interface for changing, updating and appending data.
- **Utility functions** assist in configuring the database, exporting and importing data, and maintaining the system.
- **Code table maintenance** allows the users to add, delete and modify the contents of the various codes and tables.
- The province wide database of over 11 000 occurrences currently occupies **60 megabytes** of space.
- Data are distributed in **ASCII files**, which are configured into searchable database (dBASE) files.
- **Programming language and software**: FoxBASE+/FoxPro, R&R Relational Report Writer, automatic table look-up (Proximity Technology Inc.), data compression (PkZip by PkWare Inc.).
- **Supporting documents** include a coding manual, a user's manual and technical manuals.

PRODUCTS, DISTRIBUTION AND SUPPORT:

- Mineral location maps, with topography and geological base (1:250,000 or 1:100,000 scale)
- Paper print-outs of indexes and complete reports
- Data disks (map areas, provincial, commodity open files)
- MINFILE/pc software
- Coding and user's manuals
- Custom searches, reports and data
- Talks, workshops and help desk
- Over 400 users
- MINFILE technology and program are marketed for sale world-wide
MINERAL OCCURRENCE STATUS IN BRITISH COLUMBIA

<table>
<thead>
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<th>STATUS</th>
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<tr>
<td>SHOWING</td>
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<tr>
<td>PROSPECT</td>
<td>13.2%</td>
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<tr>
<td>DEV.PROS.</td>
<td>4.3%</td>
</tr>
<tr>
<td>PRODUCER</td>
<td>0.8%</td>
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<tr>
<td>PAST PROD.</td>
<td>15.1%</td>
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</table>
N.T.S.: 104B/1W

U.T.M.: METALS: Cu, Ag, Fe, As, Co, Au

Lot - Long.: 56°12.9' 130°20.7' PROPERTY: Granduc Mine

References:  BC MI 83302

MHAR 1931, p 47; 1953, p 82; 1954, pp 80-82; 1955, pp 14-16; 1956,

pp 15-17; 1957, p 6; 1958, p 6; 1960, p 6; 1961, p 8; 1962, p 8;


1969, p 54

BC Prelim. Map of Granduc Area, 1956

As Repts 89; 90; 328; 340

GMI 104B/1 Cu 1 Granduc (Leduc) (Edna May)

MRB Corp Files: "The Granby Mining Co., Ltd.",

"Granduc Mines, Ltd.", "Granduc Operating Co.",

Western Miner & Oil Review, Aug. 1953, p 42

(OVER)

Project 290

104B/1W

Norman, G.W.H., "Faults and Folds Across Cordilleran Trends
at the Headwaters of Leduc River, Northern B.C.,"

Petrologic Studies, Buddington Volume, the G.S.A., 1962


Norman, G.W.H. & McCue, J., "1966 Relations of Ores to Fold Patterns at Granduc, B. C."

C.I.M.M. Special Volume No. 8
MINERAL DEPOSIT INVENTORY

Map No. 1046-21

Metal ☐ Industrial Mineral ☐ Placer ☐ Coal ☐ Lapidary ☐

Name: Granduc Mine

Claim: Owner: Year(s):
Claim: Owner: Year(s):
Claim: Owner: Year(s):
Claim: Owner: Year(s):

Locations: N.T.S. 2606/91 Lat. 56°13.31 Long. 130°20.81 U.T.M.
M.D. elevation In park E. N. S. E.
Loc. plot: Source: Prec. I

Status: Producer ☐ Dev. Prospect ☐ Prospect ☐ Showing ☐

Production:
Tons 6,101,400 Grade: Au 72,753,9 oz. Ag 1,225,732,9 oz.
553,627,617 oz Zn —
Others: Year(s): 1970 to 1973

Reserves:
Tons 32,951,000 Grade: 1.6% Cu Year 1973
Tons Grade Year
Tons Grade Year

Development: Surface
Underground 40,165
Drilling 68,721
Surveys: Geol. Geophysical

Geol. Bl. Geophysical: 3730
Geol. and maps: Preliminary Map Granduc - 1956, M.N.R.

Summary description: Mineralized shear zones in metased.

Attitude of deposit: Strike Dip
Arizona Plunge

Size: Length Width Depth

Minerals: Chalcopyrite, pyrite, pyrrhotite, magnetite, galena, sphalerite, arsenopyrite.

Economic minerals

Assay

Remarks


BRITISH COLUMBIA DEPARTMENT OF MINES AND PETROLEUM RESOURCES
HOST ROCK

DOMINANT HOST ROCK:  

FORMAL HOST:
1. Group: 289 Hazleton  Formation: * * undefined
Strat-Age: 227 Lower Jurassic  Isotopic Age: Material Dated:
Dating Method:  

INFORMAL HOST:
1. Igneous/Metamorphic/Other: Name: 257 Nanika Intrusion
Strat-Age: 124 Eocene  Isotopic Age: 49.9 Ma +/- 2.3 Ma
Dating Method: 07 K-Ar  Material Dated: Whole rock (biotite hornfels)

ROCK TYPE/LITHOLOGY:

ROCK CODE  ROCK NAME
PRPR  Rhyolite porphyry
BRCC  Breccia
PRPR  Quartz monzonite porphyry
HRFL  Biotite hornfels
GRUK  Greywacke
ARGH  Argillite

GEOLOGICAL SETTING

TECTONIC BELT:  IN Insular  CC Coast Crystalline  IM Intermontane  DM Omineca  EA Eastern
TERRANE:  1. CPC Plutonic Rocks  2. ST Stikinia
PHYSIOGRAPHIC AREA: NCPT Nechako Plateau

METAMORPHISM:

GRADE:
ZL Zeolite  BS Blueschist  MV Med. Vol. Bituminous
GS Greenschist  EC Eclogite  HV Hi Vol. Bituminous
AM Amphibolite  AN Anthracite  SB Sub Bituminous
X Hornfels  SA Semi-Anthracite  L Lignite
GL Granulite  LV Low Vol. Bituminous

Geological Setting Comment:
CAPSULE GEOLOGY

Molybdenum mineralization occurs within a rhyolite plug, 600 by 900 metres in diameter, which intrudes hornfelsic clastic rocks with intercalated greywackes and argillites of the lower Jurassic Hazelton Group. The porphyry plug is part of the Cenozoic Nanika Intrusions and has been dated at 49.9 ± 2.3 million years. This rhyolite porphyry plug consists of four phases including two porphyries and two breccias. The porphyry forming the major part of the plug is a white aphanitic rock with sparse phenocrysts of quartz and feldspar. This phase intrudes an earlier breccia in which fragments of the porphyry occur along with fragments of country rock. The porphyry is intruded by a second breccia composed mainly of porphyry fragments and a small (about 2.45 metres in diameter) plug of quartz monzonite porphyry.

Mineralization is concentrated in a stockwork of quartz veins and fractures. The molybdenite mineralization is contained within a silicified zone and better grades occur in a zone immediately peripheral to the contact of the younger porphyry plug. Minor chalcopyrite, sphalerite and galena are reported to occur in separate localities.

Silicification is the most intense type of alteration but carbonate, pyrite and talcose alteration with potassic metasomatism also occur.

The Lucky Ship deposit is reported to host 13.6 million tonnes of ore grading 0.17 per cent molybdenite (Map 65).

WORK HISTORY

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<tr>
<th>YEAR</th>
<th>WORK TYPE</th>
<th>AMOUNT (m/m/ha/No.)</th>
<th>COMMENT (Owner/Operator/Results)</th>
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<td>PHYS</td>
<td>109 claims</td>
<td>Owned by Southwest Potash Corp</td>
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<td>GEOL</td>
<td>61 line-km.</td>
<td>42 claims optioned to Plateau Metals Ltd.</td>
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<td>DIAD</td>
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<td>STAK</td>
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<td>Godfrey of Southwest Potash Corp</td>
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<td>MAGG</td>
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<tr>
<td></td>
<td>DIAD</td>
<td>8439 metres</td>
<td>In 1965 Plateau Metals Ltd reported</td>
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<td>TREN</td>
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<td>13.6 million tonnes of 0.17% MoS₂</td>
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<td>1968</td>
<td>STR1</td>
<td>2 holes, 328 m.</td>
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### DEPOSIT DENT4010

**Identification**
- Mineral occurrence
- Host rock
- Geological setting
- Reserves
- Production

**Capsule geology**
- NMI No.: 808
- Status: Notes
- NTS Maps: Exploration Activity
- BC Maps: Work History
- Latitude: 56 38 00
- Longitude: 130 27 00
- Elevation: 1600 metres

**Location**
- UTM Zone: 09
- Northing: 6277299
- Easting: 411052
- Location Certainty: Within 500 m

**Comments**
- 21 zone, approximately 84 kilometres north-northwest of Stewart and 4

**Date**
- Coded: 24/07/85
- Revised: 15/11/91

**Coded by:** GSB
**Field Checked:** Y

---

### DEPOSIT DENT4020

**Ministry of Energy and Petroleum Resources**

**Append**
- Browse
- Delete
- Move
- Insert

**E/pc Meta Data Entry**

**Name:** ESKAY CREEK

**Commodities**
- Gold

**MINERALS**
- Characteristics: Stratabound
- Classifications: Volcanogenic
- Types: Tabular
- Faulted

**Alteration**
- Chlorite

**Age**
- Dimension: 1400x250 x 5 metres
- Strike/Dip: /

**Mineralization**
- Lower Jurassic
- Method: Lead/Lead

**Isotopic**
- Material Dated: Galena

**COMMENTS:** 21 zone; 5 to 45 metres thick. Age date of mineralization from

---

**Deposits:** 11369
Sample Data Entry Screens and Proximity Help System
MINFILE

INFORMATION
SYSTEM

GEOLOGICAL
COMPILATION
- Coding
- Data Entry
- Editing

MAP MANAGEMENT
- Compilation
- Plotting
- CAD

SYSTEM MANAGEMENT
- Database Design
- Manuals
- Tracking
- Maintenance

PRODUCT OUTPUT
- Floppy Production
- Hard Copy
- Marketing
- Distribution

MINFILE MODEL

MINERAL DEPOSIT

CAPSULE GEOLOGY /BIBLIOGRAPHY
- IDENTIFICATION
- MINERAL OCCURRENCE
- GEOLOGICAL SETTING
- HOST ROCK

ECONOMICS /REFERENCES
- RESERVES
- PRODUCTION

GSB
LIMITATIONS
- Incomplete or inaccurate reporting
- Reporting and recording bias
- Data structure knowledge required
- Data delivery and updating
- Costs & technological barriers

SOLUTIONS
- Research / Interpretation
- Ranking / Combining commodities
- Educate / Documentation
- Planning / Staff support
- Technology / Innovations

DATA CAPTURE
- Company Reports
- Provincial Annual Reports, Bulletins
- Federal Papers, Memoirs, Bulletins
- University Theses
- Press Releases
- Scientific Journals
### SOFTWARE APPLICATIONS

<table>
<thead>
<tr>
<th>Program</th>
<th>Use</th>
<th>Examples</th>
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<tr>
<td>dBASE/FoxBASE</td>
<td>Relational Database</td>
<td>Mineral Inventory</td>
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<td>R&amp;R</td>
<td>Reports</td>
<td>Master Report</td>
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<tr>
<td>Friendly Finder</td>
<td>Query (TSR)</td>
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<td>PC-PC Link</td>
<td>Data Transfer</td>
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<td>Drafting/Plotting</td>
<td>Mineral Maps</td>
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</table>
Use **MINFILE** data....

1. As a resource for information on documented mineralization in any area of B.C.

2. To develop exploration strategies

3. For geoscience research

4. To evaluate the resource potential of an area

5. For land-use planning

6. For "Desk-top Prospecting"
STATUS VS COMMODITY IN B.C.

NUMBER OF OCCURRENCES (Thousands)

- Copper
- Lead
- Zinc
- Gold
- Silver

STATUS

Past Prod  Showing  Prospect  Dev Prosp  Producer
COPPER *RESERVES IN B.C.
(MILLION TONNES, AVERAGE GRADE)
TOTAL: 5.4 BILLION TONNES GRADING BETWEEN 0.36% AND 0.895% COPPER

MEASURED GEOLOGICAL
1,594.5
0.370% CU

MEASURED RECOVERABLE
207.7
0.385% CU

INDICATED
1,002.65
0.360% CU

INFERRED
182.3
0.450% CU

ESTIMATED
610
0.895% CU

UNCLASSIFIED
1,826.2
0.546% CU

*BASED ON 44 DEPOSITS WITH RESERVES => 20 MT, 0.2% CU
The MINFILE/pc program...

1. Is stand-alone on a personal computer
2. Enables the user to search the MINFILE database on a variety of exploration and/or geological parameters
3. Allows the user to produce high quality reports on the search results
4. The data entry module allows the user to alter the data in the MINFILE database
5. Ensures that data can be easily transferred between computers
6. Can be obtained free of charge from the Geological Survey Branch, MINFILE project
MINFILE/pc Version 3.0

Requirements

- IBM-PC or compatible computer
- DOS Version 3.X or higher
- 640 Kilobytes of RAM
- 1.2 Mb, 5.25 inch floppy drive
- Disk space: 2 Mb for the program, 8 Mb per 1000 occurrences data
**2. Location**

<table>
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<th>Location search</th>
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<th>Degrees / Minutes</th>
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<td>From Longitude</td>
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<td>Physiographic Region</td>
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Choose ONE search ONLY

| Deposits : 75 |
MINFILE / pc
Report Generation
Ministry of Energy, Mines and Petroleum Resources

Reports

Master .................. 01 MINFOLE Number Index ........ 06
Production ................ 02 Primary Name Index ........ 07
Capsule Geology/Bibliography 03 Primary Commodity Index ..... 08
Map Legend ................ 04 NTS Map Index .............. 09
Map Commodity Index ........ 44 Alphabetical Index .......... 10
Data Dictionary Control .... 05 Commodity Index ............ 11

Devices

Screen .............. S Printer ........... P File .......... F
Report □ Device □ Modify settings □

Select device and report | Deposits : 10675

SRCH1820
MINFILE / pc
Search
Ministry of Energy, Mines and Petroleum Resources

Commodity Search

Primary Commodity: □ or □ or □ or □ or □ must be present

All of: □ and □ and □ and □ and □ must be present

AND

At least 1 of: □ or □ or □ or □ or □ must be present

AND

None of: □ or □ or □ or □ or □ must be present

* This search is the quickest! | Deposits : 10675
MINFILE NUMBER: 092F 330

NAME(S): MYRA FALLS (H-W), H-W, H-W MINE, MYRA FALLS

STATUS: Producer
NTS MAP: 092F12E
LATITUDE: 49 34 24
LONGITUDE: 125 35 25
ELEVATION: 326 Metres

COMMENTS: Centre of H-W zone is located 2 kilometres west of the south end of Buttle Lake (Western Miner, May 1983).

COMMODITIES: Copper, Zinc, Lead, Gold, Silver, Cadmium

MINERALS
SIGNIFICANT: Chalcocpyrite, Sphalerite, Galena, Pyrite, Tennantite
Bornite, Pyrhotite, Barite, Quartz, Pyrite, Silicific'n, Pyrite
ALTERATION TYPE: Sericite, Quartz, Pyrite
ALTERATION TYPE: Sericitic, Quartz, Pyrite
MINERALIZATION AGE: Upper Devonian, 370 Ma
ISOTOPIC AGE: 370 Ma
DATING METHOD: Rubidium/Strontium
MATERIAL DATED: Whole rock

DEPOSIT
CHARACTER: Stratiform, Massive, Volcanogenic, Syngenetic
CLASSIFICATION: Exhalative, Volcanogenic, Syngenetic
SHAPE: Tabular

HOST ROCK
DOMINANT HOST ROCK: Volcanic

STRATIGRAPHIC AGE | GROUP | FORMATION | IGNEOUS/METAMORPHIC/OTHER
Upper Devonian | Sicker | Myra |
ISOTOPIC AGE: 370 Ma
DATING METHOD: Rubidium/Strontium
MATERIAL DATED: Whole rock
Upper Devonian | Sicker | Price |
Jurassic | 166 Ma +/- 8 Ma
DATING METHOD: Potassium/Argon
MATERIAL DATED: Biotite
Tertiary | 39 Ma
DATING METHOD: Potassium/Argon
MATERIAL DATED: Biotite
LITHOLOGY: Pyroclastic Rock, Argillite, Andesitic Flow, Breccia, Quartz Feldspar Ryholite Tuff, Pillow Basalt, Feldspar Pyroxene Andesite Flow, Granitic Dike, Dacite, Rhyolite


GEOLOGICAL SETTING
TECTONIC BELT: Insular
TERRANE: Wrangell
METAMORPHIC TYPE: Regional
COMMENTS: Located in the Buttle Lake uplift.

PHYSIOGRAPHIC AREA: Vancouver Island Ranges
RELATIONSHIP: Plutonic Rocks
GRADE: Greenschist

MINFILE NUMBER: 092F 330
INVENTORY

ORE ZONE: GAP

CATEGORY: Measured
QUANTITY: 634400 Tonnes

COMMODITY
GRADE
Gold 3.2000 Grams per tonne
Silver 151.5000 Grams per tonne
Copper 1.8000 Per cent
Lead 1.1000 Per cent
Zinc 13.3000 Per cent

COMMENTS: Proven and probable geological reserves.

ORE ZONE: H-W

CATEGORY: Measured
QUANTITY: 8955100 Tonnes

COMMODITY
GRADE
Silver 39.6000 Grams per tonne
Gold 2.2000 Grams per tonne
Copper 1.7000 Per cent
Lead 0.4000 Per cent
Zinc 4.3000 Per cent

COMMENTS: Proven and possible geological reserves.

ORE ZONE: BATTLE

CATEGORY: Measured
QUANTITY: 2013700 Tonnes

COMMODITY
GRADE
Gold 1.1000 Grams per tonne
Silver 24.2000 Grams per tonne
Copper 2.6000 Per cent
Lead 0.5000 Per cent
Zinc 12.7000 Per cent

COMMENTS: Proven and probable geological reserves.

ORE ZONE: TOTAL

CATEGORY: Measured
QUANTITY: 12516100 Tonnes

COMMODITY
GRADE
Gold 2.1000 Grams per tonne
Silver 45.6000 Grams per tonne
Copper 1.9000 Per cent
Lead 0.5000 Per cent
Zinc 6.3000 Per cent

COMMENTS: Total proven and probable geological reserves of the H-W, Lynx, Price, Gap, Battle, Extension (W37), Trumpeter and 6 Level deposits.

CAPSULE GEOLOGY

The H-W volcanogenic massive sulphide deposit occurs within the southern part of the Buttle Lake uplift. This discreet belt of Upper Paleozoic rocks is bounded on the east by Upper Triassic Karmutsen Formation volcanics (Vancouver Group) and on the west by the Early to Middle Jurassic Island Plutonic Suite. The geology of the uplift has recently undergone reinterpretation and the stratigraphy has been reassigned to several new formations of a redefined Sicker Group and the new Buttle Lake Group (formerly the upper part of the Sicker Group) (Jurca, 1987; Massey, Personal Communication, 1990).

The new Buttle Lake Group consists of: (1) the Lower Permian (?) Henshaw Formation composed of conglomerate, epiclastic deposits and vitric tuffs; and (2) the Lower Permian to Pennsylvanian Azure Lake
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<th>Production Year</th>
<th>Tonnes Mined</th>
<th>Tonnes Milled</th>
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<th>Grams Recovered</th>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lead</td>
<td>1,377,572</td>
<td>29,484,968</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Zinc</td>
<td>29,484,968</td>
<td>29,484,968</td>
</tr>
</tbody>
</table>

**SUMMARY TOTALS:** 092F 330

**NAME:** MYRA FALLS (H-W)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Imperial</th>
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<tbody>
<tr>
<td>Mined: 8,646,822 tonnes</td>
<td>9,531,490 tons</td>
</tr>
<tr>
<td>Milled: 8,650,882 tonnes</td>
<td>9,535,965 tons</td>
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</table>

**Recovery:**

- Silver: 227,723,517 grams 7,321,470 ounces
- Gold: 9,677,333 grams 311,133 ounces
- Copper: 163,654,661 kilograms 360,796,666 pounds
- Lead: 13,495,374 kilograms 29,752,198 pounds
- Zinc: 317,084,492 kilograms 699,051,447 pounds

**Comments:**

1985: Combined output of H-W, Lynx (092F 071) and Myra (092F 072).
Figure 1. Steps for Data Entry in MINFILE/pc

1. Select Data Entry System
2. Select Occurrence To Edit
3. Select Screen To Edit
4. Select Edit Mode
5. Make Changes
   - Submit Changes
   - Undo Changes
7. Exit to Main Menu
### Main Menu

<table>
<thead>
<tr>
<th>SCREEN</th>
<th>DEPOSIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identification</td>
<td>Mineral Occurrence</td>
</tr>
<tr>
<td>Host Rock</td>
<td>Geological Setting</td>
</tr>
<tr>
<td>Reserves</td>
<td>Production</td>
</tr>
<tr>
<td>Capsule Geology</td>
<td>Bibliography</td>
</tr>
<tr>
<td>Work History</td>
<td>Exit to Main Menu</td>
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</tbody>
</table>

<table>
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<tr>
<th>EDIT</th>
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<tbody>
<tr>
<td>Append</td>
</tr>
<tr>
<td>Revise</td>
</tr>
<tr>
<td>Browse</td>
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<tr>
<td>Delete</td>
</tr>
<tr>
<td>Move</td>
</tr>
<tr>
<td>Insert</td>
</tr>
<tr>
<td>Submit</td>
</tr>
<tr>
<td>Undo</td>
</tr>
<tr>
<td>Options</td>
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<tr>
<td>Compare</td>
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</table>

<table>
<thead>
<tr>
<th>HELP</th>
<th>PRINT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Master report - MINFILE</td>
<td></td>
</tr>
<tr>
<td>2. Master report - Update</td>
<td></td>
</tr>
<tr>
<td>3. Production report - MINFILE</td>
<td></td>
</tr>
<tr>
<td>4. Production report - Update</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SCREEN</th>
<th>DEPOSIT</th>
<th>EDIT</th>
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</thead>
<tbody>
<tr>
<td>Select from list</td>
<td>Previous in list</td>
<td>Next in list</td>
</tr>
<tr>
<td>MINFILE No. Select</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Create</td>
<td>Delete</td>
<td>Append from updates</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>HELP</th>
<th>PRINT</th>
</tr>
</thead>
<tbody>
<tr>
<td>MINFILE/pc Help System</td>
<td></td>
</tr>
<tr>
<td>Friendly Finder : ON</td>
<td></td>
</tr>
<tr>
<td>DOS Command Shell</td>
<td></td>
</tr>
</tbody>
</table>
DEPOSIT FILE

MINFILE No. Select
Create Deleter Append from Updates
Exit to Main Menu

Identification

Names: MCKINLEY (L.140S)
Producer: Location: Greenwood
Mining Method: Open Pit: Underground: Mining Divisions: Greenwood
UTM Zone: 11
Northing: 5488380
Easting: 399557
Location Certainty: Within 500 m

Date Coded: 24/07/85
Coded by: CSB
Field Checked: N
Date Revised: 24/07/85
Revised by: GO
Field Checked: N

Mineral Occurrence

MINFILE No.: 092H1W092
Name: HARRISON GOLD
Commodities: Gold

MINERALS
Significant: Gold
Associated: Quartz
Alteration: Sericite
Alterat'n Type: Sericitic

DEPOSIT
Characteristics: Vein
Classifications: Epigenetic
Shape: Irregular
Modifiers: Fractured
Dimension: x x metres
Strike/Dip:
Trend/Plunge:

AGE
Mineralization: Tertiary
Isotopic Age: 24.5 Ma +/- 1 Ma
Material Dated: Sericite
Method: Potassium/Argon
COMMENTS: Age date from vein sericite in Portal Stock adit (Fieldwork 1984)

For multiple fields use Escape when done
Deposits: 1
MINFILE products...

1. 1:250,000 NTS area data diskettes ($5/disk)
2. Paper printouts ($5-$50)
3. Mineral inventory maps by NTS area ($5)
4. Coding manual, custom searches, MINFILE/pc and User's manual (FREE)
5. Provincial MINFILE location index ($5)
6. Open Files: Major Industrial Mineral Deposits, Major Deposits in B.C. ($10)
7. Complete digital dataset of the Province ($60)
8. Complete set of MINFILE maps for the Province on microfiche ($10)
MINFILE Client Inquires
1990–91

Total Inquiries 1457

- MINFILE Demo 214 (15%)
- Property File 181 (12%)
- Data Requests 354 (24%)
- Product Information 464 (32%)
- Program Support 244 (17%)

GSB, April 30, 1991
Mineral Deposit Databases

Project Management

- Concept, Designing, Planning (budget, staff)
- Database Design and Data Dictionary
- System Testing and Quality Assurance
- Database Administration and Maintenance (documentation and manuals)
- Data Acquisition and Processing Procedures (coding procedures)
- Training and Client Support
- Marketing and Distribution of Data
- New Technology and Future Planning
- Designing and Producing Computer Generated Products for Users
Project Management

Topics

Theory
- Concept
- Design
- Project Planning
- Implementation
- Acceptance
- Assessment
- Summary

Practical
- The MINFILE Experience

Lecture by: L. Jones, D. Jakobsen
References: Three E Management Course Notes
Concept: Idea

- Compare the current situation with a more desirable one.

- Develop idea about how to improve the situation by:
  - Problem solving techniques
  - Intuitive flash
  - Random trial and error

- Produce objective statement
  - why do the project?
  - what is the concept?
  - what is the expected result?
  - what are the benefits?
**Design:** Create a description of **WHAT** will be produced

- Understand the intent of the concept in detail
- Determine the needs of whoever is supposed to benefit from the concept
- Define the boundaries and limits of the project (scope)
- Propose a suitable product to satisfy the intent of the concept and the needs of the owner and the user
Design cont.

- Get GENERAL approval

- Make detailed design decisions to unmistakably define the product

- Get SPECIFIC approval

- Assemble a communication package (proposals, design documents)
Project Planning: Create a description of HOW the output will be produced

- Make contingency plans

- Develop work breakdown
  - by task
  - by sub-project
  - by time period
  - by resource

- Need to know:
  - what other task must precede this task?
  - who or what will do it?
  - what is to be done?
  - how long will it take?
Project Planning cont.

- Decide Precedence of events
  - make contingency plans first
  - use a MIND MAP which is a graphic representation of the events
Project Planning cont.

- consider working from finish to start
- consider using TASK BOXES

**TASK BOX**

<table>
<thead>
<tr>
<th>Task No.</th>
<th>Resource</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Daily Allocation</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Project Planning cont.

- indicate appropriate milestones

- Allocate resources

- Calculate cost and cash flow projection

- Establish a quality assurance system
Project Planning cont.

- Establish authority structure
  - who is responsible for what?
  - who do you need to communicate with?

- Produce detailed communication package

- Develop a process to monitor the work and respond to unplanned events (contingency plans to adjust $, time or resources)

- Establish deliverables and deadlines
Implementation: The product is created as designed and planned

- Establish and maintain rapport with all engaged in or affected by the project work

- Activate the work and quality monitoring system devised during the planning phase

- Respond to variances

- Re-plan, re-structure and re-define as required

- Exercise good leadership
Acceptance: Acceptance of product

- Deliver product
- Test product
- Sign-off/accept product
- Produce the final Report
Assessment

- How has the overall situation changed since the project was conceived?

- How do these changes affect the need for the project?

- Could this have been foreseen more accurately?

- Was the user's assessment of the needs correct?

- Might the needs have been better met some other way?

- Did the design conform to the criteria specified by the concept?
Assessment cont.

- To what extent did the product match the design?
- How adequate was the plan?
- Were cost and time estimates realistic?
- Was the quality appropriate?
- How good is the documentation?
- Was a better approach overlooked?

ETC.....
Summary

- Define a need
- Come up with an idea to fulfill this need
- Design a product that would meet the idea
- Plan how to produce this product
- Implement the plan and produce the product
- Accept the final product
- Assess the success of the project
The MINFILE Experience: A project 26 years in the making and still evolving

Historical background:

- 1969 - Revised Card File
- 1973 - MINDEP
- 1976 - MINFILE (Honeywell)
- 1981 - MINFILE (IBM)
- 1985 - Redesign MINFILE(VAX)
The MINFILE Experience cont.

- 1987 - MINFILE/pc V. 1.0
- 1988 - MINFILE /pc V. 2.0
- 1989 - MINFILE/pc V. 2.13
- 1991 - MINFILE/pc V. 3.0
- 1993 - MINFILE/dg

- Each of these are milestones in the project and each of these are sub-projects within the larger MINFILE project
Defining a need

- The government, industry and individual geologists collect a lot of data on B.C. mineral deposits

- The government collects data through regulatory requirements

Project Management 17
Defining a need cont.

