AGSO

USERS' GUIDE TO PETROG: AGSO'S PETROGRAPHY DATABASE

by R J Ryburn, J Knutson, M B Duggan, L D Bond & M S Hazell

Record 1994/36

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AUSTRALIAN GEOLOGICAL SURVEY ORGANISATION

CANBERRA

DEPARTMENT OF PRIMARY INDUSTRIES AND ENERGY

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ISSN: 1039-0073
ISBN: 0 642 21239 2

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ABSTRACT

PETROG, AGSO's Petrography Database, is a relational computer database of petrographic data obtained from microscopic examination of thin sections of rock samples. The database is designed for petrographic descriptions of crystalline igneous and metamorphic rocks, and also for sedimentary petrography. A variety of attributes pertaining to thin sections can be recorded, as can the volume proportions of component minerals, clasts and matrix.

PETROG is one of a family of field and laboratory databases that include mineral deposits, regolith, rock chemistry, geochronology, stream-sediment geochemistry, geophysical rock properties and ground spectral properties for remote sensing. All these databases rely on a central Field Database for information on geographic location, outcrops and rock samples. PETROG depends, in particular, on the Field Database's SITES and ROCKS tables, as well as a number of lookup tables of standard terms. 'ROCKMINSITES', a flat view of PETROG's tables combined with the SITES and ROCKS tables, allows thin-section and mineral data to be accessed from geographic information systems and plotted on maps.

This guide presents an overview of PETROG's infrastructure and describes in detail the menus and screen forms used to input and view the data. In particular, the definitions of most fields in the database are given in some depth under descriptions of the screen forms - providing, in effect, a comprehensive data dictionary of the database. The database schema, with all definitions of tables, views and indexes is contained in an appendix to the guide.

1 - INTRODUCTION

Petrography is the microscopic study of rocks - usually in the form of thin transparent slices, known as thin sections, that are only 40 microns thick. A geologist unable to classify a rock in the field will often conduct a later laboratory examination of a thin section of the rock under the microscope. In this way the mineral composition, microscopic structure and something of the history of the rock can generally be ascertained. Although less amenable to numerical analysis, petrographic information on rocks is often of equal or greater importance to the geologist than whole-rock chemical analyses.

Over many years AGSO geologists have accumulated tens of thousands of petrographic descriptions - mostly written on cards. PETROG is intended to replace these time-honoured cards with an on-line information system that gives instant access to all petrographic descriptions within the Australian continent (and some without). It can be used equally well for results from mineragraphy, the study of polished sections or rocks and ores in reflected light. The database is designed to mesh with geographic information systems (GIS) and other graphical or analytical software. Thus, the distribution and abundance of rock-forming minerals can be plotted with the help of a GIS such as Arc/Info, or graphed directly from the database with the help of Microsoft Excel, or some other graphing package.

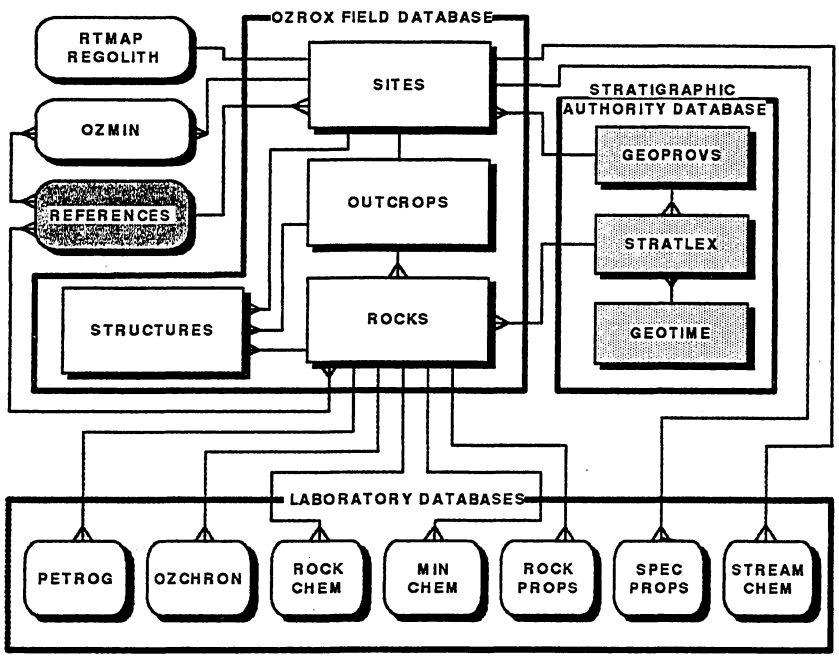

Figure 1. Simplified Structure of AGSO's Geological Database System.

PETROG is one of a number of field and laboratory databases that make up AGSO's Geological Database System (Figure 1). ROCKCHEM, for example, is a laboratory database of rock chemistry (Ryburn, 1990) that shares field and sample information with PETROG. So

does OZCHRON, the database of Australian Geochronology (Ryburn *et al.*, 1993a). Other databases such as OZMIN, AGSO's database of Australian Mineral Deposits, tap into the point location information (SITES table) in the OZROX Field Database. Comprehensive information on the rock samples and their locations also reside in OZROX, which is described in detail in the user's guide to that database (Ryburn *et al.*, 1993b). However, brief accounts of the parts of the Field Database that are critical to PETROG are also included here. All databases currently run on the Oracle 6.0 relational database management system (RDBMS) under UNIX 5.4 on AGSO's DG AViiON 6240 computer, and are accessible from all PCs, terminals and workstations on the AGSO Ethernet network.

This guide describes the infrastructure of PETROG, including all screen forms, report programs and definitions of all fields, views and tables. For information on the AViiON server, network, AGSO's Oracle environments and the use of SQL*Plus, SQL* Forms, etc., see the 'Users' Guide to AGSO's Oracle Database System' (Lenz *et al.* 1993).

2 - STRUCTURE OF THE OZROX FIELD DATABASE

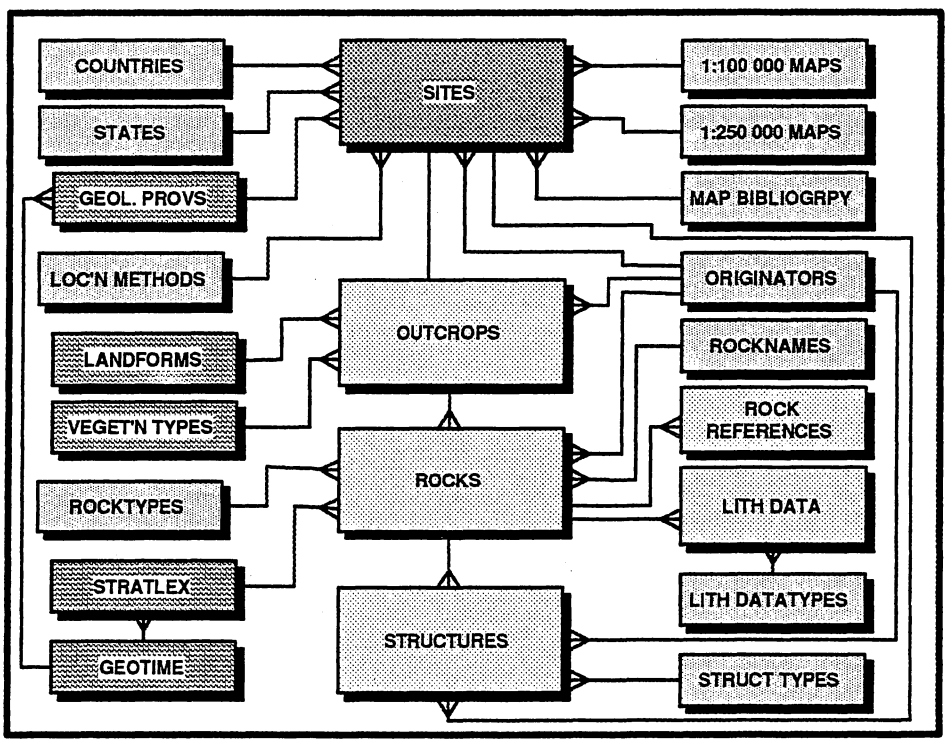

Figure 2. The structure of the OZROX Field Database showing relationships between tables with 'crows' feet' at the 'many' end of many-to-one links. The authority table labels emphasise function and are not necessarily actual table names (see below).