- The government, industry and individual geologists all need access to all this data to:
  - Avoid duplication
  - Build scientific and geological knowledge
  - Save research time
  - Avoid decisions based on incomplete data
  - Provide a sound basis for government decision-making
  - Make it possible to assess the mineral potential of different areas of the province
The Idea

In 1967:

- Create a well organized, easily accessible and complete mineral deposit file for British Columbia
Design

- Research all available data for each known mineral deposit and compile it in a consistent format.

- Create a 1-page form printed in a "fill-in-the-blanks" format for compiling the data consistently.

- The format should allow for future computerization of the data.

- The location of each deposit will be plotted on standard 1:250 000 National Topographic Maps to 3 degrees precision.

- The maps and the filled in forms will reside with the Mineral Inventory Section of the B.C. Geological Survey Branch in Victoria.
Design cont.

- The maps and forms will be accessible to everyone

- The forms will contain the following data:
  - Identification
  - Type of commodity and specific products
  - Names
  - Location
  - Property Status and Potential
  - Brief History of Development
  - References
  - Geology Summary Description
Plan

Mineral Deposit File

- Complete data for each deposit
  - Decisions based on sound data
  - Easily accessible
  - Reduced research time
  - Accurate mineral potential assessment

- Work southeast to northwest beginning with O82G and ending with 1140 NTS areas

- Design Plan
  - 1:250,000 Maps
  - Identification
  - Commodity and Products
  - Names
  - Location
  - Property Status and Potential
  - Brief History
  - References
  - Geology Summary

- Benefits

- Precedence

- Milestones
  - First area completed
  - Initial Province completed
  - File is used by staff and clients with measurable results

- Job Schedule
  - April 67/May 67: Produce form
  - June 67/March 68: Fill in forms and produce maps
  - March 68/?: Add and update data

- Contingency

- Budget

- Project Management

Find someone else to do it and support them either through a contract or a grant
Produce Product

M.T.S. 104B/1W  Deposit No. 21
U.T.M. METALS: Cu, Ag, Fe, As, Co, Au
Lot-Long: 56°12.9' 130°20.7' PROPERTY: Granduc Mine

References:
- BC MI 93302
- HNMAR 1931, p 47; 1953, p 82; 1954, pp 80-82; 1955, pp 14-16; 1956,
  pp 15-17; 1957, p 6; 1958, p 6; 1960, p 6; 1961, p 8; 1962, p 8;
  1969, p 54
- BC Prelim. Map of Granduc Area, 1956
- As Repts 89; 90; 328; 340
- NNI 104B/1 Cu 1 Granduc (Leduc) (Edna May)
- NRB Corp Files: "The Granby Mining Co. Ltd."
- "Granuc Mines, Ltd.": "Granuc Operating Co."
- Western Miner & Oil Review, Aug. 1951, p 42

(OVER)

Project 290

104B/1W 21


Norman, G.W.H. & McCue, J., "1966 Relations of Ores to Fold Patterns at Granduc, B. C."
C.I.M.M. Special Volume No. 8

- This form was accepted and the work proceeded

Project Management 23
Project Assessment

- Assessment of the project two years later indicated that:
  - The forms took too long to complete
  - There was not enough geological data available on most deposits
  - Ideas for the requirements of the geological part of the file changed with time and people
  - The file would be useful when complete but had only limited usefulness when incomplete

- It was obvious that a change was required and that the project had so far failed to meet the original objectives
Result

- The file was re-designed for computer storage and retrieval
- Initially only a few of the items on the original form were input; geology was omitted to be added later
- A new form and program were developed
- Computerization solved some of the problems
- The constant evolution of the program and the methodology of collecting data have been a response to the changing needs of the users and rapidly changing technology
PROPOSAL FOR MINFILE CODING

OBJECTIVE: Update mineral inventory for Divisional use.
FEES: Variable according to funds available and priorities.

SUMMARY

This is a proposal for the coding and publication of incomplete areas of the MINFILE database. MINFILE, a database of over 11,300 metallic, industrial mineral and coal occurrences, is extensively used by the Mineral Resources Division. The data are a component in providing information for and responding to the Ministry priorities of mineral strategy, protected area planning, and resource management. The objective is to complete priority areas according to available funds.

BACKGROUND and JUSTIFICATION

MINFILE is used extensively by government and industry for resource information, land-use planning, research and exploration planning. The Land Management and Policy Branch use it to contribute to the provincial land-use plan and protected area strategy. The Regional Geologists provide advice and information to government, industry and public clients, while maintaining an up-to-date inventory of mineral deposits and reporting on exploration activity in the province. The Geological Survey Branch delivers MINFILE data to government, industry and academia. The MINFILE database is important to the Commission on Resources and Environment (CORE), whereby it provides mineral resource assessment data for the Mineral Potential Project.

The MINFILE database must contain updated data as the information provides a critical layer of information for Geographical Information Systems and decisions based on land-related data. Approximately 3000 occurrences (includes 30% growth) or 20% of the database remain to be coded.

PROPOSAL OBJECTIVES

The objective of this proposal is to release a number of map sheet areas to both internal and external users. A budget and time commitment according to prioritized areas are proposed to support personnel in the coding, updating, editing and publication of the MINFILE data and maps.
The following is a prioritized list of the key areas based on Regional Geologist and Land-use priorities:

<table>
<thead>
<tr>
<th>PAS/CORE Regions</th>
<th>Map Areas</th>
<th>Total Occurrences</th>
<th>Coding Months</th>
<th>Edit/Pub. Months</th>
<th>Estimated Budget</th>
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<tbody>
<tr>
<td>1. Southwest Region (Mainland):</td>
<td>092HSW</td>
<td>195</td>
<td>3.0</td>
<td>1.0</td>
<td>$12 000</td>
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<td>2. Northeast Region (Prince George):</td>
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<td>1.0</td>
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<tr>
<td>3. Northwest Region (Prince Rupert):</td>
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<td>50</td>
<td>1.5</td>
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<td>$6 000</td>
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<tr>
<td></td>
<td>104I</td>
<td>120</td>
<td>2.0</td>
<td>0.5</td>
<td>8 500</td>
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<td>4. Thompson-Okanagan (Kamloops):</td>
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<td>1.0</td>
<td>23 000</td>
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<td>5. Cariboo-Chilcotin (part Thompson-Okanagan):</td>
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<td>1.0</td>
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<td>082FSE/NE</td>
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<td>1.0</td>
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<tr>
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<td>1.0</td>
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<td>Total:</td>
<td></td>
<td></td>
<td></td>
<td>$246 000</td>
</tr>
</tbody>
</table>

**BENEFITS**

The Division will benefit from:

- Providing the Province with information to meet its economic and environmental goals.
- Protected Area Strategy and CORE objectives.
- Providing information to accommodate First Nations' interests.
CONTRACT PROPOSAL FOR MAINTENANCE OF MINFILE/dg

CONTRACTOR: Systems Consultants Inc.
FEES: $20,000

SUMMARY

This is a proposal for the maintenance and updating of the new MINFILE/dg system. This system integrates MINFILE, a database of over 11,000 metallic, industrial mineral and coal occurrences, and a new module focusing on exploration and development. The system will be used by the Regional Geologists to maintain and report on exploration activity in the province, and by the GSB to maintain and deliver MINFILE data to government, industry and academia. The system is a component in providing information for and responding to the Ministry priorities of mineral strategy and planning and resource management.

The testing of the new system is near completion and practical implementation will follow. A budget is required to enhance the system, providing for more searches, better data transfer, and improved documentation. Systems Consultants Inc. will be used because of their previous experience with the system and to avoid costly learning time. The objective of this proposal is to release a stable new version of the MINFILE software to both internal and external users.

BACKGROUND and JUSTIFICATION

Over the last 4 years much effort has been put into the user-requirements, system design and development of a database for use by the Regional Geologists. In September 1992, District Geology and Geoscience Information sections of the GSB sent out a Request For Proposal for the development of a District Geology Subsystem (MINFILE/dg). This resulted in a $49,500 contract awarded to Systems Consultants Inc. in October 1992. The system is an enhancement to the existing MINFILE/pc, Version 3.0, which integrates MINFILE, Notices of Work and Exploration databases. This project resulted in the delivery of a Functional Design Document, a conversion of MINFILE/pc to FoxPro, 50 functional changes to MINFILE/pc, and a copy of the new integrated MINFILE/dg system for testing and implementation.

This system, built to original specifications, will serve as the foundation for the Regional Geologists to do data entry and simple reporting on mineral deposits, and exploration and development projects. This proposal will enhance the system to provide more searches capabilities, better data transfer facilities, and improved help system and documentation.

The Regional Geologists provide advice and information to government, industry and public clients, while maintaining an up-to-date inventory of mineral deposits and exploration activity. The MINFILE/dg system will maintain and easily access
this information. It will help to reduce data acquisition and management costs, improve the quality and consistency of the information, and provide a solid foundation for resource management and planning. Database development within the Land Management and Policy Branch (LMPB) and the Geological Survey Branch (GSB) hinges on sharing of and access to common, consistent and current land-related data.

PROPOSAL OBJECTIVES

The objective of this proposal is to release a stable new version of the MINFILE software (Version 4.0) to both internal and external users. A budget is proposed to support a contract for the maintenance and updating of the MINFILE/dg System. Functional changes will be coordinated with additional modifications to the MINFILE/pc software, as identified by system users.

The following is a list of the key objectives:

Maintenance and Changes

- update the current MINFILE User's Manual to reflect the changes in the software
- software upgrades (R&R 5.0; FoxPro 2.5)
- context-sensitive help system
- more efficient transfer facility
- code table look-up in search screens to input codes
- redesign search screens to include additions to tables
- several minor changes not completed in the first phase of development and some identified during testing

Scope and Design

- a query system for the exploration and development data
- a work history system
- an alternate code table look-up system to Proximity
- a redesign of reserves and production according to an audit

BENEFITS

The Regional Geologists will benefit from:

- selective searching and reporting
- the ability to combine 5 regional datasets into a single dataset to enable provincial statistics and reporting
- an improved, user-friendly system, including user documentation, help system and code table look-ups.
- the investigation of future enhancements for implementation in 1994/95
- redesign in areas to meet current resource strategies
REQUEST FOR PROPOSAL
Requirements Section

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1.0 Ministry Overview
2.0 Situation Overview/Objectives
3.0 Hardware and Software Environment
4.0 Requirements/Specifications
5.0 Vendor Response
6.0 Pricing
7.0 Project Management
8.0 Proposal Evaluation

Appendices

I Project Change Request Summary for MINFILE/pc, Version 3.0

II Details of Project Proposal for the Design, Development and Implementation of District Geology MINFILE

III Geoscience Information Section Business Objectives

IV System Plan for MINFILE

V MINFILE/pc Database Structure and Menu Tree

VI MINFILE/pc Proposed "New" Menu Tree

Geological Survey Branch
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1. Introduction
2. Objectives of the Branch Computer System Plan
3. System Plan Highlights of 1992-93
   3.1. Hardware and software upgrades
   3.2. Mineral Resource Evaluation (MRE)
        Mineral Potential Mapping Project (MPMP)
   3.3. District Geology Database (MINFILE/dg)
        and MINFILE system development
   3.4. Network planning and remote (District Geology) communication
   3.5. ARIS management
   3.6. Highlights within Branch sections
4. Identification of Key Issues for 1993-94
   4.1. Network strategy and implementation
   4.2. Hardware and software upgrades and training
   4.3. Operation and maintenance of existing systems
   4.4. Specific and new initiatives
5. Recommended Strategy and Priorities
6. Conclusion
7. Appendices
8. Other Key Documents

Prepared by:
Geosystems Advisory Group (L. Jones, Chair)

April 28, 1993
EXECUTIVE SUMMARY

The mandate of the Geological Survey Branch is to assemble, maintain, and market a comprehensive geoscience database for British Columbia. All sections within the Branch provide critical data to fulfilling this mandate. The Mineral Potential Project is a key initiative, challenged to deliver mineral potential maps through the integration of these databases using GIS technology. The Branch computer systems plan identified end products, day-to-day operations, common key issues, and new initiatives. An integrated approach was used to evaluate the strategy of each section.

Objectives of the system plan are:

- To upgrade management and analysis of geoscience data and the map inventory.
- To facilitate the mineral resource assessment program by providing an efficient and standardized means of producing mineral potential maps.
- To enhance digital communication within the Branch, other Ministries and clients.
- To provide a systematic methodology for the integration of the Geological Survey Branch databases.
- To maximize the value of the current investment in computer technology.
- To be compatible with the Corporate Land Information Strategic Plan.
- To align the Branch with Ministry objectives on policy, procedures and standards concerning system technology.

The following are system plan highlights from the previous year:

- The majority of Branch staff were upgraded to Ministry standard computer platforms.
- The MPMP created mineral potential maps for several areas of the province, through the creation and integration of a wide range of multi-sourced data and by key hardware and software acquisitions.
- Hardware and software upgrade requirements of staff.
- A systems development contract for MINFILE/dg resulted in delivery of a Functional Design Document, a conversion of MINFILE/pc to FoxPro, 50 functional changes to MINFILE/pc, and a copy of the new program.
- MINFILE published new User's and Coding manuals.
- Network topologies were investigated but not implemented. Communication efforts resulted in the installation and testing of a modem and a pilot LAN in the Kamloops District office.
- ARIS unit commenced automation of producing index maps and produced an annual mailout of P.A.C. account statements from the automated pc-based P.A.C. system.
- COALFILE data was ported from the VAX to the PC, in dBASE format.
The following key areas have been identified to meet branch objectives:

- Network strategy and implementation.
- Hardware and software upgrades and training.
- Operation and maintenance of existing systems: Mineral Potential, GSB Database, MINFOLE and ARIS systems.
- Specific and new initiatives: capture management and integration of data, spatial analysis strategy, MINFOLE enhancements, PC direction for ARIS, and COALFILE.

The following are the key recommendations, in order of priority, by the Geosystems Advisory Group to improve operations of the Branch and to serve our clients better; costs estimates are preliminary:

- Plan a network strategy for the Branch. Progressively install peer-to-peer LANs within all sections. ($15,000 per group (S/group) or $12,000 for server + $700/station to upgrade)
- Justify and address general and specific hardware and software acquisitions. ($75,000 - $100,000)
- Continue to maintain support for existing Branch systems. ($50,000)
- Evaluate several GIS's and data analysis packages and implement the best solution for spatial analysis. ($20,000)
- Implement a UNIX-based GIS for a corporate GIS/Data Management system. ($15,000)
- Enhance MINFOLE/pc including a new interface for search routines, redesign of the reserves and production and work history. ($40,000)
- Upgrade, promote and distribute COALFILE. ($10,000)
- Evaluate the ARIS system to improve its efficiency. ($15,000)
- Evaluate the MINFOLE system including conversion choices for a multi-user environment, digitally generated MINFOLE maps, and links between the MINFOLE and ARIS systems. ($65,000 - $80,000)
- Proceed with capture and analysis of aeromagnetic, gravity and LANDSAT data. ($2500)
- Implement individual employee career and education plans. (variable costs)
- Investigate marketing strategies. (variable costs)

The Geological Survey Branch has a highly skilled group of people and has demonstrated the ability to efficiently deliver quality products. With competition for funding and rapid technological changes, the Branch is challenged to maintain these key success factors. The Branch has the opportunity for the innovative implementation of computer technology and to become a major contributor in the land-use planning process. As well, improvements can be made on production time and overhead costs. The result will be satisfied clients, consisting of users within the Branch, groups in other Ministries, users in industry and the general public.
Systems Testing & Quality Assurance

Outline

Introduction
Why Test?
Definition of Testing
Types of Errors
Testing Principles
Test Case Design/Testing Techniques
Levels of Testing
Summary

Lecture by: L. Jones and C. McPeek
16 November 1993

Reference: Program and System Testing Techniques by Cirrus Enterprises Inc.
March 1988
Introduction

Evaluation of system development projects over the years has produced one fairly constant analysis - approximately 50% of the total cost of each project has been devoted to "testing".

Typically, however, project estimators classify testing as an "addon" and schedulers usually schedule only 10-20% of project time and budget to testing.

Testing of a system development project involves the methodical and effective testing of the components of a system, whether they be hardware or software, and the project as an entity.

Each of the following groups of individuals within an organization, will, and should, approach testing with different objectives:

a. programmers

Will be concern with accuracy of program code and whether or not requirement specifications have been met.

b. systems analysts

Will be concerned about whether the system meets functional specifications and that the business case is satisfied.

c. technical support

Will be concerned with the technical components of the system, their acquisition, and integration into the operating environment.

d. data entry/users

Will be concerned about ensuring that they have the right equipment to do the job, that the procedures are accurate, the system is user friendly and effective., and whether their needs are met.

e. system development manager/project leader

Will be concerned about the overall business case, the schedule, project resources, and budgeting.

There are techniques available which will ensure all of the objectives of these separate interest groups are met.

What portion of the cost of the system development project would be dedicated to the testing phase?
Comparison of Software Testing & QA Techniques

Baseline

Overall Productivity: Up 12%
Delivery Time: Down 12%
Test Effort: Down 43%
Delivered Defects: Down 60+%

Traditional Software Projects
Projects With Enlightened Testing & QA

Source: Studies by IBM, DEC and others
Why Test?

There are significant penalties to be paid for inadequate or improper testing:

a. Unreliable systems
b. Inefficient manpower utilization
c. Redundant testing
d. Longer than estimated development times
e. Frustrated users/customers

Purpose Benefits of thorough system testing and quality assurance:

a. to improve software quality and reliability.
b. to reduce quality-related costs associated with retesting, warranty and complaint handling.
c. to meet customer needs and achieve greater customer satisfaction
d. to provide performance improvement measures, high productivity and quicker delivery of systems
e. to improve staff morale
f. to ensure that end result fits with the design specifications

The average computer software package marketed contains 3 defects per 1000 lines of code. Keeping in mind that the majority of software products available on the market exceed more than 100,000 lines of code - this means that you can potentially encounter over 300 defects while using your favourite package.

The number of defects (faults) in a program or a system can be reduced substantially when a rigorous quality control (or testing) methodology is effectively applied. It is practically impossible to eliminate all errors in a computer system, but there are techniques which can be used to make it easier to locate errors and prevent them from occurring in the first place.
Definition of Testing

When one tests a program, one wants to add some value to the program - improving the reliability of the program.

So in order to make a program or system more reliable - it must be testing with the INTENT OF FINDING ERRORS. Testing should not be approached with the idea of proving that the program(s) works properly. A SYSTEM DEMONSTRATION is the technique used to show that a program does what it is supposed to. If it does work properly - IT CAN STILL HAVE ERRORS!

For most purposes then, a test is the process of finding errors and a SUCCESSFUL test is one in which errors ARE DISCOVERED.
Systems Testing

Definition

⇒ A test is the process of finding errors and a SUCCESSFUL test is one in which errors ARE DISCOVERED.

√ add value to the program.

√ improving reliability of the program.

√ be intent on finding errors.

√ system demonstrations show a program working.

√ IT CAN STILL HAVE ERRORS!
Types of Errors

a. Specification problems

The program specification provided the programmer is incorrect, incomplete, ambiguous, or self-contradictory. Or the specification changes as the code is being written and the programmer is aiming at a moving target.

Example: Changes to Functional Description during program development.

b. Program/function errors

Missing or wrongly worded functions within a program module - or functions which serve no purpose.

Example: Appending a file to the end of Bibliographies was originally misinterpreted, such that the programmer appended several files to one bibliography instead of one file to several bibliographies.

This is a case of not understanding the way we do business.

c. Testing errors

Incomplete or ineffective test case preparation can leave program defects undetected.

Example: Problem with lithologies when deleting then appending occurrences, without pack/reindexing. Ranking is lost in multiple fields due to indexing problem.

d. External Interfaces

External interfaces are the means by which the system communicates to the outside world. They include devices such as printers, modems, etc. There can be errors communicating between hardware components.

Example: Different printer types.

e. Internal Interfaces

Internal interfaces are interfaces with other software such as compilers, operating systems, other program modules.

Example: DOS problems with backup/restore of various versions of DOS.
Types of Errors (cont.)

f. Control and Sequence Errors

- assuming events occur in a specific sequence
- initiating a process before prerequisites have been met
- waiting for an impossible combination of prerequisites
- failing to recognize when prerequisites have been met
- missing a processing step
- using the wrong processing step
- redundant processing

Example: During data entry problems occur in a screen when entering fields randomly rather than in sequence.

g. Resource Management Problems

Improper use or allocation of memory in the CPU for use by data files, programs, subroutines, or memory variables can all create havoc with a program.

Example: Loading MINFILE/pc low Vs high memory.

h. Process Errors

- arithmetic and manipulative errors
- incorrect initialization of variables or files
- program control and statement sequence execution

Example: Production figures originally incorrect by one decimal point in database.

i. Data Errors

These errors arise in the incorrect specification of data elements, their formats, the number of elements, and their initial values.

Example: Data Coded/Date Revised fields have different date formats.

j. Documentation Errors

These are errors caused by inadequate or incorrect documentation and/or procedure instructions to the users/operators. The system is expecting one situation or occur but the user/operator does something unexpected.

Example: Reserves in MINFILE.... If reserve category is assay only one calculation can exist. If reserve category any of the others, two calculations may exist. The testing of reserves was done before the formal rules were written in the Coding Manual and these rules were not clearly outlined to all the users doing testing.
<table>
<thead>
<tr>
<th>MINFILE / dg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main Menu</td>
</tr>
<tr>
<td>Ministry of Energy, Mines and Petroleum Resources</td>
</tr>
</tbody>
</table>

Search Database .......... 1  
Report Generation .......... 2  
Utilities ................. 3  
Minfile Data Entry .......... 4  
Project Data Entry .......... 5  
Code Table Maintenance ... 6  

File 'C:\minfile\data\E33' does not exist.  
1 Cancel ✗ < Ignore >  
Gathering Info  its : 11338

Variable 'PRJTYPE_C' not found.  
1 Cancel ✗ < Ignore >  
Gathering Info  its : 11338
Testing Principles

- **Test early and often.** Detection of errors early are easier and less costly to fix.

- **Define the expected output or result** so that erroneous results are not interpreted as valid.

- A **programmer should avoid attempting to test their own program** as the programmer may not want to expose errors or may have a misunderstanding of the program specification.

- Thoroughly **inspect the result of each test.**

- **Test cases must be written for invalid and unexpected, as well as valid and expected input conditions.**

- **Examining a program to see if it DOES NOT DO what it is supposed to do** is only half the battle. The other half is seeing whether the program DOES WHAT IT IS NOT supposed to do. Example - a payroll program is supposed to print cheques and is wrong if it doesn't. It is also wrong if it prints cheques and deletes the first record of the file.

- **Avoid throw-away test cases** unless the program is a throw-away program. Creating test conditions and test data is a costly process and the investment should be saved for later use. Re-testing of a program which was modified or fixed is not as rigorous if the original test conditions were saved. Errors found in early versions of the program must be verified as fixed in later versions.

- Do not plan a testing effort under the assumption that no errors will be found. Testing is the process of executing a program with the intent of finding errors.

- **The probability of the existence of more errors in a section of a program is proportional to the number of errors already found in that section.** (roughly 80/20).

- Testing is an extremely creative and intellectually challenging task. There is more creativity required for testing than for designing a program.
Test Case Design

One of the most important considerations in program and system testing is the design and development of effective test cases.

Here are some guidelines to use when designing test cases:

Single Condition Statements

For programs containing only one condition per decision statement, a minimum test criterion is of a sufficient number of test cases to (1) evoke all outcomes of each decision at least once and (2) invoke each point of entry at least once (to ensure that all statements are executed at least once).

Multiple Condition Statements

For programs containing decisions having multiple conditions, the minimum criterion is a sufficient number of test cases to evoke all possible combinations of condition outcomes in each decision, and all entry points into the program.

Range Values

If an input condition specifies a "range" of values (e.g. item count can be from 1 to 999), identify three valid tests - two being the top and bottom of the range, and one between (1,999, 38), and two invalid tests (<1 and >999). Check for negative and zero values when the range expects positive values greater than zero.

Set of Values

If an input condition specifies a "set" of input values and each one is handled differently by the program, identify a valid test and two invalid ones. Try a blank value.

"Must Be" Values

If an input condition specifies a "must be" situation (e.g. first character must be a letter), identify one valid test and two invalid tests.

Sequence of Input

If an input condition specifies a particular sequence of input focus attention on the first and last elements of the set. Test with no values input.
Test Case Design (cont.)

Input Testing

Check for the following:

- input file (field) is empty
- input file (field) is not available
- input has 1 record
- all records are the same
- improper sequence
- security features are executed properly
- screen displays are readable and usable
- screen displays are presently in proper sequence

Output Testing

Check for the following:

- last record written or line printed
- formats proper
- files are opened and closed properly
- totals are accumulated properly
- report headers, footers, page numbering is proper
- proper page breaks
- special forms are produced properly
- data records which contain totals or other results are created or updated properly
- reports are presented in proper sequence
- screen displays are presented in proper sequence
- results of computations
<table>
<thead>
<tr>
<th>Test Procedure</th>
<th>Expected Result</th>
<th>Initials</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Perform the test cases below</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) Test menu item #1</td>
<td>Search DATABASE - screen appears</td>
<td></td>
</tr>
<tr>
<td>- Search Database</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Choice: 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b) Test menu item #2</td>
<td>Report Generation - screen appears</td>
<td></td>
</tr>
<tr>
<td>- Report Generation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Choice: 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(c) Test menu item #3</td>
<td>Utilities - screen appears</td>
<td></td>
</tr>
<tr>
<td>- Utilities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Choice: 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(d) Test menu item #4</td>
<td>Data Entry - screen appears</td>
<td></td>
</tr>
<tr>
<td>- Data Entry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Choice: 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(e) Test menu item #5</td>
<td>Query Database - screen appears</td>
<td></td>
</tr>
<tr>
<td>- Query Database</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Choice: 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(f) Test exit from main menu</td>
<td>Exit MINFILE returns to the DOS prompt</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Choice: 0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(g) Test incorrect key sequence</td>
<td>Error message</td>
<td></td>
</tr>
<tr>
<td>Enter letters and invalid numbers</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Date:</td>
<td>Time:</td>
<td>Completed by:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comments:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2 - 3
(2) **Search Database - Commodity**

**Comments:** This screen functions and appears the same as the B.C. MINFILE.

To perform any tests, a list of all MINFILE Numbers and corresponding Commodity information must be obtained. This list will be used to verify that the search was performed correctly and the correct records were retrieved.

The tester is to be creative when performing searches, use different combinations of fields and values. There are no restriction on which field may remain empty.

**Test:** An example test is given. The tester should perform many such tests, using a variety of combinations. All problems should be logged.

**Objective:** To test the functionality of the Search Database - Commodity screen.
Levels of Testing

There are six levels of testing. The first five levels are testing which should be performed by the Contract Systems Personnel and will be touched on lightly. The sixth level will be explained in more detail.

LEVEL 1 - Module Testing (or Unit Testing)
LEVEL 2 - Function Testing
LEVEL 3 - Software Integration Testing
LEVEL 4 - System Integration Testing (or Migration Test)
LEVEL 5 - System Demonstration
LEVEL 6 - User Acceptance Testing

Module Testing

Module testing is the process of testing the individual subprograms, subroutines, or procedures which comprise a program. Rather than initially testing the program as a whole, testing is first focused on the smaller building blocks of the program. The reasons for this approach are: it is a way of managing the complexity of testing, it eases the debugging task since errors can be isolated to a particular module, and it provides the ability to test multiple modules simultaneously.

Function Testing

Function testing is the process of attempting to find discrepancies between a program and its external specification (i.e. its input/output). We define a function as a set of related program modules which, when executed in proper sequence, perform a specific task. In simple terms, it is a program.

Software Integration Testing

Software Integration testing is the process of ensuring that programs which are intended to operate simultaneously or in conjunction with other programs are able to do so.

System Integration Testing

The System Integration Testing process involves a series of tests to be conducted to ensure that the newly developed set of programs will operate on the host computer, including peripherals such as printers and plotters, for which it is intended. Some of the major testing processes involved are: configuration testing, volume testing, stress testing, security testing, storage testing, recovery testing, procedure testing, and conversion/compatibility testing.

System Demonstration

The purposed of the System Demonstration level of testing is to demonstrate that the performance and efficiency expectations have been met.
User Acceptance Testing

User Acceptance testing is the process of comparing the program to its initial requirements and the current needs of its end users. The best way to conduct user acceptance testing is to devise test cases attempting to show that the system DOES NOT meet the specifications. This test is also concerned with accuracy of the user documentation. The documentation should be inspected to ensure that it conforms to the functions of the programs.

The responsibilities of the User during the User Acceptance testing will be outlined shortly, but generally, it is up to the User to determine whether or not they want to proceed with the implementation of the system as a production system. If the user accepts the system without qualification - then they have no right to criticize the operation or performance of the system.

A comprehensive user acceptance TEST PLAN should be developed, and should contain the following items: a description of the system (or component) being testing, a list of the people involved in the test and their responsibilities, where the tests are to be conducted, what computer resources are required and when, what technical support will be required and when, how long the tests are expected to take, where the source data is to be obtained from, what is to be tested, testing schedule and expected performance. Keep in mind that not only are programs to be tested, also the consideration must be given to the following when preparing test cases: user procedures, user documentation, hardware interfaces, other software interfaces, conversion of data from manual or other computer systems, training of user staff, backup and recovery, security.

A set of TEST DATA, when run against a program or series of programs, will result in output which is expected and pre-determined. Exacting test cases must be developed to ensure a good cross section of tests are carried out. They must reach all areas of the system - input, output, processing, and hardware and software interfaces.

Keep well DOCUMENTED procedures used for testing and outcomes. Well written test cases will find errors. Document those errors giving as much detail as possible. Always include the following: date, time, author, version of system you are testing, error symptom, expected results, results obtained, any sample output reports/displays which document the errors, and problem report number. IT IS BETTER TO GIVE TOO MUCH INFORMATION THAN NOT ENOUGH. Retain these forms for follow up testing and future reference.

Words of wisdom:

- if you can not re-create the error it will be hard for any systems person to correct it.
- beware of cascading errors (that is errors caused by previous errors).
- some errors detected will result in Change Requests Vs Fault Reports (i.e. if the error was not the result of a specified change originally outline in the Specifications Document then it is a new request and should be recorded as a future change).
User Acceptance Testing

⇒ the process of comparing the program to its initial requirements and the current needs of its end users.

⇒ attempt to show that the system DOES NOT meet the specifications.

⇒ accuracy of the user documentation.

⇒ determine if the system is a production system.

⇒ develop a comprehensive user acceptance TEST PLAN.
User Acceptance Testing

TEST PLAN

⇒ a description of the system (or component) being testing.

⇒ a list of the people involved in the test and their responsibilities.

⇒ where the tests are to be conducted.

⇒ what computer resources are required and when.

⇒ what technical support will be required and when.

⇒ how long the tests are expected to take.

⇒ where the source data is to be obtained from.

⇒ what is to be tested.

⇒ testing schedule and expected performance.
User Acceptance Testing

OTHER CONSIDERATIONS

- user procedures
- user documentation
- hardware interfaces
- other software interfaces
- conversion of data from manual or other computer systems
- training of user staff
- backup and recovery
- security
User Acceptance Testing

IMPLEMENTATION

- realistic test data
- develop test cases to reach all areas of the system
- document procedures used for testing and outcomes
  - date, time, author
  - version of system you are testing
  - error symptom
  - expected results
  - results obtained
  - any sample output reports/displays which document the errors
  - problem report number

*it is better to give too much information than not enough*

retain these forms for follow up testing and future reference
User Acceptance Testing

WORDS OF WISDOM

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MINFILE DETAILED DESIGN DOCUMENT

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APPENDICES

A. Edit Rules Matrix
B. B.C. Minfile Database
PROJECT FAULT REPORT

Customer Name: ___________________________ Fault #: __________________

Project Name: ___________________________ Version: __________________

Priority: _____ (1 - Testing held up; 2 - New release; 3 - Fix as time allows; 4 - Discuss and __________________)

Fault Description: __________________________________________________________________________

Prepared By: ___________________________ Date: ______________

Solution Description: ______________________________________________________________________

Responded By: ___________________________ Date: ______________
### Project Change Request

<table>
<thead>
<tr>
<th>Customer Name:</th>
<th>Request #:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Number:</td>
<td>Project Manager:</td>
</tr>
<tr>
<td>Project Code:</td>
<td>Date:</td>
</tr>
<tr>
<td>Change Requested:</td>
<td>Requested By:</td>
</tr>
</tbody>
</table>

**Reason for Change:**

**Cost Amount:**

**Prepared By:**

**Ramifications:**

**Approved (A) / Rejected (R):**

<table>
<thead>
<tr>
<th>Customer Signature:</th>
<th>Company Signature:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name:</td>
<td>Name:</td>
</tr>
<tr>
<td>Signature:</td>
<td>Signature:</td>
</tr>
<tr>
<td>Date:</td>
<td>Date:</td>
</tr>
</tbody>
</table>
Training and Client Support

TOPICS

- Introduction and Background
- Training Approach
  - Target Audience
  - Skill Level
  - Hands-on Experience
  - Costs
  - Documentation
  - Workshop
- Client Support
  - The Problem
  - Options
  - The MINFILE Help desk
- Conclusion

Lecture by: D. Jakobsen

Training and Client Support
Introduction and Background

- 5 years ago none of the geologists on the MINFILE project had computers.

- The MINFILE database resided on the mainframe computer (VAX) and the geologists gave filled-in forms to data entry clerks.

- There was no training or documentation and computer knowledge or skills were not required.

- In April 1989, the geologists each got a 286 desktop computer and the fun began.
Introduction and Background cont.

- Some learned quickly, some learned slowly, some learned not at all.

- Initially we used our computers as typewriters because we didn't know any better.

- Fortunately, Larry had excellent computer skills and we pestered him constantly for help.

- We received many calls from clients requesting help and/or information.

- We made haphazard attempts to train our "front-line" staff on MINFILE. That is, the district geologists and our colleagues in the Branch.
Introduction and Background cont.

- We struggled gamely on in this way until 1991.

- The most recent version of the software (MINFILE/pc V.3.0), which includes the data entry module, was developed in 1991.

- Now we could input the data directly on our personal computers.

- At the same time, the MINFILE database was removed from the VAX to the personal computer.

- Because of these two things we quickly had to learn some new skills.
Introduction and Background cont.

- These included:
  - Security
  - Data transfer
  - System testing
  - Back-ups and storage
  - Various software packages that we now use routinely.

- MINFILE/pc V. 3.0 is a fairly complex piece of software and the team needed to understand it to be able to help our clients. We also had to recognize the need for more formal training, documentation and user support.
Training Approach

- Target Audience:
  ⇒ General public to
  Major mining
  companies and staff.

- The lowest common skill
  level of this target audience
  is NO computer knowledge,
  therefore, basic computer
  skills need to be taught.
  ⇒ Previously, we insisted
    that clients have a
    basic knowledge of
    DOS, but eventually
    realized that this
    didn't work.
  ⇒ Computer basics for
    some staff training
    can be left out.
Training Approach cont.

- Hands-on Experience:
  ⇒ To learn new software you must use it and computer training must include hands-on exercises, a lecture is not enough.

- Costs:
  ⇒ We do external training on a cost recovery basis, excluding salaries.
Training Approach cont.

- Documentation:
  - Our first user's manual was published in Dec. 1992.
  - It took us a long time to recognize the need for a manual. We believed that the program was so easy to use that a manual was unnecessary.
  - The manual significantly reduced our support activities.
  - We also have information materials that we use to advertise the project and our products.
WORKSHOP: THE MINFILE TRAINING APPROACH

- The workshop was developed through trial and error.

The Key features are:

- The Workshop Notes match the workshop exactly.

- Hands-on exercises, using appropriate examples, are interspersed with lectures (remember the attention span of participants).

- Low student/teacher ratio, lots of personalized help and attention.
WORKSHOP cont.

- The computer is shown on the overhead for live demonstration purposes.

- The timing on the Agenda is flexible so that each section has the necessary time.

- The language is kept simple, avoiding jargon.

- We try to have fun, keeping it light and using lots of graphics.
WORKSHOP cont.

- The first formal internal training workshop was in Nov. 1991.

- The first formal external training workshop was in Nov. 1992.

- We have now done the external workshop 3 times, for about 45 clients.
WORKSHOP cont.

- Advertising Brochure
REGISTRATION

HURRY, HURRY, HURRY...
FIRST COME, FIRST SERVED!

FILL IN THE FOLLOWING FORM, DETACH AND MAIL OR FAX BY APRIL 9/93 TO:

D. JAKOBSEN, MINFILE UNIT
GEOLOGICAL SURVEY BRANCH
#201 - 553 SUPERIOR STREET
VICTORIA, B.C. V8V 1X4
PHONE: 356-2829 FAX: 356-8153

FIRST NAME __________ INITIAL __________ LAST NAME __________

COMPANY __________

ADDRESS __________

CITY __________ POSTAL CODE __________

TELEPHONE: HOME __________ BUSINESS __________

NOTE:
- There will be no registration available at the Workshop, you MUST pre-register.
- Payment of $100.00 (payable to: Minister of Finance) MUST accompany your registration, this will be returned to you if there is no room in the workshop.
- You will be contacted to confirm your participation.
- We reserve the right to cancel if the response is poor.
- Cancellation by the participant will not be accepted after Apr. 9/93.

MINFILE/pc V. 3.0

KEG '93

ARE YOU PLANNING ON ATTENDING KEG '93?
☐ YES ☐ NO

IS MINFILE/pc V. 3.0 A MYSTERY TO YOU?
☐ YES ☐ NO

ARE YOU INTERESTED IN A LOGICAL SOLUTION?
☐ YES ☐ NO

WOULD YOU LIKE TO EXPLORE THE MINFILE DATABASE?
☐ YES ☐ NO

COULD YOUR COMPUTER SKILLS USE SOME HELP?
☐ YES ☐ NO

IF YOU ANSWERED YES TO ANY OF THESE QUESTIONS, READ ON...
ATTEND THE BEST
(not to mention only)
BASIC MINFILE/pc WORKSHOP
IN THE WORLD!!!

WE ARE PLEASED TO BE ABLE TO
INVITE YOU TO A ONE DAY WORKSHOP:

DATE: APRIL 18, 1993
TIME: 08:30 TO 16:30 HOURS
PLACE: ACCESS CENTRE, CARIBOO COLLEGE -
DOWNTOWN CAMPUS
152 - 63 WEST VICTORIA STREET
KAMLOOPS, B.C.

COST: $100.00 PER PERSON (INCLUDES:
COFFEE, COURSE MATERIALS AND
MANUALS, MINFILE/pc PROGRAM
AND SAMPLE DATASET, AND THE
USE OF A COMPUTER FOR THE DAY)

LIMIT: 15 PARTICIPANTS
**WORKSHOP cont.**

- Agenda

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<tbody>
<tr>
<td>✓ Basic DOS</td>
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<tr>
<td>✓ Introduction to MINFILE</td>
</tr>
<tr>
<td>✓ Installing the Program and Data</td>
</tr>
<tr>
<td>✓ Searching the Data</td>
</tr>
<tr>
<td>✓ Data Interpretation</td>
</tr>
<tr>
<td>✓ Reporting on Search Results</td>
</tr>
<tr>
<td>✓ Utilities and Data Transfer</td>
</tr>
<tr>
<td>✓ Data Entry</td>
</tr>
<tr>
<td>✓ Discussion and Evaluation</td>
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Client Support

The Problem

- Before the release of V. 3.0, in April 1991, it was estimated that about 2.5 days per week were spent by the MINFILE team helping user's solve problems.

- At this time there were 400 clients and the MINFILE team dealt with 1062 inquiries during the period 1990-1991.

- Marketing efforts were steadily increasing the amount and type of clients and these were using a wide variety of hardware.
Client Support cont.

- Version 3.0 of the MINFILE/pc program was more complex and the team anticipated an increase in support activities.

It was clear that we needed to deal with this issue, so we investigated some options:

A. Support and Maintenance from the consultants (SHL Systemhouse):
   ⇒ They would set up a Help desk available from 8 am to noon, Monday to Friday, staffed by an experienced and knowledgeable person.
Client Support cont.

⇒ The price for this deluxe solution was $50,000 per year.

B. Continue with the existing situation; a help desk type solution in-house:
   ⇒ This would mean a continued demand on staff time.

C. Hire an in-house expert:
   ⇒ High cost.

D. User pays for support:
   ⇒ Requires support from an outside vendor who then does the work and collects the fees.
Client Support cont.

E. Client support to be handled with a combination of an in-house help-desk and a general maintenance and support contract with SHL.
   ⇒ Approximately 70% of the work in-house and 30% by SHL.

We chose option E and the MINFILE Help desk was developed.
Conclusion

As soon as possible, we recommend that:

- In-house staff be trained on all appropriate software and hardware.


- A Help desk system be implemented.

- Client training be initiated.
### HELP DESK

#### Problems Database Structure (PROBLEMS.DBF):

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#### Address Database Structure (ADDRESS.DBF):

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<td>Notes</td>
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INTRODUCTION:
The British Columbia Geological Survey Branch (GSB) maintains a comprehensive mineral inventory database of over 11,000 metallic mineral, industrial mineral and coal occurrences known as MINFILE. The database has evolved over the past 25 years from a simple manual card file to a powerful mainframe and microcomputer based Geoscience Information System. The MINFILE database is available to a diverse user-community through MINFILE/pc, a menu-driven program for IBM/pc compatible computers. MINFILE/pc is a search-report and data-entry program valuable to researchers of the MINFILE database.

The program allows user's to search the data, report on search results and add, delete or change the mineral occurrence data in the database. By January 1993, 536 clients had received the MINFILE/pc program.

The HELPDESK program is the client support supplement to MINFILE/pc for the internal use of the GSB. This program keeps two databases: an Address database (ADDRESS.DBF) and a Problems database (PROBLEMS.DBF). The program utilizes a run-time version of FOX+ and Proximity Scan. The HELPDESK program contains user-friendly pull-down and pop-up menus and has a brief on-line help facility.

The Address database contains client addresses and the MINFILE products that each client has. This database is useful for creating mailing lists to notify clients of upgrades to MINFILE/pc and new data releases. The GSB must track the number of copies of MINFILE/pc V. 3.0 because it incorporates Proximity Scan, a licensed piece of software that the GSB purchases.

The Problems database contains information on the problems that clients have contacted the GSB about. When a client contacts the GSB with a problem, the database is examined for a similar problem and the solution. This enables the GSB to quickly solve client problems and evaluate the problems that clients are experiencing for correction in future releases of MINFILE/pc.
PROBLEMS:
The Problems routines assume that the Problems database exists. The
database, if missing, can be re-created using dBASE or FOX+. A list of the file
structure occurs at the end of this document. A form, called a Problem Log, is
used to gather the problem information. This form is then given to the staff
member who maintains the HELPDESK. The name and address of clients
contacting the GSB with problems should be in the database.

READ PROBLEM:
This option will read the problems stored in the Problems database. When
selected, a screen pops up and prompts you to enter a problem area or type:
DOS, MINFILE, data, hardware or other. Tabbing from field to field will allow
you to select a specific client by entering the company or last name. Input the
first few letters of the problem area or type, company name or last name.
Proximity Scan will search the database and find up to 64 of the closest
matches. An entry is selected by moving up or down with the arrow keys until
the desired entry is highlighted and then pressing CTRL-ENTER (press the
CTRL and the ENTER keys simultaneously). A screen containing all the
information on that entry will pop up. To exit this screen press any key.

ENTER PROBLEM:
This option allows the user to enter a problem into the Problems database from
the Problem Log. A window pops up when this option is selected and prompts
you for the client's last name or company. The entry is then chosen by
highlighting it and pressing CTRL-ENTER. The input screen pops up with blank
fields that are then filled. The address, phone number, fax number and
MINFILE/pc version information is listed at the bottom of the input screen. This
information should be verified for accuracy while speaking with the client.

At the input screen you will be prompted for a description of the problem (2-
lines), a description of the solution given to the client (2-lines), the problem type
or area (DOS, MINFILE, data, hardware or other), a fix flag ("y" or "n"), the time
taken in minutes, the date, the communication type (phone, fax, office, mail or
other) and the initials of the staff member who received the problem.

NOTES:
• The problem area or type and the communication type fields both give you
  pop-up menus so you simply select the appropriate choice.

• Problems are split up into five types or areas: DOS, MINFILE, data, hardware
  or other.

• The fix flag is added if the problem is caused by the MINFILE/pc program and
  needs to be fixed in future versions.
• The date defaults to the current date but can be changed.

• The communication type (phone, fax, office, mail or other) is mainly for statistical purposes.

• Some edit checks are built into the Problems routine. The data will not be added if important fields are left blank. These fields are: Problem line 1, Solution line 1, problem area or type, communication type and time. This forces the inclusion of important information and allows the user to exit if they change their mind.

BROWSE:
This option is only to be used by experienced database people because it can permanently alter or damage the data. This routine is used to change information, to enter something that the edit checks do not allow or to delete and undelete (before "packing") records. The commands are listed at the top of the screen and other commands can be accessed using the F10 key.

PACK:
This routine is used to remove all deleted records permanently and to shrink the size of the database, it "packs" the database.

DELETE:
This option allows you to choose a record to delete. The routine uses Proximity Scan and has the same commands as described in the READ PROBLEM and ENTER PROBLEM sections. Once a record has been chosen, by pressing CTRL-ENTER, the program will ask you if you really want to delete the record ("y" or "n"). This makes it difficult to delete an entry accidentally. The deleted entry is flagged in the database and will not appear except when using the BROWSE routine. You can undelete the entry by going into BROWSE, selecting the entry by highlighting it and pressing CTRL-U. To permanently remove the entry, pack the database.

ADDRESS:
This option assumes that the Address database already exists. If the Address database is missing a new one can be created using the structure listing found at the end of this document and the FOX+ or dBASE programs. A form, called the Client Record, must be filled out when a client receives a MINFILE product. The form is then given to the staff member maintaining HELPDESK for input.
READ ADDRESS:
This option allows the user to read the addresses currently stored in the Address database. When chosen a screen will pop up and prompt you to enter the name of the company you wish to look up. To look up the client using a different piece of information (e.g., phone number) you can use the tab key to move through the record until you reach the desired field. Enter the first few letters of the word you are looking for and Proximity Scan will list up to 64 of the closest matches found in the database. Use the up and down arrows to highlight the record you want and press CTRL-ENTER simultaneously. A screen will pop up containing all the information on the client. This includes the version of MINFILE/pc the client has, if he has a User's manual, information package, etc. Press any key to exit the address screen.

ENTER/EDIT ADDRESS:
This option allows you to edit an existing address record or add a client name to an existing company record. A window pops up when this option is chosen and prompts you to input the company name. Highlight the record of interest using the cursor keys and press CTRL-ENTER. The input screen will pop up with all the information stored in that record as the default information. You can move around from field to field and edit the information. Once you reach the bottom you are prompted to add or replace the record. If you are adding a name to an existing company record then you want to add the record. If you are updating the information then you want to replace the record.

To add a client to the Address database press the ESC key while in the first screen. A blank input screen will appear and you can fill-in the information. The routine verifies that the company name or the last name of the client is entered. If both are left blank the record is not added. The notes field at the bottom of the screen is used to document special data requests and any other information that might be important to record.

BROWSE:
See the BROWSE sub-section under the PROBLEMS section.

PACK:
See the PACK sub-section under the PROBLEMS section.

DELETE:
See the DELETE sub-section under the PROBLEMS section.
OPTIONS:
This area gives you a couple of miscellaneous options to aid you in using HELPDESK.

HELP:
This is the on-line help program. When chosen, a menu will pop up to allow you to choose either Entering Information, Reading Information, Browsing, Packing or Configuration. Highlight the area (using arrows) press ENTER and a screen will pop up with the requested help information. To exit the help screen press any key.

CONFIGURE:
This option enables the user to change the background pattern and the background color used in the HELPDESK screens. This allows users to choose a screen that is easy on the eyes. A screen with ten different patterns will pop up when this option is selected and you choose a pattern. A new screen then pops up allowing the user to choose one of ten color combinations. These choices are stored in a file called screen.mem. The changes are kept until changed again, even if the user exits the program.

RECOMMENDATIONS:
The HELPDESK program does not have the capability of creating reports within the program. R&R Relational Report Writer is a good report program for use with FOX programs and is recommended for use with HELPDESK.

It is recommended that only one person add information to the HELPDESK. If more than one person is adding information to the databases then several different copies of the databases would exist. The person entering the information should distribute an updated copy of the Address and Problems databases at least once a month. Forms have been created for this purpose and should be used.
Problems Database Structure (PROBLEMS.DBF):

<table>
<thead>
<tr>
<th>Field</th>
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<th>Length</th>
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Address Database Structure (ADDRESS.DBF):

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Ministry of Energy, Mines and Petroleum Resources
MINFILE Project, Geological Survey Branch
201 - 553 Superior St, Victoria, B.C., V8V 1X4
Tel.: (604) 356-2826 Fax: (604) 356-8153

For Data disks or paper, contact:
Crown Publications Inc.
546 Yates St., Victoria, B.C. V8W 1K8
Tel.: (604) 386-4638 Fax: (604) 386-0221

26/08/91
Problems Log for MINFILE/pc

Company: ________________________________
Client Name: ____________________________
Problem: __________________________________________

Solution: __________________________________________

Prob. Type: DOS MINFILE Hardware Data Other

Program Fix? Y / N

Date: _____/____/____ (dd/mm/yy)

Time Taken _____ Mins.

Communication Type: Phone Fax Office Mail Other

Received By: ____________________________

26/08/91
## Client Record

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</tbody>
</table>

**TYPE:**
- P - Phone
- C - Correspondence
- O - Office
- F - Fax
- D - Delegate
- EM - EMail
- M - Meeting
- T - Training

**CODE:**
- PI - Product Information
- DR - Data Request
- PS - Program Support
- PF - Property File
- DEMO - Demonstration
- A - Administrative
- P - Project
- ARIS - Assessment Report

**AFFILIATION:**
- I - Industry
- G - Geological Survey Branch
- G - Government
- P - Public
- C - Contractor
- U - University
Marketing and Data Distribution

OUTLINE:

Introduction
Marketing Concepts
Strategy and Planning
The Marketing Plan
Marketing Implementation
Distribution
Examples
Summary

Lecture by: L. Jones
17 November 1993

Marketing

BUSINESS PURPOSE:

⇒ identify and create a client
⇒ identify needs
⇒ products and services to meet needs
⇒ communicate product or service
⇒ make the product or service
⇒ price to reflect costs
⇒ follow-up and servicing

MARKETING DEFINED

⇒ the process of planning and executing the conception, pricing, promotion and distribution of ideas, goods and services to create exchanges that satisfy individual and organizational objectives.
Elements of the Marketing Mix Operate within an Environmental Framework
Marketing

TARGET MARKET *(client identification)*

⇒ major national and international exploration and mining companies
⇒ environmental groups
⇒ consultants
⇒ academia
⇒ government
⇒ rock and mineral collectors
⇒ geochemical labs.

STRATEGY AND PLANNING

⇒ develop corporate strategy
⇒ develop marketing strategy
⇒ develop marketing plan.

CORPORATE STRATEGY

⇒ the overall purpose and direction of the organization that is established in the light of the challenges and opportunities found in the environment, as well as available organizational resources. This is sometimes expressed as a **mission statement**.
Marketing

GEOLOGICAL SURVEY BRANCH MANDATE:

The Geological Survey Branch of the Ministry of Energy, Mines and Petroleum Resources is charged with providing the geological inventory required to develop British Columbia’s mineral resources, to improve government’s stewardship of our mineral endowment, and to help manage and protect Crown lands.

The Branch’s mandate is to:

Assemble, maintain, and market a comprehensive geoscience database for B.C. to provide a sound base for

1. exploration & development of the province’s mineral resources;
2. planning & resource management decisions by governments; and,
3. public information on geological resources and hazards.
Exhibit 2-2  The SWOT Analysis—with Suggestions of What to Look For

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<th>External</th>
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<tr>
<td><strong>Strengths</strong></td>
<td><strong>Weaknesses</strong></td>
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<td>Adequate financial resources?</td>
<td>No clear strategic direction?</td>
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<td>An acknowledged market leader?</td>
<td>Lack of managerial depth and talent?</td>
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<td>Well-conceived functional area strategies?</td>
<td>Missing any key skills or competencies?</td>
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<td>Access to economies of scale?</td>
<td>Poor track record in implementing strategy?</td>
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<tr>
<td>Insulated (at least somewhat) from strong competitive pressures?</td>
<td>Plagued with internal operating problems?</td>
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<td>Proprietary technology?</td>
<td>Falling behind in R&amp;D?</td>
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<td>Cost advantages?</td>
<td>Too narrow a product line?</td>
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<td>Product innovation abilities?</td>
<td>Weak market image?</td>
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<td>Proven management?</td>
<td>Below-average marketing skills?</td>
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<td>Other?</td>
<td>Unable to finance needed changes in strategy?</td>
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<td>Serve additional customer groups?</td>
<td>Likely entry of new competitors?</td>
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<td>Enter new markets or segments?</td>
<td>Rising sales of substitute products?</td>
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<td>Expand product line to meet broader range of customer needs?</td>
<td>Slower market growth?</td>
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<td>Diversify into related products?</td>
<td>Adverse government policies?</td>
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<td>Add complementary products?</td>
<td>Growing competitive pressures?</td>
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<td>Vertical integration?</td>
<td>Vulnerability to recession and business cycle?</td>
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<td>Ability to move to better strategic group?</td>
<td>Growing bargaining power of customers or suppliers?</td>
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<td>Complacency among rivals firms?</td>
<td>Changing buyer needs and tastes?</td>
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<td>Faster market growth?</td>
<td>Adverse demographic changes?</td>
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<td>Other?</td>
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Marketing

MARKET STRATEGY PLANNING

⇒ state objectives
⇒ identify problems and opportunities
⇒ study previous plans
⇒ alternative strategies
⇒ identify risk factors
⇒ action plan
⇒ contingency plans

OPERATIONAL ORGANIZATIONAL REQUIREMENTS

⇒ Identify:
  • resources held
  • resources required
  • resource gaps
⇒ responsibilities
⇒ timetables
⇒ implementation and controls

THE MARKETING PLAN

⇒ a program of activities that lead to the accomplishment of the marketing strategy.
⇒ what should be included in the Plan to meet strategy objectives and organization effectiveness?
Strategic Planning Process Model

Company
Resources
Management
Performance
  balance sheet
  income statement
Market mix

Market segments
Consumer profiles

Environment
  political
  environmental
  sociological
  technological
  competition

SWOT - focus
(match strengths with opportunities)

Core Business Strategy - strategy formulation

Operating Plans - implementation (Marketing Plan)
  budgets

Review - follow-up

Process (Figure 6-2):

1. analyze market and environmental opportunities and threats
2. analyze business strengths and weaknesses
3. generate objectives and strategy
4. evaluate objectives and strategy
5. plan implementation and control programs
Marketing
THE MARKETING PLANNING PROCESS

I. Situation Analysis: Where Are We Now?
   A. Historical Background
   B. Client Analysis
      Who are the clients we are trying to serve?
      What market segments exist?
      How many potential are there?
      What are their requirements?
   C. Marketing opportunities: What exist for the organization?

II. Marketing Objectives: Where Do We Want to Go?

   Example: The objective of this marketing plan is to develop a strategy to attract investors to explore and develop gold resources. The plan will identify a target market, strategies, issues, opportunities, and data gathering and implementation methods.

III. Strategy, Developing a Marketing Mix: What should we do with each of the marketing mix elements? How can we get there?
   A. Product/Service Decisions
   B. Pricing Decisions
   C. Distribution Decisions
   D. Communication Decisions
   E. Financial Considerations
   F. Control Aspects: monitor, change, feedback
Marketing

IMPLEMENTING THE PLAN: The Marketing Mix

marketing mix is the blending of the four elements (price, product, communication, distribution) of marketing to satisfy clients.

✔ product management requires decisions about what kind of product is needed, its uses, package design and new-product development. Products include services which are performance and symbolic attributes designed to produce client-satisfaction.

✔ pricing includes methods of setting reasonable, possibly profitable and justified prices.

✔ distribution is the selection and management of marketing channels, which are the steps that products take to the client, and the physical distribution of the products.