OZROX has five main data tables - SITES, OUTCROPS, ROCKS, LITHDATA and STRUCTURES - of which SITES and ROCKS are of particular interest to PETROG. These tables are accessed via the Sites and Rocks screen forms, which are briefly described later in this guide (see sections 7 and 8). Most of the other tables in Figure 2 are lookup tables used to validate the classifications and nomenclature used in the main tables.

The main data tables in OZROX are owned by the Oracle user 'NGMA' (OZROX was formerly known as the NGMA Field Database. However, the ownership of various tables by 'NGMA' is too firmly embedded in numerous AGSO applications to contemplate changing). The ownership of all tables is indicated in the full table names by the prefix occurring before the decimal point. The contents of the main OZROX data tables are as follows -

TABLE NAME	CONTENTS
NGMA.SITES	ground sites location data, accuracy & lineage
NGMA.OUTCROPS	outcrop-related data, including drill holes
NGMA.ROCKS	rock samples and lithological data
NGMA.LITHDATA	extendable attributes for the ROCKS table
NGMA.STRUCTURES	mesoscopic structures at a site or outcrop
NGMA.ROCKREFS	bibliographic reference *versus* rock samples

In addition, the following views of the above tables allow ordinary users (as opposed to owners or custodians) to add, update and delete their own data - NGMA.USITES, NGMA.UOUTCROPS, NGMA.UROCKS, NGMA.ULITHDATA NGMA.USTRUCTURES and NGMA.UROCKREFS. There are also a number of authority tables and one view, not all of which belong to NGMA. Those of possible interest to PETROG users include -

TABLE OR VIEW	CONTENTS	CUSTODIAN
NGMA.ORIGINATORS	contributors of data	Murray Hazell
NGMA.AGSOCOUNTRIES	list of valid countries	Rod Ryburn
NGMA.AGSOSTATES	list of valid Australian States	Rod Ryburn
NGMA.QMAPS	Australian 1:250 000 map sheets	Murray Hazell
NGMA.HMAPS	Australian 1:100 000 map sheets	Murray Hazell
NGMA.LOCMETHODS	spatial location methods	Richard Blewett
NGMA.ROCKTYPES	basic classification of rock types	Lesley Wyborn
NGMA.LITHNAMES	lithological names	Jan Knutson
NGMA.LITHDATATYPES	extendable lithological attributes	P. Stuart-Smith
NGMA.AGSOMINERALS	mineral names	Morrie Duggan
NGMA.ROCKDATATYPES	view of lithdatatypes/agsominerals union	
STRATA.GEOPROVS	Australian geological provinces	D. Palfreyman
STRATA.STRATLEX	Australian stratigraphic names	Cathy Brown
STRATA.GEOTIME	geological time scale	John Laurie

As a general rule, only the designated custodians are permitted to change the data in these tables. Full definitions of all tables, indexes and views used by the OZROX Field Database are given in the appendix to Ryburn *et al.* (1993b).

3 - STRUCTURE OF PETROG

As indicated in Figure 3, PETROG consists of three main data tables and three validation tables. As its name implies, the central data table is THINSECTIONS, which holds one record for each thin section in the database. In addition to the many-to-one link shown to NGMA.ROCKS, THINSECTIONS is also tied to NGMA.SITES by the inclusion of a Site ID. TSATTRIBS is an extendable attributes table that allows a variable number of controlled attributes and values to be attached to each thin section. This is for attributes, such as alterations or texture, that apply to the section as a whole, rather than individual components. Note that several values of the same attributes may be entered - e.g., two different kinds of alteration. The third table, TSMINERALS is for the quantifiable components of a thin section - in crystalline rocks this means rock-forming minerals. In sedimentary rocks, though, each record is for classes of detrital grains, matrix, cement, etc.

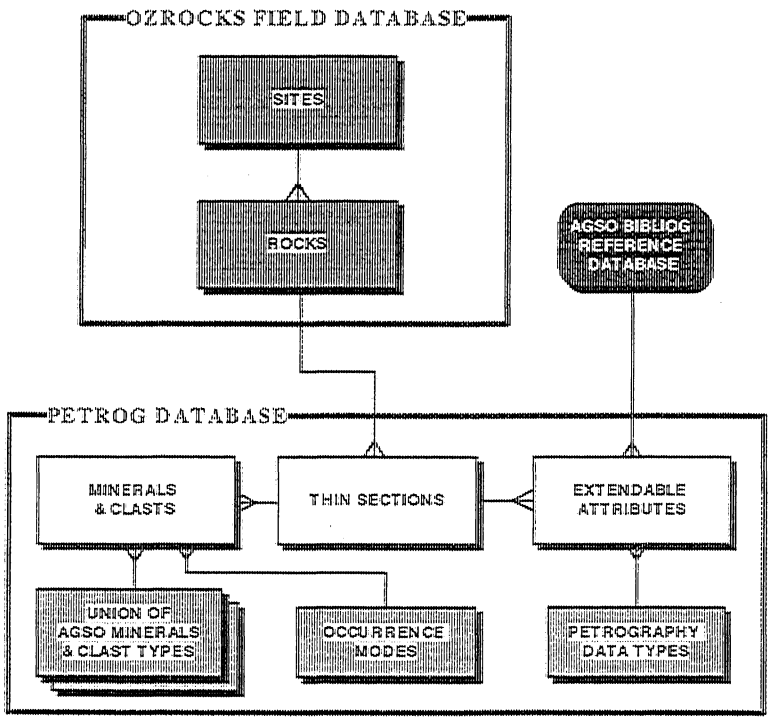

Figure 3. Structure of PETROG showing joins to OXROX tables and the Bibliographic Reference Database. The validation tables are lightly stippled. The 'many' end of many-to-one joins are indicated by 'crows feet'.

The validation or lookup tables shown in Figure 3 limit possible entries into the data tables to defined sets. The TSDATATYPES table validates entries into the TSATTRIBS table - only attributes and values listed in TSDATATYPES can be entered into TSATTRIBS. Entries into the TSMINERALS table are controlled by a view called TSMINCLASTS, which is a union of the validation table NGMA.AGSOMINERALS with the TSCLASTYPES table for detrital clast nomenclature. This emulates a single table listing clast types first, followed by mineral names. Not shown in figure 3 is the NGMA.ORIGINATORS table, which validates originators entered in THINSECTIONS. ORIGINATORS lists the names and numbers of all 'Originators' of rock samples. The Originator Number is an essential component to the identification of all sites and samples (see section 4) and is present with the Site and Sample ID in the THINSECTIONS table.

The tables used by PETROG and their contents are listed below. The Oracle owner of each table is indicated by the part of each table name before the 'decimal point'.

TABLE OR VIEW	CONTENTS
PETROG.THINSECTIONS	thin section data, including ID and rock name
PETROG.TSATTRIBS	extendable attributes of a thin section as a whole
PETROG.TSMINERALS	mineral or clast components of the thin section
NGMA.ORIGINATORS	list of valid originators for THINSECTIONS
PETROG.TSDATATYPES	list of valid attributes and values for TSATTRIBS
PETROG.TSMINOCCMODES	list of valid occurrence modes for TSMINERALS
PETROG.TSCLASTYPES	list of valid clast types for TSMINCLASTS
NGMA.AGSOMINERALS	list of valid mineral names for TSMINCLASTS
PETROG.TSMINCLASTS	union of AGSOMINERALS + TSCLASTYPES - a validation view for use with TSMINERALS
PETROG.ROCKMINSITES	view joining SITES, ROCKS, THINSECTIONS and TSMINERALS - for use by Arc/Info
PETROG.MAXTSNO	table for tracking TSNO in THINSECTIONS

Full definitions of all tables, views, grants and indexes belonging to PETROG are listed in the appendix to this guide. The custodian for TSDATATYPES, TSCLASTYPES and TSMINOCCMODES is Jan Knutson.

4 - SITE AND SAMPLE NUMBERING

Tables in PETROG and the OZROX Field Database maintain original site and sample 'numbers' with the help of an Originator Number (Origno). In most cases the sample number will be the same as the site number, perhaps with one or two appended letters to distinguish several samples at the one site, but ***sample numbers can be unrelated to site numbers.*** If all sites and samples were from AGSO, and had unique registered numbers, then the site and sample numbers would be sufficient on their own. However, AGSO databases also contain data provided by universities, State geological surveys, companies and private individuals, all of whom use their own numbering systems. The Originator Number is needed to preserve uniqueness amongst diverse numbering systems. Originator numbers are recorded against names in the NGMA.ORIGINATORS authority table.

The originator of a site or sample is the person or organisation primarily responsible for the data. This could be the person who observed the site or collected the sample, a laboratory worker, or an author of published results - someone who might reasonably be expected to know about the sample and its collection point, and perhaps be able to supply further information. Note that the name of the Originator is recorded only once in the database. All other references to the Originator use the Originator Number, which is listed against the name in the NGMA. ORIGINATORS table.

A site in the SITES table is fully identified by a unique combination of Originator Number and Site ID (Siteid), the latter being any sequence of numbers and letters up to 16 characters long. The uniqueness of an Originator Number and Site ID combination is enforced by a unique index covering these fields. Similarly, a sample in the ROCKS table is fully identified by a unique combination of Originator Number and Sample ID (Sampleid), which is protected by a trigger in the ROCKS form - it is not possible to enter a combination already in the ROCKS table. Although a sample number on its own is usually sufficient to fetch the required sample, do not forget that ***sample numbers on their own are not necessarily unique.*** The THINSECTIONS table in PETROG records the Originator Number, Site ID and Sample ID. Site and sample data must be entered into OZROX before the thin section data can be entered into PETROG.

5 - SECURITY AND ACCESS

Select-Only Database Access

The Oracle production environment allows all internal AGSO users select-only access to the main data tables in both the OZROX and PETROG. The menu system provides 'read-only' versions of the forms that allow users to select most of the data in the databases, but not to insert, update or delete data. Users should also have select-only access to all validation tables. When in SQL*Plus, all users may select data from any of these tables provided they include the owner's name plus a full stop in the name of the table or view, e.g. -

SELECT SAMPLEID FROM NGMA.ROCKS WHERE ORIGNO = 56;

SELECT SITEID FROM PETROG.THINSECTIONS WHERE ORIGNO = 56;

Insert, Update and Delete Oracle Access

In both OZROX and PETROG all internal Oracle users in the production environment can add, change or delete ***their own data.*** This is accomplished via special named views. Those relevant to PETROG, and their corresponding base tables, are as follows -

BASE TABLE	INSERT/UPDATE VIEW
NGMA.SITES	NGMA.USITES
NGMA.ROCKS	NGMA.UROCKS
PETROG.THINSECTIONS	PETROG.UTHINSECTIONS
PETROG.TSATTRIBS	PETROG.UTSATTRIBS
PETROG.TSMINERALS	PETROG.UTSMINERALS

From the menu, special 'Insert/Update' versions of each form cover the above views. The restrictions applying to the above views are the same in each case. For example, the view UTSATTRIBS of the TSATTRIBS table is defined as -

CREATE VIEW UTSATTRIBS AS
*SELECT * FROM TSATTRIBS WHERE ENTEREDBY = USER;*

The word **USER** in the above statement is an Oracle function that returns the current Oracle username. Each of the above tables has the mandatory field **ENTEREDBY** for the username of the person entering the data. This scheme guarantees that the users see only

their own records in the insert/update versions of the forms, and only they or the data custodians can alter or delete them.

Users wishing to use SQL*Plus to insert, update or delete records in the above main tables (or SQL*Loader to load records from an ASCII file) must use the above views.

Custodians' Access Privileges

All custodians have been given appropriate access privileges to the data or authority tables that they administer. They may select, insert, update and delete all data in these tables via screen forms or from SQL*Plus. They cannot drop tables or alter the structure of tables. Note that custodians use the 'read-only' forms to insert, update and delete rows in the main data tables. This is because their access privileges apply to the base tables, not to views of the tables. The 'insert-update' versions of the forms, which correspond to the insert/update views in the database, only allow access to records in which the ENTEREDBY field has their personal Oracle username.

Owners' Access Rights

The Oracle user known as PETROG has complete privileges on all the tables it owns in the Petrography Database, as does the user NGMA in the OZROX Field Database. In other words, these users are the owners of their respective databases. However, once a database has been 'locked' in the production environment, all changes affecting the structure of tables and views must first be submitted by the owner to the database administrator via the change-control directory (see Kucka,1994).

6 - MENU SYSTEM

Access to OZROX and PETROG is via a tree-structured menu system. This provides access to SQL*Plus, some reporting programs and nearly all screen forms associated with the AGSO Geological Database System. Most ad-hoc queries, data inserts and updates are done via screen forms, although you should also know that batch retrievals and updates are often done via SQL*Plus (see Lenz *et al.*, 1993). To run the menu type -

ngma <ENTER>

- after logging into the AViiON UNIX environment and specifying your terminal type. This automatically puts you into the Oracle production environment and brings up the SQL*Menu login screen. After entering your Oracle username and password, the first menu screen is displayed. This currently looks like this -