✔ communication - selling, advertising, promotion, and publicity. Communicate the benefits of investing.
MINFILE/pc 3.0

ORDER FORM

MINFILE/pc v3.0 □ □ Data: ______________
User's Manual □ _______________________
Product List □ ________________________
Coding Manual □ ______________________
Info. Package □ ______________________

Name ________________________________
Company Name ________________________
Address ______________________________
City _________________________________
Province __________________ Postal Code ________________
Telephone No. ________________ Fax No. ______________
Date Received ______________ Recv. By _____________
Date Sent ______________ Sent By ______________

Ministry of Energy, Mines and Petroleum Resources
MINFILE Project, Geological Survey Branch
201 - 553 Superior St. Victoria, B.C. V8V 1X4
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**1993 Mines & Expl. Coding Manual V.3.32**
  - Disk only; data of Open File 1994-1.
- Disk only.
- Disk.
- Disk only; includes report generator.
- Microfiche; covers 101 NTS areas.
- Information Circular 1992-28
DISTRIBUTION OF PROVINCIAL DISKETTES

*NOTE: Areas NOT released contain incomplete and/or inaccurate data.
MINFILE Project Management

PROJECT ELEMENTS

- Concept, designing, planning (budget, staff)
- Database Design and Data Dictionary
- System Testing and Quality Assurance
- Database Administration and Maintenance (documentation and manuals)
- Data Acquisition and Processing Procedures (coding procedures)
- Training and Client Support
- Marketing and Distribution of Data

⇒ New Technology and Future Planning

- Designing and Producing Computer Generated Products for Users
Future Trends

- LAN (Local Area Networks)
- Client/servers
- CD-ROM (compact disc-read only memory)
- GIS (Geographical information systems)
- AI (Artificial Intelligence / Expert Systems)
KEY AREAS FOR SYSTEM ENHANCEMENTS
Opportunity for leadership roles by sections

✓ Hardware upgrades
✓ Software upgrades
✓ System development
✓ Networking
✓ Application integration
✓ Training
KEY SUCCESS FACTORS

- highly skilled group of people; ability to respond quickly to change
- ability to efficiently deliver quality products; respected reputation

CHALLENGES

- competition for funding
- rapid technological changes
- communication

OPPORTUNITIES/BENEFITS

- innovative implementation of computer technology
- become a major contributor in the land-use planning process
- improvements on production time and overhead costs
- enhance service quality
- reduce business life cycle
- satisfied client-base
ADVANTAGES/BENEFITS OF LANS

- ability to share information (transfer files)
- efficient information retrieval
- improve personal and workgroup productivity
- provide shared access to hardware (printers)
- share software
- e-mail
- backups

- LAN discipline (administration, concepts, issues)
- proving ground
- communications
A Tale of Three Networks

Traditionally, you've had to choose between a peer-to-peer network, which offers flexible printer and file sharing, and a server-based LAN such as NetWare, which requires a central server and administrator but offers a better platform for sharing applications. Today, thanks to DOS 5.0's memory tricks and advanced peer-to-peer technology, you can run NetWare and your peer-to-peer NOS on the same workstations and get solid multiuser support plus simultaneous freestyle resource sharing.
Diagram 2: The exposed lower layers of the proposed Reference Model of Geomatics
COMPUTER TECHNOLOGY TRENDS
L.D. Jones, June 29, 1992

INTRODUCTION

While mainframes will still have a role in the handling of strategic corporate data, PC's are considered the engines for the end users due to the power, ease of use, industry support and low cost. While an organization's base data and systems exist, the organization is challenged to use the data from a strategic business perspective. In business, technology is important, but how to implement it is the key to success. Businesses are stressing the need for reliability, industry standards and the ability to expand.

Business planning leads to information systems planning. Businesses will generally use technology tools to achieve the goals of the organization; technology, although strongly influences organizations, should not dictate how an organization does business. Major corporations generally first define their business role and strategy. Data is then collected, with the key or primary data, such a personnel and accounting, on mainframes. The organization will then derive secondary or support data, which may reside on the mainframe or on PC's. Technology activities or a model will then fit into the overall business strategy of an organization. While an organization's base data and systems exist, the organization is challenged to use the data from a strategic business perspective.

This report will discuss some of the major trends of the Canadian computer industry and focus on technology specific to the corporate strategy of the Geological Survey Branch.

<table>
<thead>
<tr>
<th>CHALLENGE:</th>
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</thead>
<tbody>
<tr>
<td>grow with the changes in user needs and technology</td>
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<tr>
<td></td>
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</table>
| information strategy  
| minimum of cost and effort |

<table>
<thead>
<tr>
<th>MESSAGES:</th>
</tr>
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<tbody>
<tr>
<td>Technology alone cannot solve business problems</td>
</tr>
<tr>
<td>Need people and business strategy</td>
</tr>
<tr>
<td>Technology is important, but how it is used is the key to success</td>
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THE COMPUTER TECHNOLOGY INDUSTRY

General Trends

The computer technology industry is very competitive and is undergoing a complete structural change. Technological enhancements are rapidly advancing and, as a result, quickly become outdated. Computer prices are decreasing while performance increases, thus causing an economic environment of declining margins. Businesses are moving from mainframes to PCs, and to client-server technology. Scalable versions of operating systems, such as Unix, which will run on platforms from workstations to supercomputers, are in the forefront. With the move away from mainframes, business are turning to outsourcing, which is the leasing of equipment and expertise, to operate their corporate computer systems. Internationally, joint ventures are common, such as Japanese-American computer consortia, where the Japanese have the hardware technology and the Americans have the software. Multimedia, the ability to interact with computers in multiple ways during the same session, will become a reality and is expected to grow dramatically (50% increase in sales/year).

In the Canadian software industry there is a lack of qualified people. Skills are becoming obsolete; there are too many programmers and demands for people with PC-based application-development skills. Training is not
being adequately addressed by government, business and educators. However, employment growth in the industry is expected to be 20% in the next 3 years.

**MAJOR TRENDS:**
- Fewer resources
- Greater competition; structural change
- Open integration of systems
- Downsizing
  - moving applications off a mainframe and onto smaller machines, usually networked microcomputers or personal computers (PCs).
- Customer-driven
  - connectivity, security, integration, growth, configuration, flexibility, and innovation.

**SOLUTIONS:**
- Client/server technology
  - reduce computing costs, more productive applications and better access to information.
- Distributed computing; software applications
- Standards compliance
- Standard interfaces (Windows)
- Flexibility, growth and cost effectiveness
- Scalability
  - multiprocessing, upgradable, protect investment.
- Pervasive, consistent internetworking
- Outsourcing
  - the leasing of equipment and expertise to operate corporate computer systems; contracting out non-strategic functions.

Customers are becoming more sophisticated. They want connectivity, security, integration, growth, configuration flexibility, and innovation. Users of computer technology are demanding the ability to switch among differing hardware and software brands with ease; industry is responding by developing client-server applications, Unix operating systems and open systems. Users want more choice in hardware and software to match the best environments and applications for their business needs. For open systems and client-server applications to succeed they will have to provide two key functions: internetworking and interoperability. Internetworking concerns the linking, with gateway and local-area network technology, of separate platforms. Open systems (OSI,TCP/IP) provide the set of common standards that vendors require to implement products that can be linked. Interoperability addresses how applications interact across the network. Examples are databases and E-Mail gateways. Clients will want an amalgam of well-accepted PC LAN-based components, such as Windows, Windows applications, a solid but simple E-Mail with good directory services and X.400 gateways.

- Identify the business motivation
  - how to improve operating efficiency and costs;
  - how to provide a competitive advantage and accelerate the business cycle.

- Analyze the flow of information
  - logical work flow within the organization;
  - design networks, processing power, and data distribution.

- Establish the system architecture
  - networks - LAN;
  - databases - multi-user, data integrity, compatibility of access methods;
  - development tools - SQL-based; user interface builders; and integrated development tools.

- Establish the application architecture
  - after Freitag
The market for reduced instruction set computing (RISC) based systems will grow at a compounded annual rate of 28% from 1991 to 1995 while unit revenues will grow at a 45% rate, according to a report by Electronic Trend Publications. Reasons for this are RISC is linked with UNIX, the price of a RISC system will continue to drop sharply, resulting in RISC desk-top systems, which will replace mainframes.

![CLIENT/SERVER IMPLEMENTATION:]

**CLIENT/SERVER BUDGET:**

- Hardware and operating system ($35 000)
  486 PC, 16M RAM, 800M hard drive, UNIX, ethernet, SB6 servers
- Application software ($4000)
  relational database, SQL
- Training and support ($40 000)

Sales of mainframes declined 4.7% in 1991, while overall computer hardware sales grew 3.1%. Sales were slowed by lack of upgrade capability in mainframes and economic and technological uncertainty. Currently, 200 Canadian companies, including major utility companies, travel agents, insurance companies and banks, operate roughly 400 mainframes. Existing mainframes may be replaced, but their total number will not likely increase substantially. Data processing and manipulations will take place at lower-level computers and the mainframes will become data repositories and file servers. Major companies will still require the mainframe to handle huge amounts of data and the multitude on existing users. Mainframes are also easier to manage and back up.

**Downsizing**

Downsizing refers to moving applications off a mainframe and onto smaller machines, usually networked microcomputers or personal computers (PCs). While mainframes will still have a role in the handling of strategic corporate data, PCs are considered the engines for the end users due to the power, ease of use, industry support and low cost. PCs are typically one-third to one-half the cost of mainframes when software and network costs are included. As well, mainframe software and thinking are being ported onto PC networks. With this shift, applications such as E-Mail are being moved. The AS/400, as a minicomputer platform for vertical, business-oriented solutions, is becoming a popular choice as an alternative to MVS type of environments. The technology and software tools to support downsizing are still "immature". Concerns for businesses involved in downsizing include costs of converting the software or getting the old system running on the new hardware as networks are not as simple as the central processors of the mainframes.

**Networking**

All currently noncommunicating PCs are potential candidates for interconnection. Large corporations are increasingly developing a company-wide strategy of including both mainframes and PCs within their overall computing capability. User are accustomed to the friendliness of microcomputers and demand that packages be equally easy to install, access and use. They want transparent access to the host so that they can work on host-applications using the capabilities of the PC. Desired features may include context-sensitive help, on-line tutorials, menu-driven installation and configuration, and common user-interfaces. The PC-to-host market is becoming saturated and, with the move to corporate LANs, gateway-products to gain access to mainframes appear to be gaining popularity.

In a recent survey of PC-LAN users, the most important purchasing criteria are compatibility with existing LANs (31%), vendor reliability (20%), quality (12%), commitment to open systems standards (11%), lowest price (9%), post-sale support (8%), highest performance (5%), technical innovation (2%). LAN design, installation and management is a highly specialized discipline requiring experts who understand the complex interdependencies between hardware and software and networks.
Standards and Open Systems

The International Standards Organization (ISO) develop or adopt standards for computer languages, architecture and systems, in order to overcome the problems of incompatibility between computer platforms. National standards organization, such as those in the U.S.A., are very influential in setting computing standards due to their large high tech industry. New standards often influence the computing market for products and jobs. For example, new directions in computing standards are being set by Open Systems Interconnect (OSI), which sets standards for the movement of data within systems and Open Systems Architecture (OSA), which attempts to eliminate problems of computer incompatibility and vendor dependence.

Solutions for open systems networking will force organizations to either implement a coexistence strategy or a transition strategy. A transition will occur when a organization runs one protocol, but wishes to run only another protocol. A harder alternative is the coexistence of two different protocols in an organization.

The telecommunications industry, has experience rapid growth and communications protocols for the business world tend to be those developed by vendors such as IBM and DEC. In general, a communication protocol is a set of rules for formatting the transmission of data, consisting of a destination header, the message and a error-checking trailer. Industry has been slow to adopt a single international standard for data communications. However, there is a gradual move towards using the OSI standard. This standard is a seven-layer hierarchy, defining the electrical characteristics, communications standards, and software applications for computer systems. The first four layers define the transfer of data and the top three layers, called the user layers, deal with computer sessions and data processing. See OSI reference model.

<table>
<thead>
<tr>
<th>OSI REFERENCE MODEL</th>
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<tbody>
<tr>
<td>7 Application</td>
</tr>
<tr>
<td>6 Presentation</td>
</tr>
<tr>
<td>5 Session</td>
</tr>
<tr>
<td>4 Transport</td>
</tr>
<tr>
<td>3 Network</td>
</tr>
<tr>
<td>2 Data Link</td>
</tr>
<tr>
<td>1 Physical</td>
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</tbody>
</table>

- Application/Information content displayed in layer 6.
- Code conversion and data formatting; terminal standards, display rules.
- Coordination of interaction between end-application processes; English language translated into network technology.
- End-to-end data integrity and quality of service; assembles and disassembles data packets for layer 5.
- Switching and routing of information.
- Transfer of units of information to the other end of a physical link, responsible for data integrity between nodes.
- Transmission of the bit stream to the transmission medium.

<table>
<thead>
<tr>
<th>OPEN SYSTEMS</th>
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<tbody>
<tr>
<td>1. Hardware</td>
</tr>
<tr>
<td>2. Software</td>
</tr>
<tr>
<td>3. Applications</td>
</tr>
</tbody>
</table>

- from CISC (complex) to RISC (reduced instruction set)
- from Proprietary to Open Systems
- from Timesharing to Client/Server

<table>
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<tr>
<th>WHY - OPEN SYSTEMS:</th>
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<tbody>
<tr>
<td>1. Standards</td>
</tr>
<tr>
<td>2. User-driven vs vendor-driven</td>
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<tr>
<td>3. Investment protection</td>
</tr>
<tr>
<td>4. Adaptable to change</td>
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<tr>
<td>5. Do more with less</td>
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</tbody>
</table>

Computer Technology Trends, L. Jones, June 1992
**WHAT - OPEN SYSTEMS**

A vendor-neutral applications environment compliant with international standards.

**HOW - OPEN SYSTEMS**

- Connectivity
  - the ability to move any piece of information within the network, regardless of the media transmission technologies.
- Interoperability
  - enables all system elements to exchange information between network devices, regardless of the vendor.
- Portability for the user and application
- Leverage strengths of all environments
- Distribute portions of applications across a network
- Share processing power and data management
- Specialty services available to all
- Any system can be a client or server

**Electronic mail**

Electronic mail (E-Mail) includes fax, electronic data interchange (EDI), Telex, voice mail and other products. E-Mail is increasingly seen as a tool for enhancing productivity and as a platform for further application development. Standard message exchange protocols and user directories, developed under the OSI model, further stimulate new products that will serve to build a global E-Mail network that rivals telephone networks.

E-Mail is one of the key applications developing in the LAN environment, as it opens the door to enhancing productivity through improved communications. Rudimentary messaging capabilities are included with most LAN operating system software; however, products with more enhanced features are being sought after by many users. LAN vendors will likely add more attractive features to their mail component. The key competitive factor in this market is protocol observance or connection to outside services.

E-Mail growth has been spurred by the growth of PCs, data communications, and application software standardization. The growth of standard interchange methods, such as the X.400 standard, hopes to create a uniformity in communications protocols and to eliminate the barriers imposed by proprietary systems. This provides groups with the global compatibility and functionality to construct private, multi-vendor networks for electronic mail exchange. See figure 1 on E-Mail Connectivity Schematic.

Full-featured E-Mail systems include mailboxes, editors, store and forward, directories, distribution lists, bulletin boards, message headers and storage, security and access to outside systems. In addition to these basic technologies, opportunities exist for the development of advanced features and applications, to further organize and manage office communications. These extended features include application programming interfaces (APIs), attachments, EDI, facsimile, forms, graphical user interfaces (GUIs) and gateways.

E-Mail has measurable advantages over alternative forms of communication, such as telephones, postal and courier services, and intracompany mail. Restrictions however, include the scope of service, ease of use, cost and security. Efficiency benefits, such as speed of delivery and message turnaround, must be weighed against large start-up costs. Traditional cost justification methods, such as costs on a per-user basis and message volume, are difficult to measure. Justifications may become strategic payoffs such as time savings, multitasking, and the acceleration of shared ideas and their documentation in a workgroup. Thus messaging becomes an extension of the thinking process as opposed to the automation of some process otherwise handled in some other medium. E-Mail, if carefully planned and considered an investment and an asset, will likely benefit an organization in positive, unforeseen ways.
Organizations are moving from private (in-house) and public E-Mail systems, to local area network (LAN)-based E-Mail systems, which are growing at a rate of 150% per year. E-Mail is playing a more significant role in business applications. Commercial electronic mail systems appears to be emerging at the leading edge of a trend towards inter-corporate electronic mail and will form a key part of the electronic data exchange. Five to 8% of E-Mail is sent externally to other companies and this is predicted to increase substantially as more companies wish to establish direct links with their business partners, suppliers and customer. Larger companies are increasingly looking to X.400-based systems, which address tying electronic data interchange into internal mail systems. Domain networks like the Internet and UUCP are growing and may emerge as national and international E-Mail backbones.

CONCLUSION

Although not as active as it once was, the PC-to-mainframe communications market is still important to the growing number of companies that want access to information and applications residing on mainframes or minicomputers. Many computer companies however, unable to compete with the extensive product lines of major vendors, have found a niche market in micro-to-minicomputer links or Macintosh-to-host connectivity products. Although product-purpose is identical, the market strategy differs, such as modular versus complete solutions, each having its advantages, depending on the knowledge of the user. Businesses will focus on technological applications for two levels: the large computers to handle the increased volume of data and decentralized processing units in order to permit the shifting of the business closer to the points of service. Clients will want an amalgam of well-accepted PC LAN-based components, such as Windows, Windows applications, a solid but simple E-Mail with good directory services and X.400 gateways. The challenge is to keep informed on where the technology is going in five to 10 years down the road. Technology is important. But how to implement it is the key to success in networking.

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A Computer Program which Uses an Expert Systems Approach to Identifying Minerals

Allan Bruce Hart
Kenneth George McQueen
School of Applied Sciences
Canberra College of Advanced Education
Belconnen, A.C.T., 2616 Australia

Jan Dennis Newmarch
School of Information Sciences
Canberra College of Advanced Education
Belconnen, A.C.T., 2616 Australia

ABSTRACT
This paper describes a mineral identification program which utilizes a shell system for creating expert systems of a classification nature. It has been specifically tailored to three subdomains, these being identification of minerals in: hand specimens, thin sections of rocks, and polished sections of rocks. The program has facilities for building new expert systems and amending existing expert systems. The expert systems created use inexact reasoning, and thus can handle both missing and inaccurate data. Explanation and help facilities are also available.

Key words: Computer assisted instruction; geology teaching; mineralogy and crystallography.

Introduction
We have developed an "expert system" designed to act as an advisor for the identification of minerals. The system is called MICA (Mineral Identification by Computer Assistance) (see Hart, 1986a) and can be used as an aid by students and teachers for mineral identification in hand specimen or when using a petrographic microscope.

The system has the following features:

(a) a limited subject domain (identifying minerals);
(b) the ability to handle both erroneous and missing data;
(c) help and explanation facilities;
(d) a facility for checking the appropriateness of entered values;
(e) a facility to allow a system manager to expand the data base by adding further properties and minerals;
(f) a facility for asking which tests should be applied next to help in the identification.

These features allow the system to be classified as an expert system (Anonymous, 1985).

Other geologically based expert systems include the Dripper Advisor System (Smith and Baker, 1983), Prospector (Duda and others, 1978; Duda and Gaschnig, 1981; Gaschnig, 1982; Campbell and others, 1981), and LITHO (Bonnet and Dahan, 1983). All of these systems are related to prospecting.

Smith and Leibovitz (1986) have published details on a mineral data base and computer program for mineral identification called MINIDENT. Their system utilizes a large number of mineral properties including composition, optical properties, symmetry, cell dimensions, density, hardness and x-ray diffraction data, and is designed more for high level use by professional mineralogists. The system described here differs from MINIDENT in that it utilizes properties readily observed in hand specimen or under the petrographic microscope, and is designed more as a teaching aid for student use.

Defining the Problem
The main aim of the system is to provide a short list of minerals which fit a description or list of properties for an unknown mineral. A further aim is to advise the user which tests to carry out to shorten the list.

The problem of identifying minerals is basically one of classification. Minerals have a finite number of characteristics which can be used in their identification, and the problem is theoretically simple. It is made more complex when the data entered are either incomplete or inaccurate. Some properties may also be very similar, and the system must be able to cope with users who cannot distinguish subtle differences in values, or who are not aware of terms that more accurately describe particular qualitative properties.

For the operation of the system, mineral properties can be divided into two groups: (1) properties which consist of discrete values and which are normally described by a single word or a phrase (for example, in hand specimen: lustre, colour, streak, form, crystal system, whether the mineral is magnetic, and so forth); and (2) properties which can be expressed with numeric values (for example, hardness and specific gravity).

How the System Identifies Minerals
Kerr (1959) claims that much wasted time and effort in identifying minerals can be avoided if a systematic approach is adopted. The MICA system has been designed to follow a systematic logic routine (Figure 1). Properties will always be tested in the same order. In general this will be the order in which they were entered onto the data base, but this can be changed if desirable.

In practice the system:

(a) asks the user to list all observable properties (in a sequence commonly used in mineral identification);
(b) creates a list of all minerals it knows about;
(c) assigns each mineral an initial score of 20;
(d) asks the user to enter values for each property;
(e) checks the value entered against all values on the data base for each mineral;
(f) if a mismatch occurs, deducts the value associated with a property from the score for that mineral;
(g) deletes minerals with a score of zero or less;
(h) presents a list of most probable minerals (from most likely to least likely) with their remaining score as a value out of 20.

Once the system has given its answers, the user can ask it how it arrived at its score for a particular mineral. The user can also ask which tests should be performed next (in practice these will be the tests which enable the top three minerals to be distinguished from each other).

Special Cases – Partial Mismatches
For mismatches of quantitative measurements, a sliding scale, similar to that used in fuzzy logic (Zadeh, 1965; Gains, 1976; Negoi, 1985), is used. For example, if a user estimated the specific gravity of galena to be 8.0 (whereas, galena's actual specific gravity ranges from 7.4 to 7.6 (Dana, 1932)), this would be an excusable mistake and consequently would be

Expert Systems Approach to Identifying Minerals

Figure 1. Basic sequence of steps used by MICA to identify minerals.

- Request list of Observable Properties from User
- Create List of Minerals from Data Base
- Ask User to Enter Value for Property

For Each Mineral in list (from 2)

- Check Value against Data Base
  - Type: Qualitative
  - Value: Linear Function
- Deduct Score for Mismatches
- Delete Mineral if Score <= 0

Order of Properties set by Program
- Quantitative Value
- Subgroup Sets

List Minerals in Order of Score

been used. The approach taken here is to have a series of attributes (mineral properties), each of which is defined by a set of higher-level attributes (attributes of these properties), descriptions, and "legal values." The higher-level attributes consist of both "housekeeping" functions (such as property name, name of file where data are stored, number of decimal places stored on the data base, question to ask the user when obtaining a value for this property), and knowledge used in determining the correct mineral (for example, processing algorithm, dependency, and score associated with the property). The descriptions and "legal values" are kept in a dictionary which is separate from the storage of other attributes. The dictionary serves two purposes: first, to validate data entered by the user, and second, to provide descriptions for the help facility.

Knowledge Acquisition

The shell editor allows the system manager to create a new knowledge base for a different domain. In this case the editor takes the system manager through a step-by-step process ensuring that all the information that the system needs (including descriptions) is entered. This information includes all properties and all minerals to be used in the new domain.

Once a new data base has been created, any part of it can be amended. Amending descriptions, scores, or adding new legal values for a property, adding aliases for a value, or adding groupings of values only affects the dictionary entries. If a new property is added, then the system manager must enter the following:

(1) a description of the property;
(2) each legal value for that property and its description (or its minimum and maximum values);
(3) a score for that property;
(4) the value of that property for each mineral on the data base.

If a new mineral is added, then the system manager is prompted to enter in its formula as well as the value for every property appropriate to that mineral.

Implementation

The current version of MICA (Version 2) was developed in UNSW Prolog on a SUN workstation, under the UNIX operating system, and using one megabyte of memory. Currently under version 2, two demonstration data bases have been set up. The first has 92 minerals and 12 properties for identification of minerals in hand specimen. The second uses 38 minerals and 9 properties for microscopic analysis of minerals in thin section. Both data bases can be expanded to approximately 200 minerals and the program is designed to incorporate a data base for the identification of minerals in polished section using reflected-light microscopy.

The system uses a minimum of 254k bytes of memory. The amount of memory used during a terminal session is dependent on how much processing is done, but an average session is likely to use a total of 500k bytes of memory. (Supplying data for all 12 hand specimen properties in the data base used 428k bytes of memory and took four minutes to arrive at the answers.) The slowness is partly due to the fact that the system uses an interpretive version of Prolog. Memory requirements are affected to some extent by the inefficiency of the system's garbage collector.

Results

In addition to extensive checking by the authors, the system was tested for both hand-specimen and thin-section identification of unknown minerals using three groups of students from different levels of the undergraduate-degree-level geology course at the Canberra College of Advanced Education. The success of the system during testing depended on the ability
### Expert Systems Approach to Identifying Minerals

<table>
<thead>
<tr>
<th>MINERAL</th>
<th>MICA SCORE* (POSN)#</th>
<th>MINERAL WITH TOP SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Group 1: First year (hand specimen)</strong> (11)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hornblende</td>
<td>13</td>
<td>(+2)Andalusite (15)</td>
</tr>
<tr>
<td>Orthoclase</td>
<td>5</td>
<td>(+4)Calcite (13)</td>
</tr>
<tr>
<td>Hematite</td>
<td>2</td>
<td>(+2)Uraninite (6)</td>
</tr>
<tr>
<td>Hornblende</td>
<td>8</td>
<td>(+4)Turquoise (19)</td>
</tr>
<tr>
<td>Chlorite</td>
<td>20</td>
<td>(1)Chlorite (20)</td>
</tr>
<tr>
<td>Garnet</td>
<td>11</td>
<td>(10)Opal (18)</td>
</tr>
<tr>
<td>Hornblende</td>
<td>9</td>
<td>(3)Actinolite</td>
</tr>
<tr>
<td>Orthoclase</td>
<td>20</td>
<td>(1)Feldspar (20)</td>
</tr>
<tr>
<td>Fluorite</td>
<td>13</td>
<td>(1)Calcite, Fluorite (13)</td>
</tr>
<tr>
<td>Orthoclase</td>
<td>14</td>
<td>(2)Andalusite (15)</td>
</tr>
<tr>
<td>Fluorite</td>
<td>13</td>
<td>(1)Fluorite (13)</td>
</tr>
</tbody>
</table>

| **Group 2: Second year (thin section)** (7) |
| Augite        | 3                   | (12)Staurolite (15)    |
| Olivine       | 18                  | (2)Pigeonite (20)      |
| Kyanite       | 17                  | (1)Kyanite (17)        |
| Hornblende    | 11                  | (1)Hornblende (11)     |
| Tremolite     | 11                  | (1)Actinolite**        |
| Garnet        | 17                  | (1)Sphalerite, garnet  |
| Andalusite    | 11                  | (3)Hornblende (14)     |

| **Group 3: Third year (thin section)** (6) |
| Serpentine    | 9                   | (3)Muscovite (14)      |
| Plagioclase   | 7                   | (1)Andalusite, feldspar|
| Prehnite      | 9                   | (1)Prehnite (9)        |
| Biotite       | 17                  | (1)Biotite (17)        |
| Plagioclase   | 18                  | (1)Feldspar (18)       |
| Augite        | 20                  | (1)Augite (20)         |

Table 1. Results of student trials of MICA. Note: *top score = 20 (high score accurately described, low score inaccurately described); #if several minerals have the same score = placed in front of position: **actinolite and tremolite are identical in thin section.*

of the observers to enter reasonably accurate data, but even so, it was able to cope with significant errors in a number of the total properties. Results of these tests are summarized in Table 1 and indicate that in most cases MICA is able to place the correct mineral among its top six suggested answers, even given inexperienced observers. In each test the student was also asked to identify the mineral after describing its properties. Overall, MICA performed better than the students, particularly at the first- and second-year level, commonly giving a correct result for the same properties, for which a student misidentified the mineral. This probably reflects the weaker knowledge base of the inexperienced observer.

### Conclusion

The demonstration data bases have shown that the MICA system can be a useful aid for identifying minerals. The shell aspects of the system enable it to be used for several different subdomains (for example, hand specimen, thin section, and polished section) within the overall domain of mineral identification. It could also be extended to include a data base of chemical analyses for rapid mineral determination from electron microprobe data. The ability to add or delete properties enables an individual laboratory to tailor the system to its own requirements. As minerals are easily added or deleted, the data base can be gradually built up over a period of time. The demonstration data bases have also illustrated that it is easy to correct mistakes on the data base once they are discovered.

It is expected that in full scale operation there will be a setting-down period of about six months while errors in the data base are found and corrected. During this settling-down period scores will also need to be adjusted so as to give optimal results. Fine tuning and adjustments to the grouping of early confused values would also greatly improve the reliability of the results.

The system has considerable merit as a teaching aid in that it can reduce the time spent checking through reference lists of mineral properties. This is often a frustrating exercise for students, particularly at the initial learning stage. The facility for interrogation of the system also allows the user to check which observed properties have affected a particular result and helps familiarise the user with diagnostic mineral properties.

The system is currently being incorporated into the second- and third-year geology programs at the Canberra College of Advanced Education.

### Acknowledgements

We thank those students who so willingly co-operated in the testing of the system.

### Availability of the MICA System

Copies of the MICA system, together with a user's manual (Hart, 1986b) and a system manager's manual (Hart, 1986c), are available from the Canberra College of Advanced Education at nominal cost determined by the C.C.A.E. These are available on half-inch 1600 bpi tape, using the "tar" and "cpio" formats of Unix. Requests should be directed to Dr. Jan Newell, at the College address.

Before this system can be used, UNSW PROLOG must be purchased from Dr. C. Sammut, Department of Computer Science, University of New South Wales, Kensington, N.S.W., Australia (approximate cost A$150).

### References Cited


Expert Systems Approach to Identifying Minerals


About the Authors
Allan Hart at the time of writing this paper was a Masters student in computing at Canberra College of Advanced Education. He is interested in geological applications of computerized expert systems.

Dr. Ken McQueen is a lecturer in geology at the Canberra College of Advanced Education. His interests are in the fields of economic geology, ore mineralogy, and metamorphic petrology. His teaching responsibilities include first-year geology and second-year mineralogy and petrology courses.

Dr. Jan Newmarch is a lecturer in artificial intelligence and expert systems at the Canberra College of Advanced Education. His interests are in the fields of logic programming and expert systems.

DATA MODELLING CONCEPTS

OUTLINE:

Introduction
Philosophy of Data Modelling
Why Data Model?
Levels of Models and Terminology
Modelling Data Entities and Relationships
Keys
Data Dictionary
Referential Integrity
Normalization
Physical Modelling/Denormalization
Practical Application

Lecture by: L. de Groot, L. Jones
18 November 1993

Reference: Technology, Engineering & Computing (TEC)
University of Victoria
INTRODUCTION

The objective of this lecture is to develop an appreciation of what is involved in preparing data models. This will help you to prepare initial data models for your own area of the enterprise and to participate effectively in later reviews of the overall data model. While the task of preparing the actual data model for the enterprise is left to the expert, the assistance of knowledgeable users is essential.

PHILOSOPHY OF DATA MODELLING

Data modelling is an art, not a science. While there are rules which need to be followed, most complex models have more than one correct representation.

a) Data tends to remain stable over time. Processes (applications) tend to change over time.

b) Application development should therefore be data driven.

c) All users with a stake in the data MUST be actively involved in the modelling process.
   - Need to know ALL data requirements.
   - Need to buy into the model - must understand it - use of appropriate jargon makes it meaningful.

d) Data is and should be treated as an enterprise resource.

e) Data should be modelled independent of the applications which use it.

f) Proper data management requires planning and design.

g) Data should be managed by a unit with responsibility and authority.

h) Proper data management requires senior management commitment.

i) Database technology is used for controlled sharing of data.
WHY DATA MODEL?

a) Communication Vehicle

- A data model is used to communicate an understanding of the meaning of the business data and the business terms.
- Make sure you TALK and LISTEN to people. You are attempting to model the business - not your interpretation of it or of what you think it should be.
- Use the business jargon and acronyms where appropriate.
- Ensure the users understand and approve of the data model (best way is to use their terminology wherever you can).

b) Data Quality

- Data quality is a serious issue in many organizations. The definition of data is not consistent across business areas; different areas may have different coding for the same item OR they may use the same name for something which they believe is the same, but will have slightly different definitions of the data.
- For example: Date Received - in the department? in the mail room?, etc.
- One of the advantages of a data model is that it should provide consistent definitions of the data used throughout the organization.

c) Data Integrity

- Means that all statements of fact must be consistent. If there are redundant definitions, then they must be consistent.
- Redundancy occurs when the same data is stored in multiple locations. The ability to keep all copies current and synchronized becomes more difficult as the number of copies increase.
- One of the major advantages of a normalized data model is increased data integrity due to reduced redundancies, and, therefore, simpler updating.

d) Data Independence

- A data model is used to separate how the data is accessed from how it is physically stored. This allows greater flexibility in handling database growth, changes to the physical storage of the data, new applications, and isolates changes to the business functions.
- We want to avoid creating fragmented systems, each with their own set of data, and each unable to communicate with the others.

e) Data Flexibility

- Data should be defined once and once properly. If the data model is defined to support a particular application, then other applications may not be able to easily use the data and may have to go through complex conversions.
- By modelling the data independently of any application, the subsequent use of the data tends to be more flexible since it is modelled in a more generic way, rather than being tied to the way a specific application views the data. Eg. fancy query tools.
LEVELS OF MODELS

There are three levels of models - conceptual, logical and physical.

a) Conceptual Model -

- It is a *high-level model* showing the major *business entities and their relationships*.
- Meant to show non-technical staff an overview of the data.
- This model contains the business entities and their inter-relationships.

b) Logical Model

- The logical model shows the entities at a lower, more *detailed level*. It contains the *business data entities and their inter-relationships*. This model is independent of the physical implementation.

c) Physical Model

- The physical model contains the *database design*; as such it is *dependent on the actual database management* (or file system) that will be used. It contains changes made to the logical model for *performance* or other technical issues. It is the model which will be implemented.
TERMINOLOGY

a) Entity

- An entity is something of interest to the enterprise.
- In database modelling, the term entity is used for those items about which we collect and store data. It can be a person, place, thing, event or concept. It can be a real physical item such as a machine or an actual person, or it can be an abstract concept such as a job title or a customer account.
- Entity names are nouns, are always in the singular form (Eg. OCCURRENCE NOT OCCURRENCES), and may be composed of multiple words. The name should convey meaning, and should use business terms wherever possible.
- Although an entity is identified by a single name it may have multiple aliases. These aliases should be documented in the Data Dictionary. It is important to identify and document aliases, otherwise you may develop a data model which contains an entity twice.

b) Entity Occurrence

- Each entity is given a unique name. Each instance of an entity is referred to as an entity occurrence.

c) Attribute

- An attribute is defined as a characteristic, property or description.
- An entity is characterized by attributes which define and describe it. For example: a mineral occurrence has a name, number, production year, etc. Each of these items is an attribute of the entity MINERAL OCCURRENCE.
- Other terms often used in place of attribute are data element, data field, field and data item.
- An attribute is identified by a single name, but it may have multiple aliases. Again, these aliases should be documented in the Data Dictionary.

d) Attribute Value

- An actual item of data represented by an attribute is referred to as an attribute value.
- MINERAL OCCURRENCE NAME could have values of Skookum, Hollyrood, Winfield, etc. Each instance of a data value is referred to as a data occurrence. For example: if the mineral occurrence names given above form a list, then the second data occurrence of the attribute MINERAL OCCURRENCE NAME has a data value of Hollyrood.
- Frequently, an entity has a number of attributes to describe it. When an attribute uniquely defines one occurrence of an entity, the attribute is called a primary attribute, or simply, key.
- All attributes that are not primary attributes are referred to as secondary attributes. In a data base, every entity must have a primary attribute. It may have zero, one, or many secondary attributes.

An entity called MINERAL OCCURRENCE is shown in the following figure as a table to illustrate the terms described in this section. This figure is often referred to as a Data Table. Such tables form the basis of the data model for a relational DBMS.
A table to represent the attributes and values of the entity MINERAL OCCURRENCE.
MODELLING DATA ENTITIES

- MINERAL OCCURRENCE
- PRODUCTION YEAR
- COMMODITY
- QUANTITY
MODELLING DATA ENTITIES

In modelling data, we simply draw a box to represent each different entity and then write the name of the entity into the box. This is referred to as an entity chart. Each box on this diagram has a primary key and may have a number of secondary attributes. These are not shown on an entity chart.

MODELLING ENTITY RELATIONSHIPS

To become a useful model, the diagram must show the relationships that exist among the data entities. Relationships represent the business rules and policies of the organization.

Relationship names are verbs, and may be composed of multiple words. The name should convey meaning, and should use business terms wherever possible.

This section defines the types of relationships that can occur and shows how they can be represented on a diagram.

To indicate that a relationship exists between two data entities, a line is drawn to connect them and the name (description) of the relationship is placed over the line. For example:

Entities and relationships are identified by phrases like:

NOUN VERB NOUN or ENTITY RELATIONSHIP ENTITY

Some examples of these are:

- an AIRPLANE has ENGINES
- a MINERAL OCCURRENCE may have many COMMODITIES
- an EMPLOYEE may be a GEOLOGIST
- a CLERK takes RESERVATIONS on ROOMS for GUESTS
TYPES OF ENTITY RELATIONSHIPS
- ONE WAY

One-and only-one:
- a RESERVATION reserves (exactly) one ROOM

Zero-or-one:
- a MINERAL OCCURRENCE may fall within TERRANES

One-or-many:
- a MINERAL OCCURRENCE may span several MAPSHEETS

Zero-or-many:
- a GEOLOGIST may be assigned to multiple PROJECTS
TYPES OF ENTITY RELATIONSHIPS
- TWO WAY

One-to-one:

- a GEOLOGIST is assigned to one MAP AREA
- a MAP AREA has only one GEOLOGIST

One-to-many:

- a RESERVATION is for exactly one ROOM
- a ROOM may have many RESERVATION

- a MINERAL OCCURRENCE may fall within TERRANE
- a TERRANE may have several MINERAL OCCURRENCES
KEYS

Primary Key
- One or more attributes that uniquely identify an entity occurrence.
- Every entity must have a primary key.
- Any attributes, or combination of attributes, which can be used to uniquely identify an entity occurrence are called Candidate Keys. Any of these could be used as the Primary Key for the entity. One of these is chosen as the Primary Key. The selection of the Primary Key should take into account the stability of the key, that is you want a Primary Key whose value is not likely to change once the entity occurrence has been created.

Composite Key
- In those cases, where no single attribute meets the needs of a primary key, two or more attributes are combined together to form the necessary primary key. Such combined keys are called composite keys, or compound keys.
- For example: MINFILE NO. 092HNE004

Surrogate Key
- A surrogate key is an artificial attribute created to ensure a unique primary key. Sometimes composite keys can be awkward to use, and expensive to use for foreign keys; other times the primary key may be subject to change. In these cases surrogate keys, commonly called Skys, can be introduced. For example: an employee number is really a surrogate key introduced by the business itself to create uniqueness.
- Surrogate keys have a place, but they should be used with caution. They do complicate the data model and can make data access more difficult. This is especially true for end users who are using ad hoc query tools.

Intelligent Key/Business Key
- An intelligent key is one which has meaning to the user. It may have meaning in the key value itself (Eg. a client's name) or it may have embedded meaning (Eg. client numbers which start with the digit 1 are large preferred customers).

Blind Key
- A blind key is one which is never seen by the user. It is stored internally in the database, and is referenced by programs, but never by the user.
KEYS (cont.)

Foreign Key

- When the Primary Key of one entity is contained in another entity to establish a relationship between the two entities, it is called a Foreign Key.

- Foreign Keys enable the implementation of relationships in a relational data model. While they are not actually part of a logical data model, they are commonly included in the logical model for completeness.

- As an example, suppose you have two tables with the following attributes:

  Employee  (Emp-ID, Emp-Name, Emp-Add, Dept-No., etc.)
  Department (Dept-No., Dept-Name, etc.)

  - The Primary Key of the Employee is Emp-ID.
  - The Primary Key of the Department is Dept-No.

- The attribute Dept-No in the Employee table is a Foreign Key to the Department table since it identifies the relationship between the two tables (i.e. it identifies the department an employee works in).
RESOLVING MANY-TO-MANY RELATIONSHIPS

- Many-to-many relationships are not supported by most Database Management Systems.
- While many-to-many relationships are acceptable in conceptual data models, and high level logical models, they are generally removed prior to the completion of the logical data model.
- This can be accomplished by performing the normalization process, which will be covered later.

DRAWING THE DATA MODEL

- There are a number of different notations which can be used to draw data models, and a number of tools and formats which can be used to document the definitions behind the diagram.
- A data model may consist of two parts:

  1. An entity chart that shows all the entities involved and the relationships among them.

  2. A set of data tables, one for each entity on the entity chart, that shows the attributes of each entity.
In the initial data model above, there is a many-to-many relationship between STUDENT and OFFERING. This relationship is converted into an associative entity named ENROLLMENT, producing the following data model:
DATA DICTIONARY

A data dictionary stores information about the data (metadata = data about data).

A data model is composed of both the entity-relationship diagram (data model diagram), which gives a pictorial representation of the data and its relationships, and a data dictionary which describes the entities, attributes, and relationships shown in the entity-relationship diagram. A data model is not complete if it does not include the data dictionary definitions of each and every entity, attribute, and relationship.

A data dictionary can be used to answer the following types of questions:

- What is it?
- What is its identifier (primary key)?
- Where is it?
- Where does it come from?
- Who owns it? Who is responsible?
- Who has authority to access it?
- How does it relate to other data? What are the relationships?
- What are its characteristics? How do I describe it?
- What are its allowable values?
- What aliases does it have?
- Is it mandatory or optional?

There are two types of data dictionary:

1. An Active dictionary is integrated with tools. When something is changed in the dictionary, it is automatically reflected in the programs, screens, et cetera; when something is changed in a table, it is automatically reflected in the dictionary.

2. A Passive dictionary is not integrated with tools. In this case the dictionary is really a documentation tool, and all changes must be manually synchronized between the programs, tables, screens, et cetera, and the dictionary.
REFERENTIAL INTEGRITY

As an example, suppose you have two tables with the following attributes:

Employee  \((\text{Emp-ID, Emp-Name, Emp-Add, Dept-No., etc.})\)
Department \((\text{Dept-No., Dept-Name, etc.})\)

The Primary Key of the Employee is Emp-ID.

The Primary Key of the Department is Dept-No.

The attribute Dept-No in the Employee table is a Foreign Key to the Department table since it identifies the relationship between the two tables (i.e. it identifies the department an employee works in).
REFERENTIAL INTEGRITY

Definition

Referential Integrity (R.I.) allows users to define relationships between attribute values in different entities. Simply stated, referential integrity states that a reference in one entity, to another entity, must be valid.

If an entity contains a foreign key to another entity (parent), then there must exist a row in the parent table for each occurring value of the foreign key.

Need for Nulls

Relational DBMS support the concept of a null. A null is the absence of a value. It is distinct from a blank value for a character string, or a zero value for a numeric field, or a zero length string for a variable length field.

Nulls are required to implement Referential Integrity.
PREPARING A DATA MODEL FOR THE LARGE ENTERPRISE

Producing the logical data model for a large enterprise is time consuming and difficult.

Historically, there were two basic approaches:

**Top Down Modelling:**
- start at enterprise level,
- identify major entities,
- break it down into subject areas and work on business functions,
- then model at the application level.

The major problem with top down modelling is that it takes too long. Since each level of the model is completed before attempting to add more detail, the model is not useful until it is completed. Program areas cannot wait for the corporate model to be completed, so work starts on projects without it.

**Bottom Up Modelling:**
- start by identifying the business transactions,
- identify attributes,
- determine entities based on user views,
- normalize and synthesize,
- build relationships,
- merge with other models.

The major problem with bottom up modelling is that it takes too long. Note that bottom up modelling starts by identifying the attributes, and then grouping the attributes into entities. This can be a slow process. Also, since you are focusing on the operational data, you often miss the real strategic business rules.

**Best Approach**

A better approach is to do a high level corporate model, then do business area models at the detailed level.

An initial conceptual model for the whole enterprise is created which shows only the main business entities and their relationships. Such a conceptual model can serve as a framework into which the local data models can be integrated to develop the final corporate data model.

An advantage of this approach is that the conceptual model can be presented to senior management early in the data base development process. It shows how the enterprise data can be integrated without waiting for the detailed corporate data model to be prepared. Short term results are important to maintain the required support of senior management.

A disadvantage of the initial conceptual model is that it requires an understanding of the overall operation of the enterprise. It may be difficult to find a person who understands both data administration and the entire operation of the enterprise.

Scope is critical. By ensuring that the scope of the business area models is reasonable, and always ensuring that the models are staying within their scope, the models can be delivered in a reasonable amount of time. If the data models are not completed in a reasonable amount of time then application development will not be able to wait for the completion of the model and the applications will be built without the benefits of the data model.
BASIC STEPS OF DATA MODELLING

1. Determine scope of model
2. Determine business rules
3. Identify entities
4. Identify relationships between entities
5. Identify attributes
6. Determine primary key
7. Determine foreign keys
8. Identify constraints
9. Validate model

Iterate steps 2 through 9 adding more level of detail

10. Review and user sign-off

Keep asking questions. Does it make sense? Don’t make assumptions! Include user involvement continually!
NORMALIZATION

The success in the use of the data base depends upon how well the data model is prepared. It is not difficult to test the proposed model to see if the data required by, and generated by, the operational activities can be provided by, and accepted by, the data base. If data cannot be generated then the data model is modified until the data can be generated.

In the same manner the data model is tested to ensure it can provide the data required to provide the various management reports. If necessary, the model is changed so that it does provide the reports.

One difficulty arises in attempting to make sure that the data base can support ad hoc requests which cannot be predefined. Another difficulty is how to support a wide range of future changes which again cannot be predefined.

One way of solving these difficulties is to undertake a review of the data model to determine whether or not any secondary attribute is likely to become an entity at some time in the future. The change from a secondary attribute to an entity can cause exhaustive restructuring of the data base and extensive modifications to the programs that use the altered data item. It is best to define such secondary attributes as entities initially to avoid such problems. Sometimes, however, the cost is deemed to be too high relative to the chance that the secondary attribute will be defined as an entity.

A second means of designing the data model to better meet data model objectives is to Normalize the data. To normalize a data model is to design it so that it conforms to a set of predefined rules.

These rules were originally developed to aid in designing a data model for use with a hierarchical DBMS. Since the development of normalization, it has been recognized that the same approach can be used on any conceptual data model. That is, it can be used to design the data model for more flexibility regardless of what DBMS is used in implementing the data base. Due to the limitations of some DBMS, some of the flexibility in the normalized conceptual model may have to be sacrificed in order to implement the data base in a practical manner.
NORMALIZATION (cont.)

The steps in normalizing a data model are as follows:

1. Identify all the data items and the relationships among them.

2. Develop the entity chart and the corresponding data tables and the data dictionary definitions for each operation - (these are referred to as the local data models).

3. Check to see that the data model will support the data requirements and modify it as necessary.

4. Apply the normalization rules to each of the entity tables.

The result is a set of normalized data tables which together with the entity chart make up the normalized, conceptual data model.

The normal form rules are summarized as follows:

1NF   Remove repeating groups
2NF   Remove partial-key dependencies
3NF   Remove non-key (transitive) dependencies
4NF   Remove multi-valued independent attributes
5NF   Retain multi-valued dependent attributes
APPLYING THE RULES OF NORMALIZATION

The purpose of normalization is to eliminate the possibility of update anomalies. The technique of normalization is to apply a set of rules to the data model.

The normalization process consists of using a set of rules to test the data model. If the data model passes the first rule, then the data model is said to be in "first normal form" or a "first level" data model. If the data model fits the first and second rules, then the data model is said to be in "second normal form" or at the "second level". There are five rules and therefore five levels of normalization of a data model.

The usual method of expressing normalization is to say that the data table or the data model is in "second normal form", written as 2NF. Or you could be asked to "draw the data model in third normal form (3NF).

Although five levels of normalization have been defined, most data models are taken to third normal form; fourth and fifth normal form occur infrequently and are not significant to this course.

NORMALIZATION SUMMARY

Normalization can be thought of as:

One fact in one place

One phrase which is often used to describe third normal form is:

The key, the whole key, and nothing but the key

The steps to be taken in order to normalize a data table to the 3 NF are summarized in the figure below.

All conceptual files

Change all non flat data tables into flat data tables by eliminating all repeating groups.

1NF

For data tables with compound keys ensure that all secondary attributes are dependent on the whole key and not just part of it.

2NF

Change all data tables in which a secondary attribute is dependent on another secondary attribute.
i.e. ensure all secondary attributes are independent of each other.

3NF
PHYSICAL DATA MODELLING

Denormalization

Denormalization is the process of removing levels of normalization when moving from the logical data model to the physical implementation.

This is done to improve performance in time-critical applications, or to reduce resource requirements, either disk storage, or I/O. It is occasionally done to make the physical model easier to use for programs and ad-hoc query tools.

While denormalization can have benefits, it does reduce the flexibility of the data model which was produced by normalization.

The proper method of denormalization is to:

1. Take the data model to 3NF
2. Selectively denormalize based on performance requirements
3. Document why

When subsequent changes are made to the data model, they should always start with the 3NF logical data model, not with the denormalized physical implementation model.
### MINFILE/pc 4.0 DATABASE STRUCTURE

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MINFILE Project Management

PROJECT ELEMENTS

- Concept, designing, planning (budget, staff)

⇒ Database Design and Data Dictionary

- System Testing and Quality Assurance

- Database Administration and Maintenance (documentation and manuals)

- Data Acquisition and Processing Procedures (coding procedures)

- Training and Client Support

- Marketing and Distribution of Data

- New Technology and Future Planning

- Designing and Producing Computer Generated Products for Users
BASIC STEPS OF DATA MODELLING

1. Determine scope of model
2. Determine business rules
3. Identify entities
4. Identify relationships between entities
5. Identify attributes
6. Determine primary key
7. Determine foreign keys
8. Identify constraints
9. Validate model

Iterate steps 2 through 9, adding more level of detail

10. Review and user sign-off
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SKIDEGATE FORMATION
HONNA FORMATION
HAIDA FORMATION

VANCOUVER GROUP
KUNGA FORMATION
PARSONS BAY FORMATION
SUTTON FORMATION
QUATSNIC FORMATION
KARMUTSEN FORMATION

SICKER GROUP
BUTTLE LAKE FORMATION
MYRA FORMATION
NITINAT FORMATION

COAL HARBOUR GROUP
BLUMBERG FORMATION

KYUQUOT GROUP
LONGARM FORMATION
ONE TREE FORMATION
KAPOOSE FORMATION

CARMANHA GROUP
SOKE FORMATION
HESQUITAT FORMATION
ESCALANTE FORMATION

NANAIMO GROUP
GABRIOLA FORMATION
SPRAY FORMATION
GEOFFREY FORMATION
NORTHUMBERLAND FORMATION
DECOURCY FORMATION
CEDAR DISTRICT FORMATION
EXTENSION - PROTECTION FORMATION
HASLAM FORMATION
COMOX FORMATION

LAIB GROUP
REEVES FORMATION

WINDERMERE GROUP
MONK FORMATION
HORSE THEIF CREEK FORMATION
IRENE FORMATION
TOBY FORMATION

SUSTUT GROUP
TANGO CREEK FORMATION
BROTHERS PEAK FORMATION

BOWSER LAKE GROUP
ASHMAN FORMATION

HAZELTON GROUP
SMITHERS FORMATION
NILKITKWA FORMATION
TELKWA FORMATION

CACHE CREEK GROUP
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TESLIN FORMATION
FRENCH RANGE FORMATION
HORSEFEED FORMATION
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MARBLE CANYON FORMATION

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KINGSVALE FORMATION

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North American Stratigraphic Code

FORMAL UNITS DISTINGUISHED BY GEOLOGIC AGE

UNITS BASED ON MATERIAL REFERENTS

ISOCHRONOUS

CHRONOSTRATIGRAPHIC (66)

POLARITY

CHRONOSTRATIGRAPHIC (83)

GEOCHRONOLOGIC* (80)

LITHOSTRATIGRAPHIC (22)

BIOSTRATIGRAPHIC (48)

ALLOSTRATIGRAPHIC (58)

PEDOSTRATIGRAPHIC (55)

DIACHRONOUS

POLARITY

GEOCHRONOLOGIC* (88)

DIACRONIC + (91)

GEOCHRONOMETRIC* (96)

ISOCHRONOUS

* Applicable world-wide.
+ Applicable only where material referents are present.
( )Number of article in which defined.

FIG. 1.—Relation of geologic time units to the kinds of rock-unit referents on which most are based.
## North American Stratigraphic Code

### Table 2. Categories and Ranks of Units Defined in This Code*

#### A. Material Units

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#### B. Temporal and Related Chronostratigraphic Units

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*Fundamental units are italicized.
Mineral Exploration Databases

OUTLINE:

Introduction
Organization of Data and Codes
Exploration and Development - MINFILE example
Drill Hole Data - COALFILE example
Geochemical Data - RGS example
Field Data - GSB-GDS, GEOF examples
Summary

Lecture by: L. Jones
19 November 1993

References: TECDOC Section 4.5, Annex 6.5
Mineral Exploration Databases

GENERAL:

- Exploration projects generate most or all of the **detailed geologic information** in an area of interest.
- Exploration project databases contain **collected data**, such as field measurements, and calculated data, such as analytical work on samples.
- Data **presentation methods** help to evaluate regional trends and locate anomalies.
- **Good record keeping** and **proper indexing** are essential if the raw data is to be reinterpreted at a later time.
- **Modeling and interpretation** methods help to filter, reduce or enhance data.
- **Data-sets are grouped** according to the type of work performed, commonly prospecting, geological, geophysical, geochemical, physical and drilling.
- Global Positioning Systems (GPS) are useful for accurately locating sample sites.
ORGANIZATION OF EXPLORATION PROJECT DATA

Exploration Projects

- Physical Exploration
  - Drilling
  - Trenching
  - Underground Workings

- Geochemical Survey
  - Soils
  - Stream Sediments
  - Rock analysis

- Geophysical Survey
  - Magnetic
  - Electromagnetic
  - Gravity
  - Seismic
  - Radiometric
Mineral Exploration Databases

TYPICAL CONTENTS:

- Title of project
- Jurisdiction
- Location (longitude/latitude)
- Project Type (major, minor)
- The managing company or organization
- The name, address and telephone of the project coordinator or manager
- Date and type of work done
- Exploration budget and cost of the completed exploration program
- Notes on pertinent information such as geological descriptions, plans for the following year, assays, references, etc.
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### Projects

**Name:** ESKAY CREEK

**Project No.:** 0100073

**Owner:** PRIME RESOURCES GROUP INC.

**Operator:** PRIME RESOURCES GROUP INC.

**Minfile No.:** 104B 008 ESKAY CREEK

**District Seq. No.:** 40

**District Map No.:** 122

**Create date:** 24/05/94

**Revision date:** 30/05/94

**Checked by:**

---

**Exploration Notes**

24/05/94 Project created from Notice of work in MIS interface.

---

### Notices

**Name:** ESKAY CREEK

**Recvd Date:** 05/01/94

**Operator:** PRIME RESOURCES GROUP INC.

**Manager:** PRIME RESOURCES GROUP INC.

**Depst Target:** Epithermal

**ToDo:** Drilling, mapping

**Work:**

**Expl. budget:** $1,000,000

**Prod. budget:**

---

Cursor to field to change, press enter to modify

---
PROJECT NUMBER: 0100073
NAME(S): RSKAY CREEK
OWNER(S): PRIME RESOURCES GROUP INC.
NTS MAP: 104BD9W
MINING DIVISION: Skeena
DISTRICT MAP NO: 122
SEQUENCE NO: 40
NOTICES OF WORK: 1994-0001
MINFILE OCC.'S: 104B 008

PROJECT TYPE: Major property
LATITUDE: 56 37 00
LONGITUDE: 130 27 00
LOCATION ACCURACY: Within 500 m
DATE CODED: 05/24/94
DATE REVISED: 05/30/94
CHECKED BY:

NOTICES
NOTICE NUMBER: 1994-0001 Mineral
OPERATOR: PRIME RESOURCES GROUP INC.
MANAGER: PRIME RESOURCES GROUP INC.
DEPOSIT TARGET: Epithermal
WORK TO DO: Drilling, mapping
WORK DONE:
WORK STARTED: 01/15/94 WORK FINISHED: 01/31/94
EXPL. BUDGET: $1,000,000.00
PROD. BUDGET:

RECEIVED DATE: 01/05/94
APPROVAL DATE: 01/07/94
TELEPHONE: (604) 684-2345

COMPLETED: N
DISCUSSED: N
DEVELOPMENT REVIEW: N
DEVELOPMENT STAGE: Prospectus

EXPLORATION NOTES
24/05/94 Project created from Notice of work in MIS interface.
24/05/94 New Notice of work 1994-0001 received in MIS interface.

PROJECT NUMBER: 0100073
## DATABASE STRUCTURE OF EXPORTED FILES

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Template for plotting MINFILE data in QUIKMap.