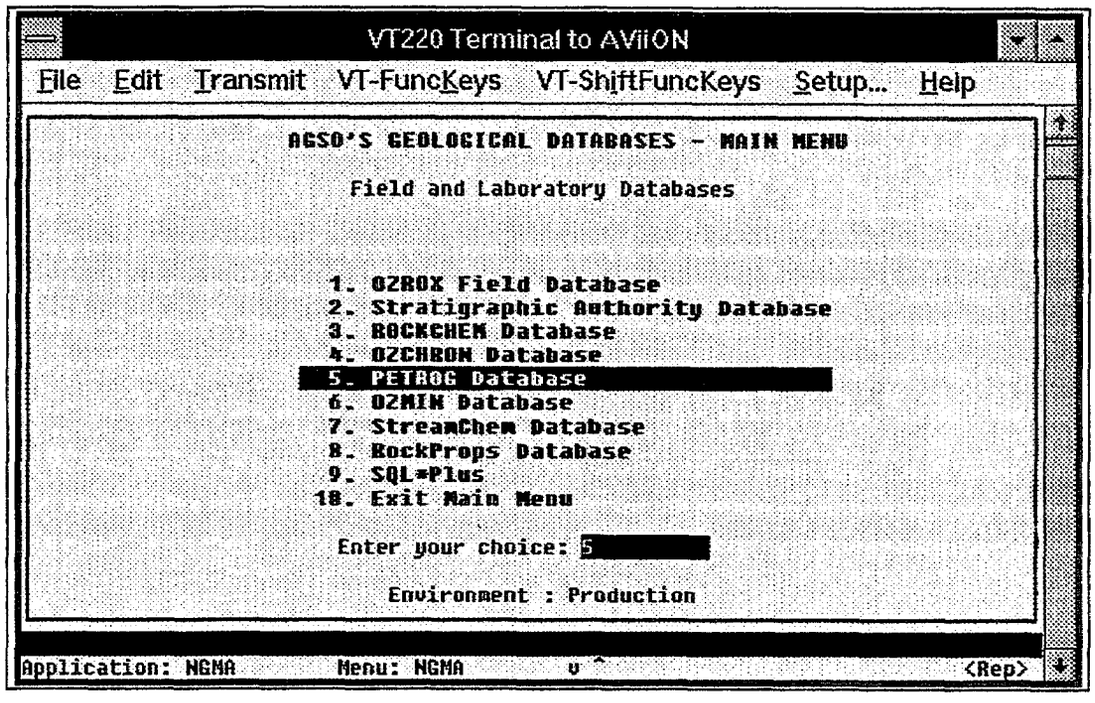

Figure 4. The Main Menu for AGSO's Geological Database System. This menu gives access to nearly all areas of AGSO's Geological Field and Laboratory Database system.

Selecting item ***10*** in the menu, or pressing the ***EXIT*** function key, takes you back to the UNIX prompt. Item ***9*** puts you into the SQL*Plus command-line environment without

having to log into Oracle again. To engage the PETROG database menu just enter *5*, or move the highlight bar down to item 5 then press ***ENTER***. The following screen appears -

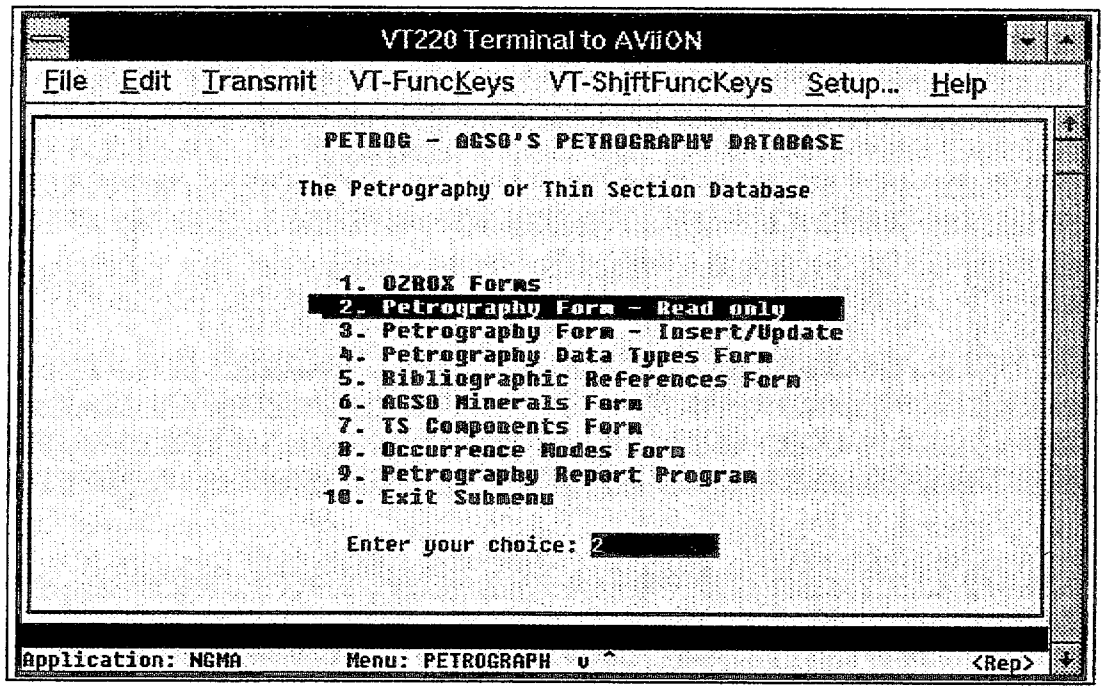

Figure 5. The Petrography Database Menu.

This menu allows you to engage all the forms and the report program relating to the Petrography Database, as well as the menus for the OZROX Field Database. To run the OZROX Sites or Rocks Forms, for example, first select item 1 in the menu. Selecting item ***10*** returns you to the Main Menu -

All the screen forms and report relevant to the PETROG Database and accessible from the above menu are now described, including the Sites, Rocks, References, and AGSO Mineral Forms from the Field Database. Refer to 'The Users' Guide to the NGMA Field Database' (Ryburn *et al.*, 1993b) for the full details of forms from the OZROX Field Database.

7 - THE SITES FORM

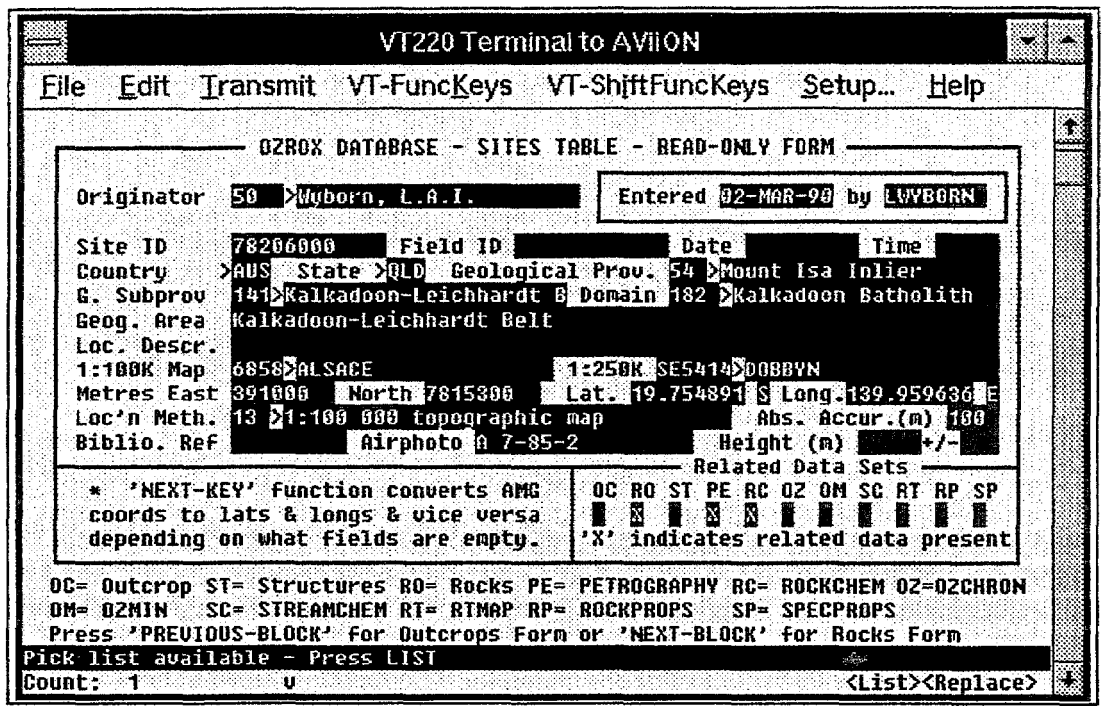

Figure 6. The OZROX Field Database's Sites Form.

The Sites Form standardises the way geographic point location data are recorded. The form attaches to the NGMA.SITES table, but also draws on standard terms from associated validation tables - such as the STRATA.GEOPROVS table. The form is primarily for surface location data relating to field geological, geochemical and geophysical observations - or of more interest to PETROG, for the locations of rock samples. You may move directly from the Sites Form to the Rocks Form by pressing ***NEXT BLOCK***. The Originator Number and Site ID are transferred to the Rocks Form, which is queried automatically.

Geographic coordinates, either as decimal latitudes and longitudes or as AMG eastings and northings, are mandatory but the form includes a key trigger (press ***NEXT PRIMARY KEY***) that converts AMG coordinates to latitudes and longitudes, and *vice versa.* The direction of conversion is determined by which fields are full and which are empty. Data relating to the accuracy of the coordinates and their provenance - i.e., how they were obtained - are important. Although the form insists on an absolute accuracy estimate in metres on the ground this is often an order-of-magnitude estimate only. Location data accurate to ±100 metres are generally acceptable when plotted at 1:250 000 scale, but may be too inaccurate for use at 1:50 000 scale. Similarly, the method used to obtain the location coordinates is essential. If a map was used, a pointer to a bibliographic reference (in AGSO's Bibliographic Reference Database) to the exact map may also be included.

Detailed information on all the fields in the SITES table is given by Ryburn *et al.* (1993b).

8 - THE ROCKS FORM

Figure 7. The Field Database's Rocks (and Structures) Form.

The Rocks (and Structures) Form is for data on lithologies, rock samples and mesoscopic geological structures that occur at a site or outcrop. It is a three-block form covering the ROCKS, LITHDATA and STRUCTURES tables. The ROCKS table has a many-to-one relationship with the SITES. The LITHDATA table has a many-to-one relationship with the ROCKS table and functions as an extendable attributes table for that table. The STRUCTURES table also has a many-to-one relationship with the ROCKS table. A system-generated 'ROCKNO' key ties all three blocks together.

If a sample exists a Sample Number must be supplied, otherwise the record is regarded as a lithology observation without a sample having been taken. The sample number can be the site number, or can be different, but it must be unique to the originator. If the site number is used and several samples were taken, then the site number is typically modified by adding letters to represent each sample. This is the recommended system, as the connection between samples and sites is made clear. However, the data comes from many sources, and as far as possible the numbering system used by the originator should be preserved.

The definitions and purposes of the fields in this form are given by Ryburn *et al.* (1993b).

9 - THE PETROGRAPHY FORM

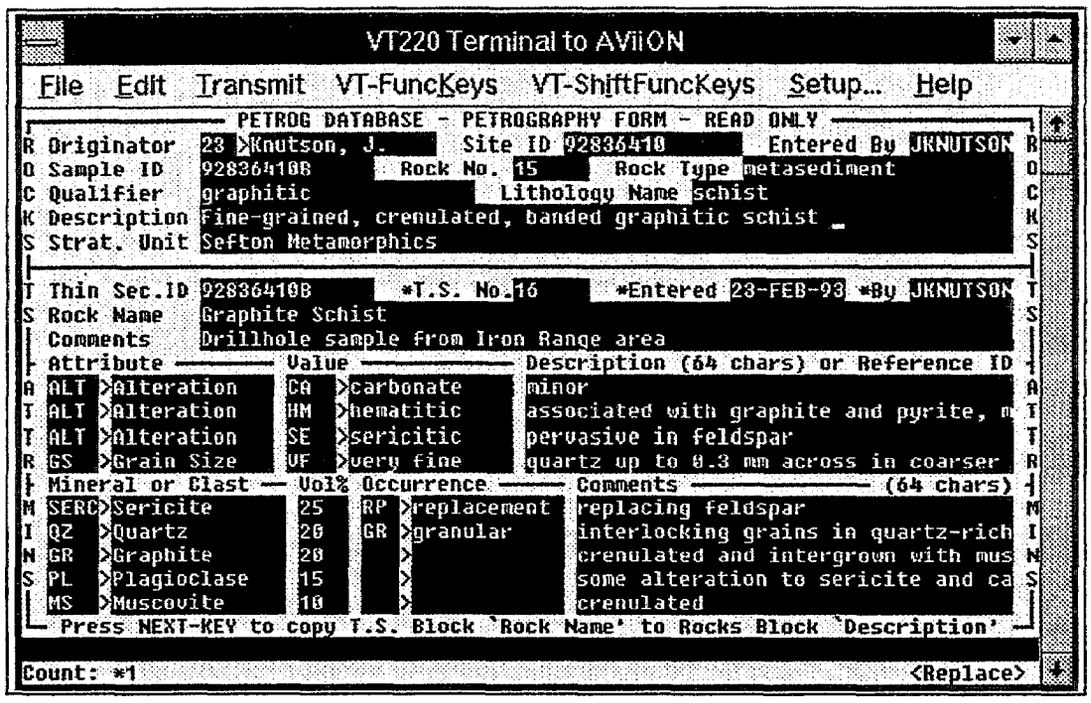

Figure 8. The Petrography Form.

The Petrography Form encompasses almost all the information that needs to be recorded about a thin section of a rock, including pointers to any relevant references in AGSO's Shared Bibliographic Reference Database. The form has four blocks corresponding to four tables - the NGMA.ROCKS table from the OZROX database and the THINSECTIONS, TSATTRIBS and TSMINERALS tables from PETROG. The master block is the ROCKS block, as a rock sample can give rise to more than one thin section. In other words, the THINSECTIONS block is a detail of the ROCKS block. The TSATTRIBS and TSMINERALS blocks are, in turn, both detail blocks of the THINSECTIONS block. A thin section may have any number of attributes and any number of component minerals or clasts. The ROCKS and THINSECTIONS blocks are joined by a combination of Originator Number (ORIGNO) and Sample ID (SAMPLEID), whereas the THINSECTIONS block is joined to TSATTRIBS and TSMINERALS by the Thin Section Number (TSNO).

ROCKS BLOCK

The Rocks Block is for query purposes only and is automatically in query mode when the form is first invoked. You normally use the Petrography Form by first executing a query in the Rocks Block as to the sample or samples required. Do not execute an open query (no select criteria) unless you have plenty of time. It is possible to query from any of the four blocks, as the form is fully 'block-coordinated'. Before a new thin section record can be

added to PETROG, information on the relevant site and rock sample must exist in the OZROX database. To enter or update data in the ROCKS table use the 'Rocks & Structures' Form from the OZROX database. However, with the help of a key trigger, the Lithological Description in the ROCKS table can be updated from the Rock Name field in the THIN SECTIONS block (see 'Rock Name' field description).

Originator - (ORIGNO) Mandatory integer of up to 5 digits that automatically displays the corresponding originator's name. Only the number of an originator already in the NGMA.ORIGINATORS table is enterable. A pop-up list of originators and their numbers may be viewed by pressing the LIST key - from which an originator may be selected with the ACCEPT or ENTER key. The originator is usually the geologist, or sometimes the organisation, that collected the rock sample at the site. It is also an indication of where to go for more information.

Site ID - (SITEID) Mandatory field of up to 16 characters for a user-supplied number or ID for the site from which the thin section comes. A validation trigger ensures that a record with the given Originator Number and Site ID already exists in OZROX's NGMA.SITES table, otherwise a thin section cannot be entered.

Entered By - (ENTEREDBY) Mandatory field for the Oracle Owner (username) of the current ROCKS record. This need not be the same as the owner of the thin section record in the next block. The date entered (ENTRYDATE) is also a mandatory field in the ROCKS table, but is not shown in the Petrography form.

Sample ID - (SAMPLEID) A mandatory field of 16 characters for the ID of the rock sample the thin section comes from. The Sample ID is unique to the Originator, but it need bear no relationship to the Site ID. AGSO originators should use an AGSO registered number with one appended letter, or two letters if more than 26 samples were taken from a site.