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<td>Symbol colour</td>
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</tr>
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<td>3</td>
<td>Label size</td>
<td>5</td>
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<td>3</td>
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<td>4</td>
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<td>NAME</td>
<td>Char</td>
<td>30</td>
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<td>AU.AG.PB.ZN.CU</td>
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<td>23</td>
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<td>Char</td>
<td>9</td>
<td>Deposit type code</td>
<td>11</td>
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<td>Char</td>
<td>7</td>
<td>NTS map</td>
<td>104809W</td>
</tr>
</tbody>
</table>

Province of British Columbia

Geological Survey Branch
LEGEND

Kitimat Smelter
Trail Smelter
Ridley Island (Prince Rupert) Port
Point Roberts / Vancouver Port
Railroads
Highways / Exploration Roads

Porphyry
Transitional and Vein
Massive Sulphide

1992

Figure 3
Exploration Highlight Projects

Development Highlights
<table>
<thead>
<tr>
<th>COMPANY NAME</th>
<th>PROJECT NAME</th>
<th>Commodity</th>
<th>ESTIMATED TONNES (000s)</th>
<th>ESTIMATED GRADE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Placer Dome Inc.</td>
<td>Kerr</td>
<td>Cu, Au</td>
<td>126 000</td>
<td>0.62% Cu, 0.274 g/t Au</td>
</tr>
<tr>
<td>Placer Dome Inc.</td>
<td>Sulphurets Gold</td>
<td>Au, Cu</td>
<td>18 000</td>
<td>0.35% Cu, 0.823 g/t Au</td>
</tr>
<tr>
<td>New Canamin Res. Ltd.</td>
<td>Huckleberry</td>
<td>Cu, Au</td>
<td>78 000</td>
<td>0.401% Cu, 0.025% MoS2</td>
</tr>
<tr>
<td>El Condor Res. Ltd.</td>
<td>Kemess North</td>
<td>Cu, Au</td>
<td>116 109</td>
<td>0.19% Cu, 0.377 g/t Au</td>
</tr>
<tr>
<td>Placer Dome Inc.</td>
<td>Shear</td>
<td>Cu, Au</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Yellowack Res. Ltd.</td>
<td>Katie</td>
<td>Cu, Au</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Crew Natural Res. Ltd.</td>
<td>Red Dog</td>
<td>Cu, Au, Mo</td>
<td>25 000</td>
<td>0.35% Cu, 0.44 g/t Au, 0.006% Mo</td>
</tr>
</tbody>
</table>

### Massive Sulphide Deposits

<table>
<thead>
<tr>
<th>COMPANY NAME</th>
<th>PROJECT NAME</th>
<th>Commodity</th>
<th>ESTIMATED TONNES (000s)</th>
<th>ESTIMATED GRADE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cominco Ltd.</td>
<td>Par</td>
<td>Pb, Zn, Ag, Ba</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Teck Explorations Ltd.</td>
<td>MGM/Bend</td>
<td>Zn, Pb, Ag</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Cominco Ltd.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kokanee Explorations Ltd.</td>
<td>Fors</td>
<td>Ag, Pb, Zn</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Chapleau Res. Ltd.,</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barkhor Res. Inc.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kokanee Explorations Ltd.,</td>
<td>Leg</td>
<td>Zn, Ag, Ba</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Legion Res. Ltd.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minnova Inc.</td>
<td>Seneca</td>
<td>Zn, Cu,</td>
<td>533</td>
<td>0.91% Cu, 0.22% Pb, 7.06% Zn, 68.8 g/t Ag, 1.44 g/t Au</td>
</tr>
<tr>
<td>International Curator Res. Ltd.</td>
<td></td>
<td>Au, Ag</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Westmin Resources Ltd.</td>
<td>Thelwood Valley</td>
<td>Cu, Pb, Zn, Ag, Au</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>(Myra Falls)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Transitional & Vein Deposits

<table>
<thead>
<tr>
<th>COMPANY NAME</th>
<th>PROJECT NAME</th>
<th>Commodity</th>
<th>ESTIMATED TONNES (000s)</th>
<th>ESTIMATED GRADE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lac Minerals Ltd.</td>
<td>Red Mountain</td>
<td>Au</td>
<td>840</td>
<td>12.68 g/t Au</td>
</tr>
<tr>
<td>(Marc Zone)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gold Fields Canadian Mining Ltd.</td>
<td>Nizi</td>
<td>Au, Ag</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Minnova Inc.</td>
<td>Wolf</td>
<td>Au</td>
<td>n/a</td>
<td>n/a</td>
</tr>
</tbody>
</table>

---

**1992**

**Table B**

**Exploration Highlight Projects**
LEGEND

Kitimat Smelter
Trail Smelter
Ridley Island (Prince Rupert) Port
Point Roberts / Vancouver Port

Railroads
Highways / Exploration Roads

Advanced Exploration
Development
Permitted in 1992

1992

Figure 2
Advanced Exploration / Development Highlights
<table>
<thead>
<tr>
<th>COMPANY NAME</th>
<th>PROJECT NAME</th>
<th>COMMODITY</th>
<th>ESTIMATED TONNES (000s)</th>
<th>ESTIMATED GRADE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Porphyry Deposits</strong></td>
<td></td>
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<td></td>
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<tr>
<td>Taseko Mines Ltd.</td>
<td>Fish Lake</td>
<td>Cu, Au</td>
<td>1080 000</td>
<td>0.23% Cu, 0.41 g/t Au</td>
</tr>
<tr>
<td>El Condor Resources Ltd.</td>
<td>Kemess South</td>
<td>Cu, Au</td>
<td>207 000</td>
<td>0.23% Cu, 0.64 g/t Au</td>
</tr>
<tr>
<td>St Philips Resources Inc.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jordex Resources Inc.</td>
<td>Expo/Hushamu</td>
<td>Cu, Au, Mo</td>
<td>173 260</td>
<td>0.25% Cu, 0.31 g/t Au, 0.01% Mo</td>
</tr>
<tr>
<td>Imperial Metals Corp.</td>
<td>Mount Polley</td>
<td>Cu, Au</td>
<td>49 000</td>
<td>0.38% Cu, 0.55 g/t Au</td>
</tr>
<tr>
<td>Gibraltor Mines Ltd.</td>
<td>Gibraltar North</td>
<td>Cu</td>
<td>50 000+</td>
<td>0.4% Cu</td>
</tr>
<tr>
<td>CMP Resources Ltd.</td>
<td>Q R</td>
<td>Au</td>
<td>1 200</td>
<td>5.2 g/t Au</td>
</tr>
<tr>
<td>Placer Dome Inc.</td>
<td>Mount Milligan</td>
<td>Cu, Au</td>
<td>284 000</td>
<td>0.2% Cu, 0.58 g/t Au</td>
</tr>
<tr>
<td><strong>Massive Sulphide Deposits</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Westmin Resources Ltd.</td>
<td>Battle Zone/Myra Falls</td>
<td>Cu, Pb, Zn, Ag, Au</td>
<td>3 018</td>
<td>2.9% Cu, 0.4% Pb, 14.0% Zn, 24.0 g/t Ag, 1.0 g/t Au</td>
</tr>
<tr>
<td>Geddes Resources Ltd.</td>
<td>Windy Craggy</td>
<td>Cu, Au, Ag, Co</td>
<td>297 440</td>
<td>1.38% Cu, 0.2 g/t Au, 3.83 g/t Ag, 0.069% Co</td>
</tr>
<tr>
<td>Curragh Resources Ltd.</td>
<td>Stronsay</td>
<td>Pb, Zn, Ag</td>
<td>22 080</td>
<td>2.8% Pb, 9.4% Zn, 60 g/t Ag</td>
</tr>
<tr>
<td>Homestake Canada Ltd.</td>
<td>Eskay Creek 21B</td>
<td>Au, Ag</td>
<td>1 190</td>
<td>59.41 g/t Au, 2659.3 g/t Ag</td>
</tr>
<tr>
<td>Redfern Resources Ltd.</td>
<td>Tulsequah Chief</td>
<td>Cu, Pb, Zn, Au, Ag</td>
<td>7 800</td>
<td>1.6% Cu, 1.18% Pb, 6.47% Zn, 2.74 g/t Au, 109.72 g/t Ag</td>
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<tr>
<td><strong>Transitional &amp; Vein Deposits</strong></td>
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<td></td>
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<tr>
<td>Equity Silver Mines Ltd.</td>
<td>North Waterline Zone</td>
<td>Cu, Au, Ag</td>
<td>750</td>
<td>0.68% Cu, 209 g/t Ag, 4.18 g/t Au</td>
</tr>
<tr>
<td>Chini Gold Mines Ltd.</td>
<td>Mets</td>
<td>Au</td>
<td>53.5</td>
<td>11.62 g/t Au</td>
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<tr>
<td>Golden Rule Resources Ltd.</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Manson Creek Resources Ltd.</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canarc Resources Corp.</td>
<td>Polaris-Taku</td>
<td>Au</td>
<td>2 590</td>
<td>14.74 g/t Au</td>
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<tr>
<td>Suntac Minerals Corp.</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Newhawk Gold Mines Ltd.</td>
<td>Brucejack Lake</td>
<td>Au, Ag</td>
<td>749.3</td>
<td>15.43 g/t Au, 647.2 g/t Ag</td>
</tr>
<tr>
<td>Granduc Gold Mines Ltd.</td>
<td>(Brucside)</td>
<td>(West Zone)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fairfield Minerals Ltd.</td>
<td>Elk</td>
<td>Au</td>
<td>308.4</td>
<td>22.18 g/t Au, 24.68 g/t Ag</td>
</tr>
</tbody>
</table>

1992

Table A
Advanced Exploration / Development Projects

Copper
Mineral Exploration Databases

DRILL HOLE DATA:

Contents:

- Drill hole name, collar location and elevation, and total length of hole
- Downhole survey data
- Lithological descriptions or stratigraphic units
- Sampling and assay data

Drilling Types:

- Becker hammer, churn, diamond - surface, diamond - underground, overburden, percussion and rotary.
Drill Hole Data

- four tables
- connected with a unique key (HOLE-ID)
- ASCII or spreadsheet format

1. Drill hole name, collar location and total length of hole
2. Downhole survey data
3. Lithological descriptions
4. Sampling and assay data

Examples of tables:

**Table 14a: Header**

<table>
<thead>
<tr>
<th>HOLE-ID</th>
<th>X-COORD</th>
<th>Y-COORD</th>
<th>Z-COORD</th>
<th>LENGTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>...</td>
<td>......</td>
<td>......</td>
<td></td>
<td></td>
</tr>
<tr>
<td>KAM-15</td>
<td>6684.37</td>
<td>456.39</td>
<td>118.42</td>
<td>185.93</td>
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<tr>
<td>KAM-16</td>
<td>6345.87</td>
<td>395.38</td>
<td>120.45</td>
<td>178.65</td>
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<tr>
<td>KAM-17</td>
<td>7522.26</td>
<td>520.15</td>
<td>116.72</td>
<td>135.58</td>
</tr>
<tr>
<td>KAM-18</td>
<td>7254.84</td>
<td>486.35</td>
<td>123.95</td>
<td>215.14</td>
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</table>
### Table 14b: Survey Data

<table>
<thead>
<tr>
<th>HOLE-ID</th>
<th>DISTANCE</th>
<th>AZIMUTH</th>
<th>DIP</th>
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<td>...</td>
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<tr>
<td>KAM-16</td>
<td>0.00</td>
<td>135.0</td>
<td>47.1</td>
</tr>
<tr>
<td>KAM-16</td>
<td>10.00</td>
<td>135.3</td>
<td>47.0</td>
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<tr>
<td>KAM-16</td>
<td>20.00</td>
<td>135.4</td>
<td>46.8</td>
</tr>
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<td>...</td>
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<tr>
<td>KAM-17</td>
<td>0.00</td>
<td>127.2</td>
<td>60.0</td>
</tr>
<tr>
<td>KAM-17</td>
<td>25.00</td>
<td>127.0</td>
<td>59.4</td>
</tr>
<tr>
<td>KAM-17</td>
<td>50.00</td>
<td>126.7</td>
<td>59.1</td>
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</tbody>
</table>

### Table 14c: Lithology

<table>
<thead>
<tr>
<th>HOLE-ID</th>
<th>FROM</th>
<th>TO</th>
<th>ROCK-TYPE</th>
<th>REMARKS</th>
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<tbody>
<tr>
<td>...</td>
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<td>...</td>
</tr>
<tr>
<td>KAM-16</td>
<td>28.20</td>
<td>42.30</td>
<td>Chlorite schist</td>
<td>Fine-grained, brecciated</td>
</tr>
<tr>
<td>KAM-16</td>
<td>42.30</td>
<td>46.50</td>
<td>Biotite schist</td>
<td>Specks of pyrrhotite</td>
</tr>
<tr>
<td>KAM-16</td>
<td>46.50</td>
<td>53.25</td>
<td>Quartzite</td>
<td>Medium-grained</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
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<td>...</td>
<td>...</td>
</tr>
<tr>
<td>KAM-17</td>
<td>38.45</td>
<td>44.32</td>
<td>Granite</td>
<td>Coarse-grained</td>
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<tr>
<td>KAM-17</td>
<td>44.32</td>
<td>55.85</td>
<td>Metagreywacke</td>
<td>Chloritized</td>
</tr>
<tr>
<td>KAM-17</td>
<td>55.85</td>
<td>68.56</td>
<td>Granite gneiss</td>
<td>Fractured</td>
</tr>
</tbody>
</table>

### Table 14d: Assays

<table>
<thead>
<tr>
<th>HOLE-ID</th>
<th>FROM</th>
<th>TO</th>
<th>SAMPLE NO</th>
<th>U-PPM</th>
<th>CU %</th>
<th>etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>...</td>
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<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>KAM-16</td>
<td>42.30</td>
<td>43.00</td>
<td>Ra-654</td>
<td>160</td>
<td>0.02</td>
<td></td>
</tr>
<tr>
<td>KAM-16</td>
<td>43.00</td>
<td>44.00</td>
<td>Ra-655</td>
<td>390</td>
<td>0.08</td>
<td></td>
</tr>
<tr>
<td>KAM-16</td>
<td>44.00</td>
<td>45.00</td>
<td>Ra-656</td>
<td>750</td>
<td>0.12</td>
<td></td>
</tr>
<tr>
<td>KAM-16</td>
<td>45.00</td>
<td>46.00</td>
<td>Ra-657</td>
<td>440</td>
<td>0.04</td>
<td></td>
</tr>
<tr>
<td>...</td>
<td>...</td>
<td></td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>KAM-17</td>
<td>45.00</td>
<td>46.00</td>
<td>Ra-713</td>
<td>275</td>
<td>0.06</td>
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</tr>
<tr>
<td>KAM-17</td>
<td>46.00</td>
<td>47.00</td>
<td>Ra-714</td>
<td>645</td>
<td>0.12</td>
<td></td>
</tr>
</tbody>
</table>

...
Mineral Exploration Databases

GEOPHYSICAL DATA:

Contents:

- Surveyor
- Instruments used
- Analog or digital records
- Area covered
- Station location
- Data measurements and calculations dependent on geophysical method

Geophysical Types:

- Dip needle, electromagnetic - airborne, electromagnetic - ground, gamma ray spectrometer - airborne, gamma ray spectrometer - ground, gravity, induced polarization, infra-red, magnetic - airborne, magnetic - ground, mise-a-la-masse, radar, radiometric - airborne, radiometric - ground, radiometric - drill hole probing, radon gas scintillometry, resistivity (alone), scintillometer - airborne, scintillometer - ground, seismic, self potential.
Mineral Exploration Databases

GEOCHEMICAL DATA:

Contents:

⇒ Source of geochemical data
⇒ Sample number
⇒ Location of sample site, elevation
⇒ Sample material (sediment, soil, water)
⇒ Site information (stream parameters, rock type, sample description)
⇒ Analytical values for each sample

Geochemical Types:

⇒ Biogeochemistry, fission track etch, heavy minerals, metallurgic, rock, sampling/assaying, silt, soil, water.
British Columbia
Regional Geochemical Survey Data
NTS Map sheet 92N - Mount Waddington: BC RGS 34

DATA FILES

92N.DAT - Listings of field and analytical data:
The field and analytical data for each sample are stored in single, fixed length fields as a flat ASCII file.

DOCUMENT FILES

README.DOC - The file you are currently reading.

FORMAT.DOC - Data format for recorded field observations and analytical results.
Explanation of codes for field variables.

92N.DOC - A description of sample collection, analysis, and preparation details
Codes for geological formations.
<table>
<thead>
<tr>
<th>FIELD</th>
<th>DESCRIPTION</th>
<th>COLUMNS</th>
<th>TYPE</th>
<th>LENGTH</th>
<th>EXAMPLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>NTS Map-Sheet</td>
<td>001-006</td>
<td>A</td>
<td>6</td>
<td>104N16</td>
</tr>
<tr>
<td>02</td>
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1992 RGS RELEASE
Sample Location Map - 2568 Sites

1992 RGS RELEASE
Precious Metal Anomaly Map
- Rating = 3
- Rating > 3 and < 9
- Rating >= 9
Mineral Exploration Databases

COALFILE:

- 6 related .dbf files

**Bulk.dbf**

⇒ location, report number, bulk sample, license no., seam name

**Comment.dbf**

**Explore.dbf**

⇒ operator, owner, status

**Map.dbf**

⇒ area, scales, type

**Trench.dbf**

⇒ method, samples, location

**Borehole.dbf**

⇒ identification, drill type, location, elevation, log type, contractor, depth, direction, dip
Mineral Exploration Databases

FIELD DATA:

Recommended Features for a Field Data System:

✓ Easy retrieval, sorting and manipulation of field data to assist in map compilation and plotting.

✓ Ability to create page size to map size plots at any scale.

✓ Ability to retrieve data and create reports and tables.

✓ Consistency in the way field data is collected and reported.

✓ Geologic databases created can be incorporated into a GIS and automated map plotting system.

✓ Ability to use dBASE files that are related to each other by station number.
Mineral Exploration Databases

FIELD DATA (cont.):

Contents:

⇒ Station location, longitude/latitude, traverse, map area
⇒ Structural measurements
⇒ Mineral occurrence data
⇒ Rock types and alteration data
⇒ Descriptive notes
⇒ Analytical results of geochemical data
⇒ Radiometric age dates
⇒ Fossil name and age
⇒ Isotope analyses
⇒ Photo number
⇒ Petrographic data
⇒ Date and coder

Field Data Types:

⇒ Geological: geological, petrographic, photo.
⇒ Physical: legal surveys, line/grid, pits, reclamation, road, local access, stripping, topographic/photogrammetric, trail, trench, underground development, underground surveys.
Figure 1. Relational structure of the Geological Database System. Records in related files are linked to the station location file by station number. Related files also contain location coordinates and can "stand alone" for plotting purposes.
GEOF

A COMPUTER PROGRAM TO TRANSLATE ORGANIZED ASCII COMPUTER GEOLOGICAL FIELDNOTES TO DATABASE READABLE STRUCTURE

GEOF (Geological Editor Of Fieldnotes)
Copyright November 1, 1991.

A. Atrens¹, L.C. Struik² and A. Haynes²

1993

Open File 2618

¹Statistics Canada
Ottawa

²Geological Survey of Canada, Cordilleran Division
Vancouver
90-503
E473580
N6110675
1470
!to here have flattened diorite and actinolite-schist;
/c
!isos;
#
quartzite
white, light grey;
=qtz mm0.3-0.5;
...
BEIG cm40-80;
!thickness of the quartzite bed. The schist (metatuff?) is thicker on either side, and is intruded by diorite;
...
Ø90-503 quartzite;
F1: 340/09;
Sl: 162/50w;
diag;
PIC 8bw-30,31,32 of anticline of quartzite and schist. Looking to the northwest with hammer at the top, pick point to the east;
Figure 2. This flow-diagram shows the steps in the GEOF system of translating the field notes to comma-delimited files of data.
Earth Science Information Databases

OUTLINE:

Introduction
Indexes
Codes and Key Terms
Published Systems - GEOSCAN, GEOREF
PC-based Systems - PROCITE
Un-published Systems - GSB Index, ARIS
Summary

Lecture by: L. Jones
19 November 1993

References: TECDOC Section 4.3, Annexes 6.2 and 6.3

Province of British Columbia • Geological Survey Branch
ORGANIZATION OF EARTH SCIENCE DATABASES

Data Directory
(Master database)

- Earth Science Bibliographies
- Index of Geological Mapping
- Index of Air Photography
- Index of Geophysical Mapping
- Index of Geochemical Mapping
- Index of Drill Holes
Earth Science Information Databases

BIBLIOGRAPHIES:

⇒ Published geoscience material is collected systematically by several organizations on a global scale.

⇒ A thesaurus is a guide to the usage of keywords (indexing terms), their hierarchical relationships and synonyms.

⇒ Unpublished bibliographic data on geoscience material includes reports and maps in the archives of geological surveys and exploration and mining companies.
Earth Science Information Databases

EXAMPLE OF DATA ELEMENTS FOR UNPUBLISHED REPORTS:

- Title of report
- Name(s) of author(s)
- Name of source organization
- Name of report series
- Serial number or code of report
- Number or range of pages
- Notes on illustrations, appendices, maps
- Year of report
- Types and scales of maps in the report
- Language of report
- Subject keywords
- Geographic names
- Longitude/latitude
- Text of abstract
- Free field for comments
- Location of document
- Name and date of recorder
Earth Science Information Databases

INDEXES

Data Elements for Geological, Geophysical, Geochemical and Topographic Map Indexes:

- **Title** and year of publication
- **Name(s) of author(s)**
- **Name and address of organization** that serves as repositories for data
- **Name of report series**
- **Serial** and number of publication
- **Map projection and scale**
- **Country and geographic area**
- **Area covered in square kilometers**
- **Longitude/latitude** of the boundaries of map coverage and center of map
- **Form of data release** (hard copy: paper; digital: file type and size, media format, hardware and software compatibility)
- **Availability**
- **Free field for comments**
Earth Science Information Databases

INDEXES (cont.)

Geological map indexes
⇒ typically contain mappable rock units, structural elements observed and type of samples taken

Geophysical map indexes
⇒ typically contain the kind of geophysical data and its characteristics and details about the survey, such as spacing of flight lines and flight characteristics

Geochemical map indexes
⇒ typically contain the type of sample and analytical methodologies used for each sample type

Topographic map indexes
⇒ typically contain contour interval and features
Earth Science Information Databases

INDEXES (cont.)

Data Elements for Air Photography Indexes:

⇒ Listing of organizations that provide air photos
⇒ Agency code
⇒ Date of coverage
⇒ Scale of photography
⇒ Focal length of lens used
⇒ Type of film
⇒ Cloud cover
⇒ Location, such as coordinates of the corners of each photograph
INDEXES (cont.)

Data Elements for **Drill Hole Indexes**:

⇒ Record number
⇒ Name of organization or project
⇒ Identification number
⇒ Location
⇒ Bearing and inclination
⇒ Total length
⇒ Location of drill core
⇒ Location of drill hole log or report
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CLASSIFICATION CODES (AGI)

Reference
SHIMOMURA, Ruth H. (Editor), GeoRef Thesaurus and Guide to Indexing; America Geological Institute, (1989)
731 p.

Category Codes

01 Mineralogy and Crystallography (mineral data, crystal structure, crystal chemistry, crystal growth, phase equilibria, etc.)
02 Geochemistry (surveys, trace elements, isotopes, cycles, instruments, etc.)
03 Geochronology (absolute age, fission-track, time scales, tephrochronology, tree rings, exposure age, etc.)
04 Extraterrestrial geology (Moon, Venus, Mars, Mercury-Planet, Jupiter, Planetology, etc.)
05 Petrology, Igneous and metamorphic (Igneous rocks, metamorphic rocks, metasomatism, metamorphism, phase equilibria, magmas, lava, intrusions, inclusions, etc.)
06 Petrology, sedimentary (sedimentary rocks, sediments, sedimentation, diagenesis, sedimentary structures, etc.)
07 Marine geology and oceanography (ocean floors, ocean basins, ocean waves, circulation, continental shelf, continental slope, etc.)
08 Paleontology, general (studies on fossil plants and animals, concepts, life origin, applications, methods, etc.)
09 Paleontology, paleobotany (fossil plants, palynology)
10 Paleontology, invertebrate (taxonomy, morphology, evolution, etc.)
11 Paleontology, vertebrate (taxonomy, morphology, evolution, etc.)
12 Stratigraphy, historical geology and paleoecology (biostratigraphy, lithostratigraphy, evolution of land masses, paleomagnetism, paleogeography, biogeography, etc.)
13 Areal geology, general (area studies dealing with more than one aspect of geology)
14 Areal geology, maps and charts (maps, cross sections, diagrams, with no separate text)
15 Miscellaneous and mathematical geology (biography, bibliography, annual reports, popular and elementary geology, mathematical principles, historical accounts, etc.)
16 Structural geology (tectonics, folds, faults, fractures, structural analysis, orogeny, etc.)
17 Geophysics, general (theoretical studies, experimental studies, models, observatories, etc.)
18 Geophysics, solid-earth (tectonophysics, plate tectonics, sea-floor spreading, crust, mantle, core, paleomagnetism, plate tectonics, etc.)
19 Geophysics, seismology (earthquakes, elastic waves, etc.)
20 Geophysics, applied (geophysical surveys, geophysical methods)
21 Hydrogeology and hydrology (ground water, drainage systems, recharge, hydrochemistry, etc.)
22 Engineering and environmental geology (foundations, earthquakes, dams, reservoirs, storage, rock mechanics, soil mechanics, pollution, conservation, reclamation, etc.)
23 Surficial geology, geomorphology (landform description, landform evolution, environment, etc.)
24 Surficial geology, Quaternary geology (glacial features, glaciation, sediments, palynology, stratigraphy, etc.)
25 Surficial geology, soils (genesis, morphology, composition, etc.)
26 Economic geology, general and mining geology (mineral resources, water resources, production, concepts)
27 Economic geology, metals
28 Economic geology, non-metals
29 Economic geology, energy sources (petroleum, gas, coal, oil shale, geothermal energy, etc.)
CLASSIFICATION CODES (BRGM-CNRS)

Reference


Earth Sciences

220 MINERALOGY, GEOCHEMISTRY, EXTRATERRESTRIAL GEOLOGY

A. Mineralogy
   01 Mineralogy: general, methodology, regional studies
   02 Silicates
   03 Non-silicates

B. Geochemistry
   01 Geochemistry: general, methodology, regional studies
   02 Water geochemistry
   03 Soil and rock geochemistry

C. Isotopic Geochemistry, Geochronology
   01 Isotopic geochemistry
   02 Geochronology

D. Cosmochemistry, Extraterrestrial Geology
   01 Extraterrestrial geology
   02 Meteorites, Tectites, Impactites

221 METALLIC AND NON-METALLIC DEPOSITS

A. Metallic and Non Metallic Deposits
   01 Geochemical exploration, methodology, general
   02 Metal geology
   03 Useful material except metal geology

222 CRYSSTALLINE ROCKS

A. Crystalline Rocks
   01 Igneous and metamorphic rocks petrology, volcanic processes, magmas
   02 Experimental petrology

223 SEDIMENTARY ROCKS AND MARINE GEOLOGY

A. Sedimentary Rocks
   01 Petrology of sedimentary rocks except quaternary
   02 Coal
   03 Hydrocarbons
   04 Physical properties of sedimentary rocks

B. Marine Geology

224 STRATIGRAPHY, AREAL GEOLOGY, GENERAL GEOLOGY

A. Stratigraphy

B. Areal Geology, Maps
   01 Areal geology
   02 Geologic maps, cartography

C. General Geology

225 TECTONICS, INTERNAL GEOPHYSICS

A. Tectonics, Structural Geology, Plate Tectonics

B. Internal Geophysics
   01 Geophysics, general, magnetic, electric and thermic methods and properties
   02 Solid-earth geophysics, tectonophysics, gravimetry
   03 Earthquakes, seismology
   04 Applied geophysics

226 HYDROLOGY, ENGINEERING GEOLOGY AND SUPERFICIAL GEOLOGY

A. Hydrology, Hydrogeology
   01 Hydrology
   02 Hydrogeology
   03 Water resources
COMPUTER DATABASE SYSTEMS FOR THE EARTH SCIENCES: APPLICATIONS AND PROSPECTS IN MINERALOGY, MINERAL RESOURCES AND MUSEUM CURATION

On behalf of
The Mineral Database Workshop,
29th International Geological Congress,
Kyoto, Japan, 29-30 August 1992

By
Graham C. Wilson
Turnstone Geological Services Ltd.
P.O. Box 130, Station "B", Toronto
Ontario CANADA M5T 2T3

Tel (416)-466-3386

Mon 29-Jun-1992
TGSL Project 1992-006
1st edition, version 1
96 pages, 16 tables
Table 1. A Short List of Databases Available for Purchase / On-Line Access.

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<td><strong>GeoRef</strong> is available on-line and on CD-ROM. An ‘industry standard’ Earth Sciences database, global in every sense.</td>
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<td><strong>GeoArchive</strong> is available on-line and on CD-ROM. A UK-based system with ≈ 675,000 records. Broad-based like GeoRef, covering economic geology, energy resources, hydrology, oceanography and other fields. Varied search options. Coverage from 1974 to present.</td>
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<td><strong>Worldwide metal mining - March 1990 release of gold mines in the Western world.</strong> The <strong>Metallica 2000 system</strong>, later expanded to other metals, includes &gt; 1700 mines plus 400 major and 400 other mining and exploration firms. Reports can be output / downloaded to Lotus 1-2-3</td>
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<td><strong>MIN-MET Canada v.2</strong>, a database of &gt; 21 MB of company annual reports and other sources, with data on &gt; 2500 companies and &gt; 8700 occurrences.</td>
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Only a glimpse of many academic- and industry- oriented databases on the market. See also notes on database systems in the text, some of which are available for purchase or selective access.