Rockno - (ROCKNO) A system-generated mandatory positive integer of up to 6 digits which is the primary key for the ROCKS table.

Rock Type - (ROCKTYPE) A positive integer of up to two digits that identifies the basic rock type from a look-up list of 17 possibilities. This field is designed for a first-pass coarse classification of rock types, as follows -

Number	Rock Type
1	unknown
2	felsic intrusive
3	intermediate intrusive
4	mafic intrusive
5	felsic extrusive
6	intermediate extrusive
7	mafic extrusive
8	ultramafite
9	alkaline igneous
10	clastic sediment

11	chemical sediment
12	metabasite
13	felsic gneiss
14	metasediment
15	metasomatite
16	ore
17	regolith

Lithology Qualifier - (QUALIFIER) A 20-character optional field for the qualifying term, if any, before the Lithology Name field that follows. An abbreviation may be entered in the associated short field that automatically retrieves the full term. The full term is what is stored in the ROCKS table. The qualifying term must be in the NGMA.LITHNAMES authority table and classified as Type 'Q' for qualifier. An example of a Qualifier is 'pelitic' (abbreviation 'PEL"), as in 'pelitic schist'. Valid lithology qualifiers may be selected from a pop-up list obtained by pressing ***LIST***.

Lithology Name - (LITHNAME) A 32-character optional field for a lithology name. An abbreviation may be entered in the associated short field to fetch the full term, but the full term is what is stored in the ROCKS table. Only names already in the NGMA.LITHNAMES authority table, and classified as Type of 'I', 'M' or 'S' (igneous, metamorphic, sedimentary), may be entered. Valid lithology names may be selected from a pop-up list obtained by pressing ***LIST***.

Stratigraphic Unit - (STRATNO) The name of the stratigraphic unit pointed to by the STRATNO number field in the ROCKS table. This name comes from the Stratigraphic Lexicon (STRATA.STRATLEX). Informal names from the INFORMAL field in ROCKS are not displayed in the Petrography Form.

THIN SECTION BLOCK

The Thin Section Block, which corresponds to the THINSECTIONS table, contains basic information about the thin section as a whole, such as the ID of thin section and the lithological name of the rock. The THINSECTIONS table is linked to the NGMA.ROCKS table via the Originator Number and Sample ID displayed in the Rocks Block. However, the primary key for the THINSECTIONS table is the system-supplied Thin Section Number (TSNO) - which should not be confused with the user-supplied Thin Section ID.

Thin Section ID - (THINSECTID) An optional, 16-character field for a user-supplied number or other ID for the thin section. This should correspond to whatever ID is written on the thin section. The Thin Section ID is commonly the same as the Sample ID, but it could be completely unrelated. Where several thin sections are cut from one rock sample, the Thin Section ID will change while the Sample ID remains unchanged. Note that each thin section must occupy a separate record in the THINSECTIONS table.

Thin Section Number - (TSNO) A mandatory positive integer of up to 6 digits which is the primary key for the THINSECTIONS table, and is what links the table to the TSATTRIBS and TSMINERALS tables. The number is automatically inserted when a new THINSECTIONS record is committed. This field may be entered by the user only in query mode.

Entered - (ENTRYDATE) Mandatory date field for the date the current record was entered into the THINSECTIONS table. The format is the default Oracle format of 'DD-MMM-YY' - e.g., '21-JUN-94'. This field is automatically inserted by a trigger when a new record is committed. The cursor can be moved into this field only when the form is in query mode.

By - (ENTEREDBY) Mandatory field of up to 8 capital letters for the Oracle Owner (username) of the current record. This field is automatically inserted by a trigger when the record is first committed. The cursor can be moved into this field only when the form is in query mode.

Rock Name - (ROCKNAME) An optional, uncontrolled, 64-character field for a petrological name based on microscopic examination of the thin section. The name entered here can be copied directly into the Lithological Description field (DESCRIPTION) of the ROCKS table by pressing the ***NEXT PRIMARY KEY*** function key. Note, however, that this could result in a loss of information, as the name originally entered in the ROCKS table is based on field observation, and may include information not apparent in a single thin section (e.g., 'basalt with sparse olivine nodules'). Use with caution.

Comments - (COMMENTS) An optional 64-character field for any additional comments specifically about the thin section (e.g. 'Section excludes all weathered rind material') that are not covered by fields in the SITES or ROCKS tables, or the two controlled blocks that follow.

EXTENDABLE ATTRIBUTES BLOCK

The Extendable Attributes Block, which corresponds to the TSATTRIBS table, is designed to accommodate varying amounts of information about the thin section as a whole - e.g., grainsize, texture and metamorphic grade. It can also accommodate pointers to references in AGSO's Shared Bibliographic Reference Database. TSATTRIBS has the form of an 'inverted' table, similar to the table underlying the Extendable Attributes Block in the Rocks Form, in which attributes with values occupy rows in the table, rather than columns. This has the advantages that any number of attributes with values may be entered, and that new attributes, with their associated value domains, may be added to the database as the need arises. The attributes and values that can be entered are controlled by the look-up table TSDATATYPES.

Attribute - (DATATYPE) A mandatory field for an abbreviation of up to 4 capital letters pointing to an attribute ('Datatype') in the TSDATATYPES table. The attribute's name is automatically displayed in the next field. Only attributes

already in the TSDATATYPES view may be entered, but the same attribute can be used more than once (e.g. - a thin section may exhibit two types of alteration). A pop-up list of available attributes can be viewed by pressing ***LIST***. The TSDATATYPES view currently has the following attributes -

Abbreviation	Attribute Name
ALT	Alteration
CTX	Carbonate Texture
DTX	Dolomitic Texture
GS	Grain Size
ITX	Igneous Texture
MET	Metamorphic Grade
MTX	Metamorphic Texture
REF	Bibliographic Reference
SOR	Sorting
STX	Sedimentary Texture
WEA	Weathering

Note that pointers to references are inserted by entering 'REF' as an attribute and value, and the Reference ID in the Description field.

Value - (SUBTYPE) A mandatory field for an abbreviation of up to 4 capital letters referring to a value of an attribute in the TSDATATYPES view. If the value exists, its description is automatically displayed in the next field, otherwise an error message appears at the bottom of the form. A pop-up list of available values for the attribute already entered in the current record may be displayed by pressing ***LIST***. For example, the 'ALT' or Alteration attribute presently has the following values -

Abbreviation	Value Name
PR	propylitic
AB	albitic
AL	alunitic
AR	argillic
CA	carbonate
CL	chloritic
EP	epidotised
GR	greisen
HM	hematitic
KA	kaolinitic
PO	potassic
PY	pyritic
SE	sericitic
SP	serpentinised
SI	silicified
SK	skarn
ZE	zeolitic

This system allows new attributes and values to be added to the TSDATATYPES by the custodian, as and when required. (Note, however, that the custodian is not free to delete or alter existing attributes and values without first attending to any potential referential integrity problems. The TSDATATYPES table currently links to the TSATTRIBS table, and there may also be other dependent tables in the future).

Description (or Reference) - (DESCRIPTION) An optional field of 64 characters for any additional descriptive information relating to the Data Type/Subtype record. For example, one may wish to comment on the mode of occurrence of a mineral in a sample. An important exception to this is the use of the field for inserting a pointer to a reference. In this case, the ID of the reference in AGSO's Bibliographic Reference Database must be entered. As indicated by the message line at the bottom of the screen when the cursor is in this field, you can jump directly to the References Form by pressing ***NEXT KEY***.

MINERALS & CLASTS BLOCK

This block is specifically for data on the quantifiable components of a thin section. In thin sections of igneous or metamorphic rocks the components are principally the mineral species that go to make up the rock - sometimes the groundmass. In thin sections of sedimentary rocks the components are mainly classes of detrital grain or clasts, as well as the matrix or cement between the clasts.

Mineral or Clast - (MINERAL) A mandatory field for an abbreviation of up to 4 capital letters pointing to a mineral or clast in the TSMINCLASTS view. The name corresponding to the abbreviation is automatically displayed in the next field. Only abbreviations already in the TSMINCLASTS view can be entered, but the same mineral or clast can be used more than once (e.g. - a thin section may have quartz clasts and a quartz matrix). A pop-up list of available mineral or clasts can be viewed by pressing ***LIST***. Note that clast types are displayed first in this list, as there are much fewer of these than rock-forming minerals. The terms 'matrix', 'groundmass', 'cement', and 'void' are included, as these are thin section components that are commonly quantified as to their volume percentage.

Volume Percent - (PERCENT) An optional numeric field for the volume percentage of the thin section composed of the stated mineral, clast, matrix, etc. Values may be entered of up to 100.0%, and with one digit after the decimal point. Since numbers only can be entered into this field, negative numbers are used in lieu of a less-than symbol. Thus, '-1.0' is taken to mean '<1.0' (less than one percent), and is equivalent to the conventional 'accessory' or 'trace' annotation that often appears on cards. This follows the convention used in the ROCKCHEM database (Ryburn, 1990).

Occurrence Mode - (MINOCCMODE) An optional field for an abbreviation of up to 4 capital letters indicating a mode of occurrence of the stated mineral or other component. The abbreviation entered is validated by the TSMINOCCMODES table - the name corresponding to the abbreviation is automatically displayed in the next field. A pop-up list of available occurrence modes can be viewed by pressing ***LIST***.

Occurrence mode is needed to distinguish between more than one possible type of occurrence - quartz clasts, quartz overgrowths and quartz cement, for example, or groundmass K-feldspar versus K-feldspar phenocrysts. In sedimentary rocks, where a mineral like quartz has been used to indicate a monomineralic clast type, the occurrence mode should always be set to 'CL' for 'clast'. Otherwise, detrital kyanite could be mistaken for a metamorphic zone indicator when used for plotting in a GIS system. Petrographic terms for occurrence modes are many and varied, and the present list will be greatly expanded in time. A selection of some occurrence modes is listed below -

Abbreviation	Occurrence Mode
AM	amygdaloidal
AU	authigenic
BI	biogenic
CM	cement
CL	clast
CR	cryptocrystalline
GR	granular
GM	groundmass
IN	inclusion
MX	matrix
MG	microgranular
MC	microlite
OO	oolitic
OG	overgrowth
PL	pellet
PH	phenocryst
PB	porphyroblast
RP	replacement
XC	xenocryst
XL	xenolith

Comments - (COMMENTS) An optional field of 64 characters for comment or description relating to the stated mineral or component.

10 - THE PETROGRAPHY DATA TYPES FORM

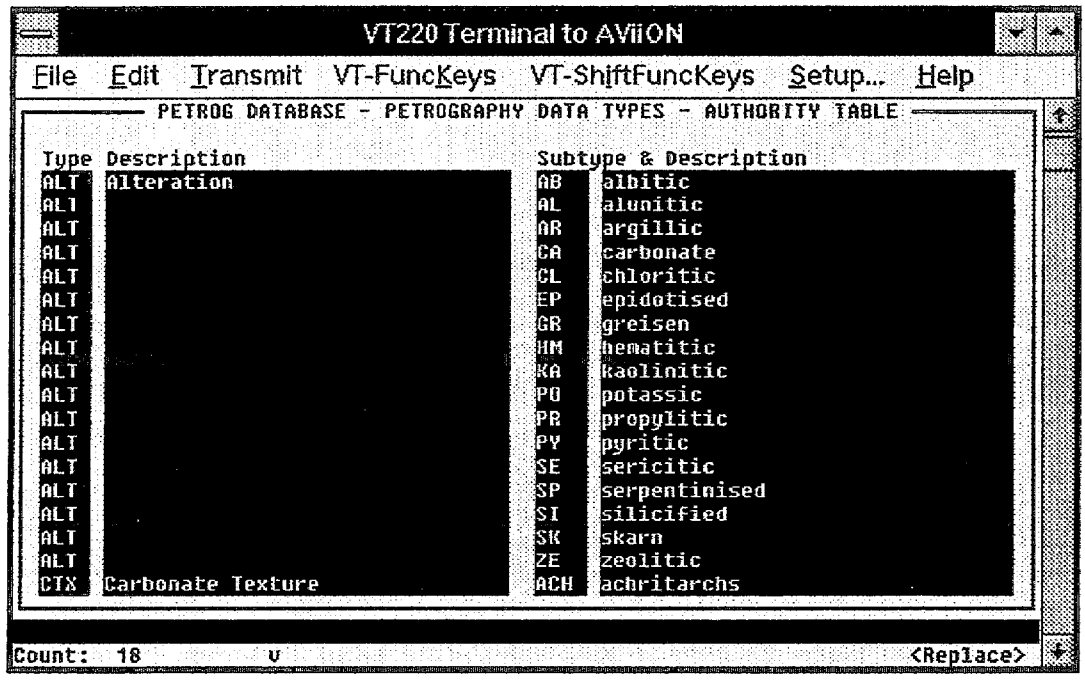

Figure 9. The Petrography Data Types Form.

The Petrography Data Types Form, which covers the TSDATATYPES table, gives access to a list of attributes and values used to validate entries in the TSATTRIBS table. The two-fold division of this list into data types and subtypes is similar to that used by the NGMA.LITHDATATYPES table that lies behind the Rocks Form in the OZROX database. The initial list is not regarded as complete. Users requiring additions to this authority table should pass their requests to the custodian (Jan Knutson, Xtn 9479).

Type - (DATATYPE) A mandatory field of up to 4 capital letters for an abbreviation for a petrography data type, or attribute - e.g. 'ALT' for Alteration.

Type Description - (TYPEDESC) An optional field of up to 32 characters for a description of the data type - e.g., 'Alteration'. As this is, in effect, an attribute name, the first letters of all main words should be capitalised.

Subtype - (SUBTYPE) A mandatory field of up to 4 capital letters for an abbreviation for a data subtype, or attribute value - e.g. 'AB' for albitic.

Subtype Description - (SUBDESC) An optional field of up to 32 characters for a description of the data subtype - e.g., 'Albitic'.