— Turnstone Geological Services Ltd, 1992 —
Database summaries as cataloged in the:

Canadian Geoscience Database Directory

| Product: | GEOSCAN  
|          | GEOSCAN  
| Publisher: | Geological Survey of Canada / Geoscience Information Division / National GEOSCAN Centre  
| Custodian: | David Reade  
|           | Head, National GEOSCAN Centre  
| Scientist: | Anthony Kopf-Johnson  
|           | GEOSCAN Data Base Manager  
| Other: |  

| Description: | GEOSCAN is a bibliographic data base containing approx. 120 000  
| Keywords: | Geoscience information; Bibliography  
| Coverage: | Not uniform  
| NTS: | All  

| Geographic references: NTS  
| Positional accuracy:  
| Map projections:  
| Dimensionality?: No  
| Time period covered: 1970 to Continues  
| Status: Operational  
| Present form of data: Digital  
| Hard copy form:  
| Host computer: HP 3000 Series 70 (Mini)  
| Operating system: MPE  
| Database software: MINISIS ; CDS/ISIS  
| Data structure: Alphanumeric  
| User base: All  
| Output formats: 9 Track Tape ; Floppy Disc ; Paper ; Accessible online  
| GIS software: No  
| Notes:  

Please add your comments and opinions as to the value of this data set to the NWT CMSD and MRM project:
A typical GEOSCAN record provides the following types of information:

**Title:** STRATIGRAPHY AND STRUCTURE OF THE MOUNT SELWYN AREA, ROCKY MOUNTAINS, NORTHEASTERN BRITISH COLUMBIA

**Author:** MCMECHAN, M E

**Source:** GEOLOGICAL SURVEY OF CANADA, PAPER 85-28, 34P. 1987.

**Subjects:** ECONOMIC GEOLOGY; PALEONTOLOGY; TECTONICS; STRATIGRAPHY; STRUCTURAL GEOLOGY

**Age:** PRECAMBRIAN; PROTEROZOIC; PALEOZOIC; MESOZOIC; CENOZOIC

**Keywords:** FOSSILS; CARBONATE ROCKS; SEDIMENTARY ROCKS; METAMORPHIC ROCKS; SEDIMENTARY STRUCTURES; METAMORPHISM; GREENSCHIST FACIES; METAMORPHISM, REGIONAL; STRUCTURAL FEATURES; FAULTS; FOLDS

**Descriptors:** ROCKY MOUNTAIN TRENCH, B.C; ROCKY MOUNTAIN THRUST BELT; ROCKY MOUNTAIN FOLD BELT; MINNES GP; STOODART GP; KECHIKA GP; CONOONTS; TRILOBITA; BRACHIOPODA; GASTROPODA; BRYOZOA; CORALS; STROMATOPOROIDS; CHAROPHYTES; PELECYPODA; OSTRACODA; MISINCHINKA GP; GOG GP

**Map Info:** MAPS (1:50 000, 1:250 000);

**Region:** BRITISH COLUMBIA

**NTS:** 0930; 0948
GeoRef is the SilverPlatter CD-ROM database that covers the fields of geology and geophysics. Produced by the American Geological Institute and based on over 3,000 journals plus books, maps, reports, and theses, GeoRef contains over 1.5 million records dating back as far as 1785.

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References in GeoRef are drawn from over 3,000 journals, as well as books, maps, reports, and U.S. and Canadian Master’s theses and Doctoral dissertations for geology and related degrees granted since 1965. GeoRef contains references to all U.S. Geological Survey publications since 1971, with references to most of the Survey publications before that date.

GeoRef is a comprehensive, global database that covers geology and its many related and peripheral topics worldwide. Included are citations, abstracts, and references about geophysics and structural geology, economic geology, paleontology and stratigraphy, engineering and environmental geology, geomorphology, geochemistry, sedimentary petrology, and many other relevant topics.

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- covers a wide range of geoscience-related topics
- contains over 1.5 million records
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**Sample Record**

**AN ACCESSION NUMBER:** 88-57107
**TI TITLE:** Translated title: Molluscan fauna and paleoenvironment of the Pliocene to Pleistocene Uonuma Group in the northwestern part of Chuo District, Niigata Prefecture, central Japan.
**AU AUTHOR:** Yasui-Satoshi
**OS ORGANIZATIONAL SOURCE:** OYO Corp., Tokyo, Japan
**CD CODEN:** CHZAS
**YR PUBLICATION YEAR:** 1988
**PD PHYSICAL DESCRIPTION:** illus., 4 tables, strat. cols., charts, sketch maps
**LA LANGUAGE OF SUMMARY:** English
**DE DESCRIPTORS:** Japan--; stratigraphy--; Pliocene--; mollusks--; biostratigraphy--; areal-geology--; maps--; paleoecology--; sedimentation--; deposition--; regression--; Far-East; Asia--; Neogene--; Tertiary--; Pleistocene--; Quaternary--; Uonuma-- Group; Chuo-District; Niigata--; central-Japan; sedimentary-basins; Hachikoku-oil-field; Chuo-oil-field; lithostratigraphy--; Shibanomata-Formation; Iwata-Formation; assemblages--; zoning--; shallow-water-environment--; sublittoral-environment--; brackish-water-environment--; geologic-maps
**DT DOCUMENT TYPE:** Analytic; Serial; Map
**MP MAP:** geol. mpa; 1:75,000
**CC CATEGORY CODES:** 12-Stratigraphy-Historical-geology-and-paleoecology

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Users can search GeoRef by title, author, organizational source, publisher, subject, descriptors, and more. Special category codes for faster searching, references to maps, and descriptions of the original documents make GeoRef an important research tool.

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SilverPlatter Information, Inc.
One Newton Executive Park, Newton Lower Falls, MA 02162-1449, U.S.A. • TEL: 617-969-2332 • FAX: 617-969-5554
Mini-micro CDS/ISIS
REFERENCE MANUAL
(Version 2.3)

Division of Software Development and Applications
Office of Information Programmes and Services

Unesco
7, Place de Fontenoy
75700 Paris

November 1988

(c) Unesco
Ministry of Energy, Mines and Petroleum Resources (MEMPR): Bibliographic Management System (BMS)
Example of data elements for unpublished reports.

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DIGITAL BIBLIOGRAPHIC INDEX
of B.C. GEOLOGICAL SURVEY BRANCH
PUBLICATIONS 1874 - 1993

Compiled by Brian Grant
and Claudia Logan

OPEN FILE 1994-13
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Use [Cntl-End] when input complete
Galena-Lead Isotope Characteristics of Mineralization
in Kokanee Glacier Provincial Park, Southeastern British
Columbia; B.C. Ministry of Energy, Mines & Petroleum
Resources, GEOLOGICAL FIELDWORK 1987, PAPER
Economic Geology/ Kokanee Glacier Park/ Nelson
Batholith/ Shale Curve/ Pericratonic Curve/ Bluebell
Curve/ Epigenetic/ Galena-Lead Isotope
Covers NTS Map(s): 082F/11, /14

NTS map sheet coverage not necessarily
in order of priority;
Maximum 4 sheets identified.
B.C. ASSESSMENT REPORT INDEXING SYSTEM (ARIS)

- a library of over 22,000 assessment reports dating from 1947
- reports of assessment submitted by the mineral industry under the Mineral Tenure Act in order to maintain claims in good standing
- $56 million dollars of exploration work submitted in 1990
- information contained in the reports is a valuable reference and research tool for mineral exploration, academic studies and resource management

Assessment Report Indexing System (ARIS) designed to assist in processing a rapidly mounting volume of assessment report administration and data management.

ARIS Database

- The ARIS system modelled after the MINFILE (Mineral Inventory File)
- The database design uses an "entity-relationship" model comprised of codes (entities), with interrelated tables of data containing common assessment report numbers
- ARIS database resides on a mainframe computer and could easily be ported to a PC-based system.

Present Functions of ARIS:

1. Data capture
2. Administration and maintenance
3. Inquiries (ad hoc and pre-programmed)
4. Distribution functions
1. Data Capture (ARIS)

Data Entry

1) General Data (locational)
2) Names (author owner operator)
3) Geological Summary
4) Keywords
5) Work Data
6) Approval Information
7) Amend/Reject Information
# 2. Administration and Maintenance (ARIS)

## Reports
1) Tables Report  
2) Name & Address Table Report  
3) NTS Map Index  
4) ARIS Summary Sheet  
5) Off Confidential Report  
6) Status Report by NTS Map  
7) Letters (approval, amend, rejection)  
8) File to Produce Map List

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4) Commodities  
5) Mining Divisions  
6) NTS Mapsheet Names  
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4. Distribution Functions (ARIS)

- contributor to GEOSCAN, a federal-provincial cooperative program. GEOSCAN is a computerized bibliographic index to geological information dealing with the Canadian landmass, and offshore areas
- produces diskettes in GEOSCAN compatible format.
- perform searches to interested clients free of charge
- complete assessment report libraries on microfiche
- copies of reports can be ordered
- ARIS available on paper, microfiche and computer diskettes. The index provides latitude, longitude, UTM co-ordinates, claim names, operator, author, type of work reported and report year. Available 14 ASCII files to facilitate access by a variety of commercial software programs, such as database management and plotting packages
- 90 index maps mainly at a scale of 1:250 000
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**CONTACTS:**


IAEA: International Atomic Energy Agency, Wagnerstrasse 5, P.O. Box 100, A-1400 Vienna, Austria, Tel. 43 1 2360 ext. 2758, Fax 43 1 234564.

Memorial University of Newfoundland, Department of Earth Sciences, Centre for Earth Resources Research, St. John's, NFLD, Canada A1B 3X5, Tel. (709) 737 8346/8142, Fax (709) 737 2589.

National GEOSCAN Centre, Geological Survey of Canada, Natural Resources Canada, 601 Booth Street, Ottawa, Ontario, K1A 0E8, Tel. (613) 996 4157, Fax (613) 996 9990.

PKGWARE, Inc., 9025 N. Deerwood Drive, Brown Deer, WI 53223.

See also Geological Survey Branch, Geoscience Database Directory, Section 3, pages 40 - 50.

Province of British Columbia • Geological Survey Branch
WORKSHOP NOTES

MINFILE

April, 1993

GEOLOGICAL SURVEY BRANCH
MINERAL RESOURCES DIVISION
MINISTRY OF ENERGY, MINES AND PETROLEUM RESOURCES
Workshop Agenda

✓ Basic DOS
✓ Introduction to MINFILE
✓ Installing the Program, Data and Notices of Work
✓ Searching the Data
✓ Data Interpretation
✓ Reporting
✓ Utilities and Data Transfer
✓ Data Entry: MINFILE and Project Data
✓ Discussion and Evaluation
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      ✓ For example  
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MINFILE/pc V. 4.0
User’s Manual

DRAFT
April, 1994

Geological Survey Branch,
Land Management and Policy Branch
Mineral Resources Division
Ministry of Energy, Mines and Petroleum Resources
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SUMMARY OF PRESENTATIONS AT THE REGIONAL TRAINING COURSE ON
COMPUTERIZED DATABASES IN MINERAL EXPLORATION AND
DEVELOPMENT, LUSAKA, ZAMBIA, MAY 1993

L.D. Jones (British Columbia Geological Survey) and
R.B. Taylor (United States Geological Survey)

1. INTRODUCTION

The purpose of this report is to summarize some of the lectures presented during the first week (May 10-15) of the workshop. The lectures focused on guidelines on the organization, management and presentation of earth science data and on systematic database development using personal computers. A key reference for the presentations is the draft copy of the IAEA TECDOC entitled Guidelines for the organization and management of earth science data on a personal computer.

Presentations by Jones and Taylor included: the strategy and philosophy in mineral resources databases; examples of the U.S. and Canadian database management systems; hardware and software requirements; guidelines to database systems; earth science information databases; mineral deposit databases including MINFILE; and mineral exploration databases. This report will outline key points of each presentation and reference further reading.

2. STRATEGY AND PHILOSOPHY IN MINERAL RESOURCES DATABASES

2.1 Reasoning

Some Whats:

- Mineral resources are unevenly distributed throughout the earth's crust.
- Most countries enjoy some mineral endowment.
- Many have a mining history dating back hundreds of years.

Some Whys:

- Few countries have a well-organized, comprehensive and easily accessible source of historic mining and geological data relating to the nature and distribution of their mineral resources.
- Such information is the starting point in the search for new orebodies.
- Readily accessible databases are essential for effective management of the existing resource and invaluable tools in the search for new orebodies.
- Add to the country's resource base.
- Stimulates mineral exploration leading to discovery of new mineral deposits.
- Development of new mines.
- Contributes to the creation of new wealth by developers, workforce, and public treasury (profits, wages, and taxes).

Some Hows:

- Effective management of mineral resources requires a knowledge of the nature of the resources to be managed, their dimensions, where they are located, their current status, and many other factors.
- Earth Science Databases - compile and update this information.
2.2 The Mineral Exploration and Development Cycle

Philosophy of Mineral Exploration Programs:

- Mineral exploration and mine development ventures involve a high level of **financial risk**.
- Information gathered at each stage of a project leads to increased confidence of **discovering and developing** an orebody.
- If the data gathered at each stage of a project is accurate and complete **lower risk factors** are involved.

Stages of Mineral Exploration Programs:

- First stage of exploration is the **choice of area**, which is generally based on analysis of available geoscience data from general surveys and previous exploration effort.
- Ready access to this type of information will simplify the task and greatly **increase success**.
- Subsequent stages include **geophysical** and **geochemical** surveys, detailed **geological mapping** and **drilling** and **underground work**.
- Costs increase at each stage, as do the spin-off **economic benefits**.
- Information generated must provide the **justification for continuing** to the next stage.
- Final stage - **ore reserves exhausted** and mine closes.
- Portion of the **profits** will be allocated to the search for new orebodies and the exploration and development cycle will be repeated.

Mineral Exploration Program Observations and Strategy:

- Detailed **geological information** will be collected during the life of the operation.
- These data are invaluable in the search for **new orebodies** in the same district and in other areas with similar geological setting.
- Data are often **lost** if the project is abandoned.
- Drill core and logs, assays, geophysical results, geological maps, mine plans and engineering reports may be buried in **private files** or may even be lost or destroyed.
- If the information is stored in a database where it can be readily retrieved and analyzed, it may lead to fresh **insights** and **new ideas** that rekindle interest in the project.
- New geological concepts, availability of new technology, commodity price increases, or improved transportation may **reactivate** old mining areas.
- Easy access to **historical and current geoscientific data**, which is gathered at great expense and sometimes is not reproducible, benefits new investors, which in turn will stimulate and promote mining exploration in an area.

2.3 Organization of Earth Science Data

- Information comprising a geoscience information system starts with a repository-type database referred to as the **master database**.
- Database subjects or **themes** describe the handling of earth science information such as bibliographies; mapping indexes (geological, geophysical and geochemical); air photography indexes; and drill hole indexes; mineral deposit information; and exploration information (drill hole, geophysical, geochemical, and field data).
- Selection of appropriate databases and their content are based on the **objectives** of an organization.
- Examples of objectives would be to **collect and store data** on the various themes; provide essential **linkages** to other databases and other levels within the same data theme; facilitate the production of various **reports and maps**; or provide an aid in **planning** future exploration programs.
- Most subject databases follow a **multi-level model**, beginning with the first-level database, which provides a **basic orientation** to the database theme.
- A second- or third-level database provides more **detailed information** on the subject data.
2.4 **Master Database - Database Directory**

- NAME of data set, Acronym
- Location
- Data form
- Host computer
- Data Custodian/Manager and Scientific Contact

2.5 **System Planning**

**System Cycle:**

- Establish business objectives and desired output.
- Scope document, user-requirements, fitting analysis (content and system).
- Detailing the proposal, with an action plan and resources required.
- Budgeting and project team selection.
- User-needs analysis and design details.
- Project schedule and detailed implementation plan.
- Develop universal tables, establish regional flexibility.
- Chose application development software and acceptable user-interface.
- Produce a PC-based application.
- System testing and documentation.
- User acceptance and evaluation.
- Marketing, distribution, training and support.

**Data and System Goals:**

- Quick and easy access to data.
- Detailed, high quality information.
- Data available in a wide variety of forms, such as custom and standard reports, and digital files for incorporation into other programs.
- Systematic management of data elements to improve data integrity and validity.
- An established methodology for the distribution of data.
- Allow the database to grow with increased requirements.
- Efficient and flexible model.
- Establish common data formats and system capabilities.
- Define links to geographical information systems.
- Implement a modern user-interface based on the latest technology.
- Standardize tables and definitions (e.g. commodities and work types).
- A versatile data dictionary will permit customized data content.
2.6 An Approach to Integrated Data Management

Challenges:

- Successfully integrate the various databases and mapping systems in a way that facilitates exchange of data for broader purposes.
- Maintain information in a manner which promotes data integrity and rapid retrieval.

Data Issues - Data Models:

- Originally recorded on paper.
- Transferred into digitally based systems.
- Data model must be constructed that provides the organizational layout of the data.
- Must serve the needs of the business application that surrounds the data.
- Many databases evolve in which model construction is minimal.
- Ad hoc database construction which occurred as technology developed.

Technology Management Issues:

- Development and maintenance of data requires human resources.
- Local and central responsibility of systems.
- Database managers and administrators.
- Routine and specialized maintenance - backups, programming.
- Inconsistencies, errors, corruption of data, and eventual abandonment of the databases and applications will result.
- Focus on future developments and planned migration strategies.
- Data static if it is collected and managed in a consistent framework.
- Data considered to be dynamic (changing in its nature, structure, and application) if collected and evolved over time.
- Requires a strategy that will work towards keeping data relevant and manageable.

Procedure:

- Establish business case and plan strategy.
- Coordinate implementation with the custodians of the databases.
- Review and recommend, where necessary, upgrading of databases.
- Manage and coordinate the exchange of data.

Database Components:

- Data model
- Administration
- Project staffing
- Documentation
- Database directory

2.7 References and Further Reading

- TECDOC: Section 4.1, 4.2, Figure 3.

3. COMPUTER HARDWARE AND SOFTWARE
3.1 Introduction

- Custom development of programs is expensive.
- Recommend purchase of existing application packages, such as spreadsheets, word processors, database systems, statistical packages and GIS programs.
- Concentrate on the integration and implementation of these applications.
- Benefits include improved functionality and reduced costs for maintenance and support of custom-built software.
- Establish business objectives before selecting computing environment.
- Evaluate software requirements first, before hardware selection, to avoid incompatibilities.
- Consider availability of support and local expertise; training requirements; standards compliance; and the size and growth requirements of the database.

3.2 Hardware

- IBM-compatible PC systems (80486 processor) recommended.
- 640-kilobyte random access memory (RAM), with at least four megabytes of extended memory.
- Large hard disk (200 megabytes).
- Parallel port for a printer; two serial ports for plotter and digitizer.
- VGA graphics system.
- Peripheral devices: laser printer; digitizer (capable of sending data as an ASCII string); plotter (HPGL).
- Mass storage devices for large data sets and system backup.
- UPS (uninterrupted power supply) recommended in areas of erratic power supply.

3.3 Software

- Operating systems: DOS and MS Windows.
- Word-processing systems: capable of working in, or exporting a simple ASCII file (ASCII characters 33-127), without control characters.
- Spreadsheet format: Lotus 1-2-3 (.WK1) format.
- Database management systems (DBMS): .DBF format of dBASE has become a de facto standard.
- Other supporting software packages: report writers; file compression utilities.
- Custom development: if funds are available; may make the organization's work process more efficient; documentation of the developed product is very important.

3.4 Future Trends

- LAN (Local Area Networks)
- Client/servers
- CD-ROM (compact disc-read only memory)
- GIS (Geographical information systems)

3.5 Reference

- TECDOC: Section 2.
4. GUIDELINES TO DATABASE SYSTEMS

4.1 Definitions

- **Database** is an organized set of related data that is drawn together to fit defined needs.
- **Database management system** (DBMS) consists of a database and a set of programs to access the database. It provides a structured environment that is both convenient and efficient to use in storing, accessing and reporting data.
- **Database file** contains data with a particular theme.
- **Record** all the data for a particular entry.
- **Field** is an item of information within a record.
- **Database structure** defines a database file.
- **Database key** uniquely identifies the sites of each record.
- **Data dictionary** contains details of the structure of the database, definitions of the contents of each field and listings of acceptable entries for fields of explicit content.
- **External interface** is defined as the mechanism in which the user captures or enters the data.
- **Data model** describes data and a set of operations used to manipulate that data.

4.2 Data Models

A notation for describing data and a set of operations used to manipulate that data.

**Hierarchical:**
- Tree-structured diagram
- Record replication

**Flat-File:**
- Spreadsheet style
- Single table
- Simplicity and portability
- Example: geochemical sample database

**Relational:**
- Data in multiple files
- Complex data management
- Discrete and manageable units
- Flexible; easily modified
- Example: field geology database

**Entity-Relationship:**
- Entity is a distinct object
- Relationship is an association among several entities
- Primary key is assigned to each entity
- Increased data integrity
- Easier future modification
- Enhanced performance capabilities
- Example: mineral deposit database

4.3 Database System Design

- Base on an organization's **business objectives**, functions and processes, and its **available resources**.
- Conduct a **system study** to help identify **requirements for users** and implement a process to achieve efficient access to, and manipulation of, data.
- Use a **data classification hierarchy** to described data according to subject area and group.
- **Good design techniques** will include data modeling, data flow diagrams and normalization.

4.4 Conventions and Standards

- Store data in **ASCII** (American Standard Communication Information Interchange) format.
Lotus 1-2-3 (.WK1) and dBASE (.DBF) formats are recommended.

4.5 Database Administration

- Objective to maintain a standard, structured and secure database.

- **Data acquisition**: collecting, managing and modifying data.
- **Data integrity**: detect errors; provide logic and range checks.
- **Data currency**: data values are reconfirmed or updated within an appropriate time period.
- **Data access control**: granting of permission for the creation, retrieval, use, modification and disposal of data.
- **Data custodianship**: designation of a functional responsibility for the creation, integrity and maintenance of data.
- **Data links**: interchange with diverse applications and needs.

4.6 Project Staffing Qualifications

- Understanding of computerized database concepts, model and design.
- Understanding of geoscience data acquisition, data elements and their relationships.
- Ability to design computerized databases using a widely available database management system.
- Ability to access, retrieve, and transfer data.

4.7 Database Documentation

**Components of Document Planning:**

- User-needs analysis
- Purpose, scope and contents of documentation
- Document specification
- Work plan
- Organization (menu hierarchy, topic or function)

**Types of Documents:**

- Training documents (user manuals, tutorials and quick reference cards)
- Reference documents (technical programmer notes)
- Marketing documents (descriptive brochures)

4.8 Reference

- TECDOC: Section 3, Figure 1, 2.

Larry D. Jones; January 11, 2008; PROCEED.DOC
5. GEOSCIENCE DATABASES

5.1 General

- **Master database** is the directory or index of all the databases in an organization.
- **Specific or theme databases** include: bibliographies; indexes on geological, geophysical and geochemical maps; air photography index; drill hole index; mineral deposit data; and exploration information, including drill hole, geophysical, geochemical and field data.
- Many of the databases follow a **multi-level model**.
- **First-level** or first-order database contain general information on common data observations, such as location of an activity or deposit, who did the work, commodities present and primary references.
- **Second- or third-level** database will provide more detailed information of the subject data.
- Organize and record data in a **systematic and consistent** manner, according to standards.

5.2 Master Database Example

Name of data set, Acronym:
- Responsible organization
- Purpose and description
- Keywords

Location:
- Lat. min - Lat. max; Long. min - Long max
- Coverage and scales

Data form:
- Positional Accuracy
- Time span
- Data quality and access
- User Base

Host computer:
- Operating system
- Data Structure
- Set size
- DBMS used
- "GIS" Software
- Output formats and Output media

5.3 Example of British Columbia Geoscience Databases

**Assessment Report Indexing System**

ARIS is a relational database that is an index and an administrative tracking system to the Geological Survey Branch's Mineral Assessment Report Library of more than 22,000 reports. Approximately 1000 new reports are added annually. The database is used to display the distribution of exploration and development activity and for research and mineral potential projects. A group of fields for each Assessment Report are extracted in 8 ASCII files from the VAX mainframe to diskettes. This data may be used on the PC within database management and small mapping projects using QUIKMap software.

<table>
<thead>
<tr>
<th>Host computer:</th>
<th>VAX Mainframe; PC</th>
<th>Operating system:</th>
<th>VMS; DOS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data model:</td>
<td>Entity-relationship</td>
<td>DBMS:</td>
<td>SUPRA; ASCII; dBase</td>
</tr>
<tr>
<td>Data size:</td>
<td>22000 records; 70 MB</td>
<td>Number of files:</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Fields per record (maximum/average): 60/40.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
COALFILE

COALFILE contains summarized coal assessment reports dating from 1900, submitted by exploration companies in compliance with the Coal Act. The data is organized in six related files - Explore, Comment, Map, Trench, Bulk and Borehole. There is a 3-year confidential period for coal exploration assessment reports and only non-confidential data is publicly available. Distribution policy and administration of the database is currently being established.

Host computer: PC  
Operating system: DOS  
Data model: Relational  
DBMS: dBase  
Data size: 8025 records; 3 MB  
Number of files: 6  
Fields per record (maximum/average): 171/78.

NTS Bibliographic Index

Bibliography of BC Geological Survey publications, including author, title, type of publication and map area. The data file is used to publish a map location and author index.

Host computer: PC  
Operating system: DOS  
Data model: Flat-File  
DBMS: dBase  
Data size: 2800 records; 10 MB  
Number of files: 1  
Fields per record (maximum/average): 5/5.

B.C. MINFILE

MINFILE contains over 11,000 metallic, industrial mineral and coal occurrences for B.C. Each of these occurrences contain 84 data elements describing mineral deposits in terms of geography, geology and economics. The database is used by government, industry and academia for resource management, land-use planning, exploration and research. MINFILE/pc, Version 3.0, a menu-driven data-entry, search and report program for IBM-compatible computers, accesses the database. An exploration and development module is currently in development.

Host computer: PC  
Operating system: DOS  
Data model: Entity-relationship  
DBMS: MINFILE/pc; FoxBASE+/FoxPro  
Data size: 11300 records; 60 MB  
Number of files: 69  
Fields per record (maximum/average): 84/46.

PROPERTY FILE

PROPERTY FILE is a library of research material on the mineral occurrences contained in the MINFILE database. The FILE contains news clippings, field notes, company prospectuses, and historical maps, photographs and documents. The FILE is used by government, industry and academia for research. The public has access to view these paper files.

Geological Field and Analytical Data
(Geological Database System)

A dBase relational database contains locations for stations in UTM coordinates, structural measurements, alteration codes, mineralization, rock type and map unit, lists of fossils, age dates, geochemistry and isotopic data. Areas have been mapped at 1:50 000 scale since 1986. Data is not being marketed; available as flat ASCII files on request by interested users.

Host computer: PC; Notebook PC  
Operating system: DOS  
Data model: Relational  
DBMS: GSB-GDS; dBase  
Data size: 30000 records; 20 MB  
Number of files: 15.
 Fields per record (maximum/average): **280/50.**

**B.C. METAL**

Acronym: BCMETAL

BCMETAL is the historical metal production database for British Columbia. It contains mine location and name, and metal production since 1888. BCMETAL is a proto-type software, written in FoxBase, that allows query by name, location (NTS and Mining Division), year of operation, and metal type produced. Total production for any mine, year or Division may be calculated.

Host computer: PC

Data model: Relational

Data size: 1452 records; 8 MB

Fields per record (maximum/average): 33/25.

**Regional Geochemical Survey**

Acronym: RGS

RGS database contains multi-element analytical determinations, sample location information, bedrock associations and field observations of over 38,000 stream sediment and water samples in British Columbia. The database is used for exploration and development activities; geochemical, metallogenic and environment studies; and mineral potential, resource management and land-use projects. Digital data are stored in standard ASCII format.

Host computer: MacIntosh; PC

Data model: Flat-File

Data size: 38000 records; 10 MB

Fields per record (maximum/average): 62/60.

**Petroleum and Natural Gas/Schedule of Wells**

Acronym: PANG/WELLS

The database contains geological and engineering data, plus production and reserve data, on all wells drilled for petroleum or natural gas in British Columbia.

Host computer: VAX Mainframe

Data model: Relational

Data size: 140 MB

**5.4 Example of U.S.G.S. Geoscience Databases and Software**

**MRDS - Mineral Resource Data System Contents**

- Record Number and Type
- Information Source
- Reporter and Affiliation, and Entry Date
- Site Type, Name and Synonyms
- Country, State, County and District/Area
- Primary Quadrangle and Scale
- Latitude And Longitude
- Commodities
- Production
- Deposit Type and Code
- Host Rock Name and Lithology
- Host Rock and Mineralization Age
- Tectonic Setting
- Associated Igneous Rock and Age
- Ore Minerals and Controls
- Non-Ore Mineralogy
- Deposit Description
- Comments
- Key Words
- References

**GSMAP and Associated Programs**
These programs are written for the IBM-PC and compatible microcomputers to assist workers in the Earth Sciences, in compilation and publication drafting of geologic maps and illustrations.

GSMAP is the main graphic program that creates the database to facilitate digital compilation of graphical elements. The program uses a digitizer and plotter for entry and plotting of digital data.

GSMUTIL is a utility program to process GSMAP databases in either geodetic or Cartesian coordinates. A digitizer and plotter are not required.

GSMEDIT is a screen edit program permitting editing of databases using either geodetic or Cartesian coordinates using the keyboard of the computer.

GSMPBLD uses a digitizer to select specific lines from an existing database and assembles these lines into closed polygons or into lines in an output database.

GSMPBS uses the screen display to select specific lines from an existing database and assembles these lines into closed polygons or into lines in an output database.

QUEIT is a plotting utility that uses the HPGL disk file generated by GSMAP to make plots.

GSMROSE is a program enabling construction of rose diagrams from linear data (lines or Polygon boundaries) in GSMAP databases to assist analysis of the trends of linear data.

GSSECT enables quick and accurate generation and plotting of the topographic profile for cross sections, and other profiles drawn from contour maps.

GSDIG makes use of a digitizer to determine geodetic (latitude, longitude) coordinates or Cartesian (X, Y) coordinates from maps or drawing and create ASCII character files containing site identifiers and geodetic coordinates (degree, minutes, seconds) or Cartesian coordinates in units from the drawing or digitizer units.

GSPPOST is a program that takes data from a properly formatted ASCII file and plots on the screen, on a plotter, or writes to a disk file in HPGL to make maps displaying information associated with geographic sites by drawing symbols and/or posting numerical.

GSLITH is a program designed to organize, store, and process data that define the "vertical" sequence of rock units at locations specified by latitude/longitude coordinates. It assists in the management of drill data; the drawing of sections and plan views; and the export of ASCII files for contouring.

5.5 References

- TECDOC: Sections 4.1, 4.2, Figure 3, Table 1, Annex 6.1.
- Selner and Taylor, see Bibliography.

6. EARTH SCIENCE INFORMATION DATABASES

6.1 Bibliographies

- **Published** geoscience material is collected systematically by several organizations on a global scale.
- A **thesaurus** is a guide to the usage of keywords (indexing terms), their hierarchical relationships and synonyms.
- **Unpublished** bibliographic data on geoscience material includes reports and maps in the archives of geological surveys and exploration and mining companies.

**Example of Data Elements for Unpublished Reports:**

- Title of report
- Name(s) of author(s)
- Name of source organization
- Name of report series
- Serial number or code of report
- Number or range of pages
- Notes on illustrations, appendices, maps
- Year of report
- Types and scales of maps in the report
- Language of report
- Subject keywords
- Geographic names
- Longitude/latitude
- Text of abstract
- Free field for comments
- Location of document
6.2 Indexes for Earth Science Information Databases

Data Elements for Geological, Geophysical, Geochemical and Topographic Map Indexes:

- Title and year of publication
- Name(s) of author(s)
- Name and address of organization that serves as repositories for data
- Name of report series
- Serial and number of publication
- Projection and scale of map
- Country and geographic area
- Area covered in square kilometers
- Longitude/latitude of the boundaries of map coverage and center of map
- Form of data release (hard copy: paper; digital: file type and size, media format, hardware and software compatibility)
- Availability
- Free field for comments

Data Elements for Air Photography Indexes:

- Listing of organizations that provide air photos
- Agency code
- Date of coverage
- Scale of photography
- Focal length of lens used
- Type of film
- Cloud cover
- Location, such as coordinates of the corners of each photograph
Data Elements of Drill Hole Indexes:

- Record number
- Name of organization or project
- Identification number
- Location
- Bearing and inclination
- Total length
- Location of drill core
- Location of drill hole log or report

6.3 References

- TECDOC: Section 4.3, Figure 3, Tables 2 - 3, Annexes 6.2 and 6.3.

7. MINERAL DEPOSIT DATABASE

7.1 General

- A mineral deposit database is an organized inventory of data related to mineral occurrences.
- A relational data model is functional, flexible and expandable.
- Use in a multi-level approach.
- Use standard codes.
- Rank multiple entries, such as the commodity, mineralogy and lithology fields, in decreasing order of importance.

7.2 Multi-level Approach

First-level Data Elements:

- Deposit identification number
- Deposit name
- Commodities or minerals present
- Point location, map area
- Administrative jurisdiction
- Geologic setting
- Current status or stage of development
- Deposit type
- Commodity economics
- Brief geological descriptions
- Primary references
- Name of the collector and date of input

Second-level Data Elements:

- Host rocks in terms of name, age, lithology and relationship to the economic minerals
- Size of deposit
- Regional structural-tectonic setting
- Economic, gangue and alteration minerals
- Reserves

Third-level Data Elements:

- Elevation & location accuracy
- Alteration type
- Deposit details
- Metamorphic type and grade
- Stratigraphic name and age
- Isotopic age, material dated and dating method
- Ore reserve category, year of calculation, quantity, grade and reference
- Year of production, ore mined, ore milled, quantity and reference
7.3 Data Codes (Entities or Tables)

- Keep the database small.
- Reduce errors on input.
- Help to speed up queries on the database.
- Provide the user with classification guidelines and choices.
- May be easily redefined, modified or expanded.
- Chose codes with meaning and flexibility.
- Use standard codes based on controlled vocabularies and global frequencies, such as commodities, rocks, mineral names and stratigraphic units.

7.4 Uses of a Mineral Deposit Database

- An inexpensive research tool by industry, academic researchers and government.
- Selection of areas for exploration or research projects.
- Assists in the analysis of the distribution of geology, metallogeny and mineral deposits.
- Mineral deposit distribution plots help select prospective areas for mineral potential.
- Land-use planning and mineral resource management.
- Data may be integrated into geographical information systems (GIS).

7.5 Mineral Deposit Database Project Management

- Budgeting, planning and staffing
- Database design and data dictionary
- Data acquisition and processing procedures (coding procedures)
- Software design, development and system testing
- Database administration and maintenance
- Documentation and manuals
- Designing and producing computer generated products for user's
- Marketing and distribution of data
- Training and client support
- New technology and future planning

7.6 B.C. MINFILE as an Example

**Overview of MINFILE:**

- MINFILE is the British Columbia Geological Survey's mineral inventory database management system.
- Contains information on over 11,000 metallic, industrial mineral and coal occurrences (showings to major producing mines).
- MINFILE/pc, a menu-driven data-entry, search and report program for IBM-compatible microcomputers, accesses the database.
- Data elements are organized with a set of codes (entities), within a relational database design (entity-relationship model).
- The MINFILE system helps provide solutions in mineral exploration, land-use planning and mineral resource management.
- MINFILE information may be used in other programs such as word processors, plotted using computer-aided mapping systems, and integrated with conventional geographical information systems.
- The database contains 69 files, with 96 fields and 84 data elements.
- 86 maps (1:250,000 or 1:100,000 scale) cover 950,000 square kilometres.
MINFILE Data:

- Location
- Commodity
- Mineralogy and alteration
- Geological setting
- Lithology and host-rock name and age
- Deposit class and character
- Assays, reserves and production, and reserves
- Textual geological description (capsule geology)
- Bibliography, citing information sources for the occurrence

The MINFILE/pc Program:

- 12 menu-driven **searches** on a variety of exploration and geological parameters.
- 12 high quality **reports** on the search results.
- **Data-entry** has a pull-down and pop-up interface for changing, updating and appending data.
- **Utility functions** assist in configuring the database, exporting and importing data, and maintaining the system.
- **Code table maintenance** allows the users to add, delete and modify the contents of the various codes and tables.
- The province wide database of over 11 000 occurrences currently occupies **60 megabytes** of space.
- Data are distributed in **ASCII files**, which are configured into searchable database (**dBASE**) files.
- **Programming language and software**: FoxBASE+/FoxPro, R&R Relational Report Writer, automatic table look-up (Proximity Technology Inc.), data compression (PKZip by PkWare Inc.).
- **Supporting documents** include a coding manual, a user's manual and technical manuals.

Products, Distribution and Support:

- Mineral location maps, with topography and geological base (1:250,000 or 1:100,000 scale)
- Paper print-outs of indexes and complete reports
- Data disks (map areas, provincial, commodity open files)
- MINFILE/pc software
- Coding and user's manuals
- Custom searches, reports and data
- Talks, workshops and help desk
- Over 400 users
- MINFILE technology and program are marketed for sale world-wide

7.7 References

- TECDOC: Section 4.4, Figure 3, Tables 9-12, Annexes 6.4.
8. EXPLORATION DATABASES

8.1 General

- Exploration projects generate most or all of the **detailed geologic information** in an area of interest.
- Exploration project databases contain **collected data**, such as field measurements, and calculated data, such as analytical work on samples.
- Data **presentation methods** help to evaluate regional trends and locate anomalies.
- **Good record keeping** and **proper indexing** are essential if the raw data is to be reinterpreted at a later time.
- **Modeling and interpretation** methods help to filter, reduce or enhance data.
- **Data-sets are grouped** according to the type of work performed, commonly prospecting, geological, geophysical, geochemical, physical and drilling.
- Global Positioning Systems (**GPS**) are useful for accurately locating sample sites.

**Typical Contents of Exploration Database:**

- Title of project
- Jurisdiction
- Location (longitude/latitude)
- Project Type (major, minor)
- The managing company or organization
- The name, address and telephone of the project coordinator or manager
- Date and type of work done
- Exploration budget and cost of the completed exploration program
- Notes on pertinent information such as geological descriptions, plans for the following year, assays, references, etc.

8.2 Drill Hole Data

**Contents:**

- Drill hole name, collar location and elevation, and total length of hole
- Downhole survey data
- Lithological descriptions or stratigraphic units
- Sampling and assay data

**Drilling Types:**

- Becker hammer, churn, diamond - surface, diamond - underground, overburden, percussion and rotary.

8.3 Geophysical Data

**Contents:**

- Surveyor
- Instruments used
- Analog or digital records
- Area covered
- Station location
- Data measurements and calculations dependent on geophysical method
Geophysical Types:

- Dip needle, electromagnetic - airborne, electromagnetic - ground, gamma ray spectrometer - airborne, gamma ray spectrometer - ground, gravity, induced polarization, infra-red, magnetic - airborne, magnetic - ground, mise-a-la-masse, radar, radiometric - airborne, radiometric - ground, radiometric - drill hole probing, radon gas scintillometry, resistivity (alone), scintillometer - airborne, scintillometer - ground, seismic, self potential.

8.4 Geochemical Data

Contents:

- Source of geochemical data
- Sample number
- Location of sample site, elevation
- Sample material (sediment, soil, water)
- Site information (stream parameters, rock type, sample description)
- Analytical values for each sample

Geochemical Types:

- Biogeochemistry, fission track etch, heavy minerals, metallurgic, rock, sampling/assaying, silt, soil, water.

8.5 Field Data

Recommended Features for a Field Data System:

- Easy retrieval, sorting and manipulation of field data to assist in map compilation and plotting.
- Ability to create page size to map size plots at any scale.
- Ability to retrieve data and create reports and tables.
- Consistency in the way field data is collected and reported.
- Geologic databases created can be incorporated into a GIS and automated map plotting system.
- Ability to use dBASE files that are related to each other by station number.

Contents:

- Station location, longitude/latitude, traverse, map area
- Structural measurements
- Mineral occurrence data
- Rock types and alteration data
- Descriptive notes
- Analytical results of geochemical data
- Radiometric age dates
- Fossil name and age
- Isotope analyses
- Photo number
- Petrographic data
- Date and coder
Field Data Types:

- **Geological**: geological, petrographic, photo.
- **Physical**: legal surveys, line/grid, pits, reclamation, road, local access, stripping, topographic/photogrammetric, trail, trench, underground development, underground surveys.

8.6 References

- TECDOC: Section 4.5, Figure 3, Tables 13, 14, Annexes 6.5.

9. BIBLIOGRAPHY


TAYLOR, Richard B., SELNER, Gary I. and JOHNSON, Bruce, R., GS MRDS - A System Based on the Data Fields Used in the National MRDS System but Using dBASE III and a Microcomputer (IBM PC or


The Strategy and Philosophy in Mineral Resources Databases

OUTLINE:

Introduction
Why, How, When, Where, What, Who
The Mineral Exploration and Development Cycle
Organization of Earth Science Data
Master Database - Data Dictionary
System Planning - System Cycle
An Approach to Integrated Data Management
Summary

References:
TECDOC Section 4.1, 4.2, Figure 3
Green, Bill, 1991, Exploration with a Computer

Lecture 5 by:
L.D. Jones, May 11, 10:00-11:00
An Approach to Integrated Data Management

CHALLENGES:

• successfully integrate the various databases and mapping systems in a way that facilitates exchange of data for broader purposes.

• maintain information in a manner which promotes data integrity and rapid retrieval.

DATA ISSUES - DATA MODELS:

• originally recorded on paper.

• transferred into digitally based systems.

• data model must be constructed that provides the organizational layout of the data.

• must serve the needs of the business application that surrounds the data.

• many databases evolve in which model construction is minimal.

• ad hoc database construction which occurred as technology developed.
An Approach to Integrated Data Management

TECHNOLOGY MANAGEMENT ISSUES:

- development and maintenance of data requires human resources.
- local and central responsibility of systems.
- database managers and administrators.
- routine and specialized maintenance - backups, programming.
- inconsistencies, errors, corruption of data, and eventual abandonment of the databases and applications will result.
- focus on future developments and planned migration strategies.
- data static if it is collected and managed in a consistent framework.
- data considered to be dynamic (changing in its nature, structure, and application) if collected and evolved over time.
- requires a strategy that will work towards keeping data relevant and manageable.
An Approach to Integrated Data Management

PROCEDURE:

• establish Business Case and Plan strategy.

• coordinate implementation with the custodians of the databases.

• review and recommend, where necessary, upgrading of databases.

• manage and coordinate the exchange of data.

DATABASE COMPONENTS:

• data model.

• administration.

• project staffing.

• documentation.

• database directory.
An Approach to Integrated Data Management

DATABASE COMPONENTS:

- data model.
- administration.
- project staffing.
- documentation.
- database directory.
An Approach to Integrated Data Management

- Challenges
- Data Issues - Data Models
- Technology Management Issues
- Procedure
- Database Components
Some Whats:

- mineral resources are unevenly distributed throughout the earth's crust.
- most countries enjoy some mineral endowment.
- many have a mining history dating back hundreds of years.

Some Whys:

- few countries have a well-organized, comprehensive and easily accessible source of historic mining and geological data relating to the nature and distribution of their mineral resources.
- such information is the starting point in the search for new orebodies.
- readily accessible databases are essential for effective management of the existing resource and invaluable tools in the search for new orebodies.
- add to the country's resource base.
- stimulus to mineral exploration leading to the discovery of new mineral deposits.
- development of new mines.
- contributes to the creation of new wealth by developers, workforce, and public treasury (profits, wages, and taxes).

Some Hows

- effective management of mineral resources requires a knowledge of the nature of the resources to be managed, their dimensions, where they are located, their current status, and many other factors.
- Earth Science Databases - compile and update this information.
THE MINERAL EXPLORATION AND DEVELOPMENT CYCLE

Mineral Exploration Program Observations and Strategy:

- detailed geological information will be collected during the life of the operation.
- these data are invaluable in the search for new orebodies in the same district and in other areas with similar geological setting.
- data are often lost if the project is abandoned.
- drill core and logs, assays, geophysical results, geological maps, mine plans and engineering reports may be buried in private files or may even be lost or destroyed.
- if the information is stored in a database where it can be readily retrieved and analyzed, it may lead to fresh insights and new ideas that rekindle interest in the project.
- new geological concepts, the availability of new technology, an increase in commodity prices or improved transportation may reactivate an old mining area.
- easy access to historical and current geoscientific data, which is gathered at great expense and sometimes is not reproducible, will be of benefit to new investors, which in turn will stimulate and promote mining exploration in an area.
Philosophy of Mineral Exploration Programs:

- mineral exploration and mine development ventures involve a high level of financial risk.
- information gathered at each stage of a project lead to increased confidence of discovering and developing an orebody.
- if the data gathered at each stage of a project is accurate and complete lower risk factors are involved.

Stages of Mineral Exploration Programs:

- first stage of exploration is the choice of area, which is generally based on analysis of available geoscience data from general surveys and previous exploration effort.
- ready access to this type of information will simplify the task and greatly increase success
- subsequent stages include geophysical and geochemical surveys, detailed geological mapping and drilling and underground work.
- costs increase at each stage, as do the spin-off economic benefits.
- information generated must provide the justification for continuing to the next stage.
- final stage - ore reserves exhausted and mine closes.
- portion of the profits will be allocated to the search for new orebodies and the exploration and development cycle will be repeated.
System Planning - *Data and System Goals*

- quick and easy access to data
- detailed, high quality information
- data available in a wide variety of forms, such as custom and standard reports, and digital files for incorporation into other programs
- systematic management of data elements to improve data integrity and validity
- an established methodology for the distribution of data
- allow the database to grow with increased requirements
- efficient and flexible model
- establish common data formats and system capabilities
- define links to geographical information systems
- implement a modern user-interface based on the latest technology
- standardize tables and definitions (e.g. commodities and work types)
- a versatile data dictionary will permit customized data content
System Planning - System Cycle

- establish business objectives and desired output
- scope document, user-requirements, fitting analysis (content and system)
- detailing the proposal, with an action plan and resources required
- budgeting and project team selection
- user-needs analysis and design details
- project schedule and detailed implementation plan
- develop universal tables, establish regional flexibility
- chose application development software and acceptable user-interface
- produce a PC-based application
- system testing and documentation
- user acceptance and evaluation
- marketing, distribution, training and support
Development and Evolution of a Database Management System, a Canadian Example

OUTLINE:

Introduction
Setting of Ore Deposits in British Columbia
B.C. Geological Survey Databases
Integration of Databases - Mineral Potential Maps
System Plan Development - Example
Summary

References:
TECDOC Section 4.2, Annex 6.1

Lecture 7 by:
L.D. Jones, May 11, 14:00-15:30
Data Integration/Management Unit

It is proposed that the Division establish a distinct Data Integration/Management Unit. This unit will address the issues discussed above as well as fulfilling 3 main objectives:

1. To provide an efficient and standardized means of producing maps using GIS technology. This will be achieved through the coordinated integration of databases and map data such that thematic maps and reports can be generated for specific applications. This will result in a dynamically-based system that can generate maps and reports critical for land-use issues, and will also provide thematic reports and maps imperative for mineral resource appraisal.

2. To provide a powerful, centralized land information management tool for the Geological Survey Branch databases such as Regional Geology, MINFILE, ARIS, Coal file and Regional Geochemistry, Mineral Titles, Notices of Work, Mineral Policy. These databases would exist in various formats which serve the needs of the project/programs that require them. The system will eventually comply with the SAIF (Standard Archive and Interchange Format) format which meets the specifications of the Land Information Infrastructure and would not duplicate existing databases. The following requirements will also be supported:
   - compliance with the Division requirement to implement an across-the-board integrated data management strategy that fulfills the requirements of the LII;
   - compliance with the requirement to carry out the mineral resource assessment program under the Corporate Resource Inventory Initiative (CRII);
   - addressing the need for an upgraded geoscience data and map inventory, management and analysis system;
   - providing compatibility with the publication standards for the Division;
   - satisfying Land Use Assessment requirements;
   - compliances and compatiblility with the Corporate Land Information Strategic Plan.

3. To provide an electronic link with the LII (Land Information Infrastructure) that will enable on-line exchange of land information data in SAIF format between the Division and other ministries. This will be developed in Phase III of the implementation of the LII. Data will be captured from two main sources. External data such as radiometric or aeromagnetic data will be captured using formats required or defined from the external source. This data will be imported into the GSB GIS using a number of different translators. Data derived from other BC government sources will eventually be captured via the Land Information
Infrastructure using a common set of standards that will be defined using the Standard Archive Interchange Format (SAIF). GSB mineral potential products will also be made available through the LII.

**Data Dissemination within the GSB**
Data dissemination can be achieved through networked PC and Workstation platforms by accessing a centralized database containing the core databases and integrated products. Through the use of a client-server architecture, data can be captured and managed on the server, while being accessed and analyzed on clients. The Data Integration Unit would act as the central server for the data.

**Planned Migration Strategy**
In order for the Division to comply with the LII and build a comprehensive and spatially linked database structure, it must plan an implementation and migration strategy. This strategy consists of:

- constructing and coordinating data models of all the databases within the Division that are intended to be part of the LII;
- create a plan of database linkages across the Division;
- on the completion of database lifecycles, each database should be re-engineered to conform with Division GIS linkage requirements and the LII.

This strategy requires a team of personnel comprised of those responsible for development and/or management of the various databases within the Division, and would be coordinated by the Data Integration Unit along with ISB. This team would led by a Division representative who is familiar with the LII and the goals and database structures of the Division. This team would coordinate the transition of databases to the proposed data model structure within the Division.
Guidelines to Database Systems

OUTLINE:

Introduction
Definitions
Data Models
Database System Design
Standards
Database Administration
Database Documentation

References:
TECDOC Section 3

Lecture 10 by:
L.D. Jones, May 12, 9:00-10:00
Definitions

- **database** is an organized set of related data that is drawn together to fit defined needs.
- **database management system** (DBMS) consists of a database and a set of programs to access the database. It provides a structured environment that is both convenient and efficient to use in storing, accessing and reporting data.
- **database file** contains data with a particular theme.
- **record** all the data for a particular entry.
- **field** is an item of information within a record.
- **database structure** defines a database file.
- **database key** uniquely identifies the sites of each record.
- **data dictionary** contains details of the structure of the database, definitions of the contents of each field and listings of acceptable entries for fields of explicit content.
- **external interface** is defined as the mechanism in which the user captures or enters the data.
- **data model** describes data and a set of operations used to manipulate that data.
Earth Science Information Databases - Their Elements and Functions - Part II

OUTLINE:

Introduction
Codes and Key Terms
Published Systems - GEOSCAN, GEOREF
PC-based Systems - PROCITE
Un-published Systems - GSB Index, ARIS
Summary

References:
TECDOC Section 4.3, Annex 6.2

Lecture 12 by:
L.D. Jones, May 12, 11:15-12:15
SCREEN FORMAT for inputting data to
NTS & Author Index of British Columbia publications

AUTHOR(S): XXXXXXXXXXXXXXXXXXXX
INITIALS XXXXX
YEAR XXXX
NTS a XXXX
MAP XXXX

AUTHOR(S): XXXXXXXXXXXXXXXXXXXX
INITIALS XXXXX
YEAR XXXX
NTS b XXXX
MAP XXXX

AUTHOR(S): XXXXXXXXXXXXXXXXXXXX
INITIALS XXXXX
YEAR XXXX
NTS c XXXX
MAP XXXX

TITLE: XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

AGENCY: XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
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VOL.NO: XXXXXXXXXXXXX
PAGE(S): XXXXXXXXXXXXXX
MAP: XXXXXXXXXXXXX
SCALE: XXXXXXXXXXXX

MAP AREA: XXXXXXXXXXXXXXXXXXXXXXXXXXX

STILL IN PRINT? X (Y/N)
MAJOR REFERENCE? X (Y/N)

KEYWORDS:

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XXXXX XXXXXX XXXXX XXXXXX XXXXX XXXXX XXXXXX XXXXX

LIB.CONG.#: XXXXXXXXXXXXX
ISSN #: XXXXXXXXXXXXX

Use [Cntl-End] when input complete
## EXAMPLE OF LOCATION & AUTHOR INDEX

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** Total ** 1428

B.C. ASSESSMENT REPORT INDEXING SYSTEM (ARIS)

- a library of over 22,000 assessment reports dating from 1947
- reports of assessment submitted by the mineral industry under the Mineral Tenure Act in order to maintain claims in good standing
- $56 million dollars of exploration work submitted in 1990
- information contained in the reports is a valuable reference and research tool for mineral exploration, academic studies and resource management

Assessment Report Indexing System (ARIS) designed to assist in processing a rapidly mounting volume of assessment report administration and data management.

ARIS Database

- The ARIS system modelled after the MINFILE (Mineral Inventory File)
- The database design uses an "entity-relationship" model comprised of codes (entities), with interrelated tables of data containing common assessment report numbers
- ARIS database resides on a mainframe computer and could easily be ported to a PC-based system.

Present Functions of ARIS:

1. Data capture
2. Administration and maintenance
3. Inquiries (ad hoc and pre-programmed)
4. Distribution functions
1. Data Capture (ARIS)

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<tr>
<td>1) General Data (locational)</td>
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<td>2) Names (author owner operator)</td>
</tr>
<tr>
<td>3) Geological Summary</td>
</tr>
<tr>
<td>4) Keywords</td>
</tr>
<tr>
<td>5) Work Data</td>
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<tr>
<td>6) Approval Information</td>
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<tr>
<td>7) Amend/Reject Information</td>
</tr>
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2. Administration and Maintenance (ARIS)

Reports

1) Tables Report
2) Name & Address Table Report
3) NTS Map Index
4) ARIS Summary Sheet
5) Off Confidential Report
6) Status Report by NTS Map
7) Letters (approval, amend, rejection)
8) File to Produce Map List

Table Maintenance

1) Mining Camp Codes
2) Mineral Act Regulations Code
3) Date Codes
4) Commodities
5) Mining Divisions
6) NTS Mapsheet Names
7) Specific Work Types
8) General Work Types
9) Name & Addresses
10) Name Types
11) Keywords

System Maintenance

1) System Error Message Maintenance
2) System Error Message Inquiry
3) Prompter (Help) Maintenance
3. Inquiries (ARIS)

Inquiries

1) Claim Name
2) Owner Operator Author Name
3) Property Name
4) Mining Division
5) NTS (National Topographic System) Mapsheet
6) MINFILE Number
7) Latitude/Longitude

4. Distribution Functions (ARIS)

- contributor to GEOSCAN, a federal-provincial cooperative program. GEOSCAN is a computerized bibliographic index to geological information dealing with the Canadian landmass, and offshore areas
- produces diskettes in GEOSCAN compatible format.
- perform searches to interested clients free of charge
- complete assessment report libraries on microfiche
- copies of reports can be ordered
- ARIS available on paper, microfiche and computer diskettes. The index provides latitude, longitude, UTM co-ordinates, claim names, operator, author, type of work reported and report year. Available 14 ASCII files to facilitate access by a variety of commercial software programs, such as database management and plotting packages
- 90 index maps mainly at a scale of 1:250 000
Mineral Deposit Databases

OUTLINE:

Introduction
Data Codes, Structure and Elements
USGS Example
MINFILE Example
  What is MINFILE
  Brief History
  Data Model
  User Examples
  MINFILE/pc
  Products and Distribution
Summary

References:
TECDOC Section 4.4, Annex 6.4

Lecture 15 by:
R.B. Taylor and L.D. Jones, May 13, 9:00-12:00
Example of first-level mineral deposit data.

Structure for database:  C:\MINDEP\MINDEP1.DBF
Number of data records:  300
Date of last update:  07/07/91

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** Total **  163
Example of second-level mineral deposit data.

Structure for database: C:MINDEP\MINDEP2.DBF
Number of data records: 300
Date of last update: 07/07/91

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Example of third-level mineral deposit data.

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## Code table example

**FILE NAME: STATUS_C**

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<th>EXPLANATION</th>
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<td>Showing</td>
<td>A showing or occurrence with identified mineralization.</td>
</tr>
<tr>
<td>PROS</td>
<td>Prospect</td>
<td>A showing with development and unknown resources.</td>
</tr>
<tr>
<td>DEPR</td>
<td>Developed prospect</td>
<td>A prospect pending an economic evaluation.</td>
</tr>
<tr>
<td>ECDP</td>
<td>Economic deposit</td>
<td>A developed prospect with recoverable ore.</td>
</tr>
<tr>
<td>MINE</td>
<td>Active mine</td>
<td>A producing mine.</td>
</tr>
<tr>
<td>MINR</td>
<td>Inactive mine</td>
<td>An inactive mine with resources remaining.</td>
</tr>
<tr>
<td>MIND</td>
<td>Depleted mine</td>
<td>A mined-out or depleted ore deposit.</td>
</tr>
</tbody>
</table>
Mineral Exploration Databases

OUTLINE:

- Introduction
- Organization of Data and Codes
- Exploration and Development - MINFILE example
- Drill Hole Data
- Geochemical Data - RGS example
- Field Data - GSB-GDS, GEOF examples
- Summary

References:
TECDOC Section 4.5, Annex 6.5

Lecture 17 by:
L.D. Jones, R.B. Taylor and M. Tauchid, May 14, 9:00-12:00
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Drill Hole Data

- four tables
- connected with a unique key (HOLE-ID)
- ASCII or spreadsheet format

1. Drill hole name, collar location and total length of hole
2. Downhole survey data
3. Lithological descriptions
4. Sampling and assay data

Examples of tables:

**Table 14a: Header**

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