11 - THE BIBLIOGRAPHIC REFERENCES FORM

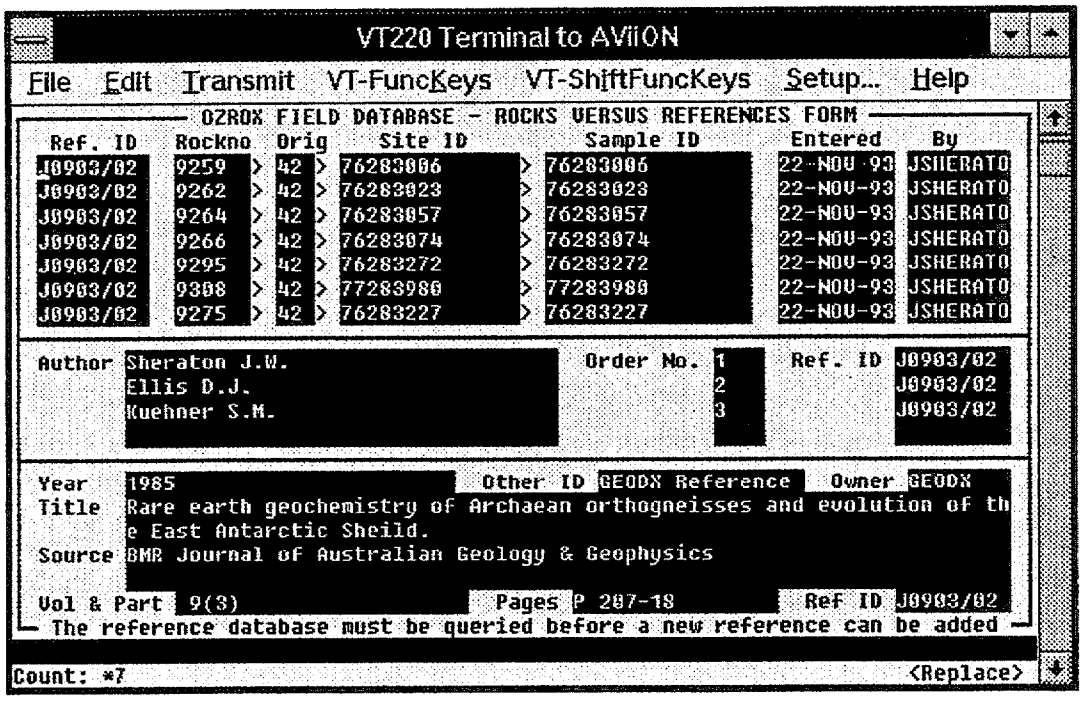

Figure 10. The (Rock) References Form.

Thin sections in PETROG may be linked to references in AGSO's Shared Bibliographic Reference Database via a 'REF' attribute and Reference ID in the Extendable Attributes Block of the Petrography Form (see pages 16-18). The AGSO Reference ID is entered in the Description field of the 'REF' record, and the above References Form can be invoked by pressing ***NEXT PRIMARY KEY*** when the cursor is in that field in the Petrography Form. Note, however, that the References Form shown in Figure 10 is primarily for linking rock samples to references, and the top block exists solely for that purpose. The top block is not used at all when specifically linking thin sections to references.

The References Form's top block corresponds to the NGMA.ROCKREFS table. It joins the NGMA.ROCKS table to the Reference Database in a many-to-many relationship. For any given rock sample there could be several references, and any one reference may refer to many rock samples. The top block shows all the Reference IDs for a particular Rockno, or all Rocknos for a particular Reference ID. The bottom two blocks, which display a reference at a time, correspond to the GEOREF.AGSOAUTHS and GEOREF.AGSOREFS views of the Reference Database. These encompass a union with the GEODX bibliography (Lenz & Modrak, 1990), which has over 22 000 references on Australian geology. As the cursor is moved from record to record in the top block, the corresponding reference is displayed in the bottom two blocks. For the purpose of accessing AGSO's Reference Database, however, the top block can be ignored.

This form can also be used to inspect and insert the references pointed to by the Bibliographic Reference field in the NGMA.SITES table. A more complete description of AGSO's Bibliographic Reference Database will be published in the users' guide to that database, but the information presented here is adequate for entering references required by PETROG, or attaching sites and rock samples to references.

To query AGSO's Reference Database by Ref. ID, authors, year, etc., press ***NEXT BLOCK*** to position the cursor in the Authors (or Reference) Block, then press ***ENTER QUERY*** to obtain a pop-up query form. Enter your query information in this form then press ***EXECUTE QUERY*** to retrieve one or more reference to the underlying form. Make your query criteria as specific as possible to speed retrieval. Single author queries are slow if there are many references by that author. Use ***NEXT RECORD*** to scroll through more than one reference, and ***NEXT KEY*** to transfer the Reference ID of the currently displayed reference to the top block - to which a Rockno must be added. In this way, pre-existing references in the References Database may be attached to rock samples.

To prevent the entry of duplicate references the form insists that you query the Reference Database before you can enter a new reference or update an existing one. Having done so, though, you are free to enter or update more than one reference. The onus is on the user to try to prevent the duplication of references in the shared database (a percentage of duplicated records is inevitable). To obtain the Reference Insert/Update Form press ***INSERT RECORD*** when the cursor is in the top block. Enter and commit the required reference. The same procedure may be used to update existing references, but only those references belonging to you (the entry form will only display references with your Oracle user name attached to them). You should not update a reference to the extent that it becomes another reference, as other people may have set pointers to the reference from other databases. Use updates only to correct errors in existing references. All new references go into the GEOREF.AUTHORS and GEOREF.REFERENCES tables.

TOP BLOCK

Not all the fields in the Top Block belong to the underlying NGMA.ROCKREFS table. As soon as a 'Rockno' is entered, the Originator, Site ID and Sample ID fields are automatically populated by a trigger from the NGMA.ROCKS table. To enter new records into ROCKREFS just add them to the bottom of the displayed records with ***NEXT FIELD***. As already mentioned, in this block the ***INSERT RECORD*** key takes you directly to the screen for entering new references.

Reference ID - (REFID) A 9-character field for the ID of a bibliographic reference in AGSO's Reference Database. The ID of GEODX references in the database are various - e.g. '79/20055', 'R156' 'GOLD239'. The IDs of non-GEODX references are always a number starting with an asterisk - e.g. '*2156'.

Rockno - (ROCKNO) As in the Rocks Form - the primary key of the NGMA.ROCKS table. Only Rocknos already entered in that table may be entered here.

Originator - (ORIGNO) As in the Petrography Form. Display field only.

Site ID - (SITEID) As in the Petrography Form. Display field only.

Sample ID - (SAMPLEID) As in the Petrography Form. Display field only.

Entered - (ENTRYDATE) As in the Petrography Form.

By - (ENTEREDBY) As in the Petrography Form.

AUTHORS BLOCK

The Authors Block provides access to the GEOREF.AGSOAUTHS view (read only).

Authors - (AUTHNAME) A mandatory character field of up to 32 characters for the surname of an author in lower case (except for the first letter) followed by a space and the author's initials with full stops and no spaces between the initials. Capital letters can also occur inside a surname (e.g., d'Albertis, McDonald).

Order Number - (ORDERNO) A positive integer of up to two digits indicating the order of the author in the authors list of the reference. This field must be entered, must start with one, and must increment by one.

Reference ID - (REFID) As in the Top Block. The pointer to the reference record.

REFERENCE BLOCK

The References Block corresponds to the GEOREF.AGSOREFS view (read only).

Year - (YEAR) A mandatory character field of up to 32 characters for the year of publication of the reference.

Other ID - (OTHERID) An optional 32 character field for any alternative reference number or ID. All references from GEODX have the value 'GEODX Reference' displayed in this field.

Owner - (ENTEREDBY) A mandatory 8-character field for the Oracle user name of the person or database owner who entered the reference in the AGSO Reference Database system.

Title - (TITLE) A mandatory field of up to 255 characters for the title of the reference. Use lower case except for the first letter of the first word and all proper names. Use a full stop at the end of the title. In symposium-style references the title of the symposium or collected works should also be entered, following the word 'In' and the names and initials of the editors - plus (Ed) or (Eds).

Source - (SOURCE) A mandatory field of up to 255 characters for the journal name or publication of the reference. Use mostly lower case - as in the title field. Do not include volume, part, or page numbers. A pick list is available from GEODX.

Volume and Part - (VOLPART) Up to 32 characters for the volume and/or part number of the publication containing the reference. A single number indicates a volume number. If a part or issue number is also included place it in round brackets, e.g., '1 (3)'. Special volumes may require text entry - e.g. 'The Sam Carey Special Volume'.

Page Numbers - (PAGENOS) Up to 32 characters for the page numbers of the reference - e.g. '234-257'.

Reference ID - (REFID) As in the Top Block of the form - the primary reference key.

12 - THE AGSO MINERALS FORM

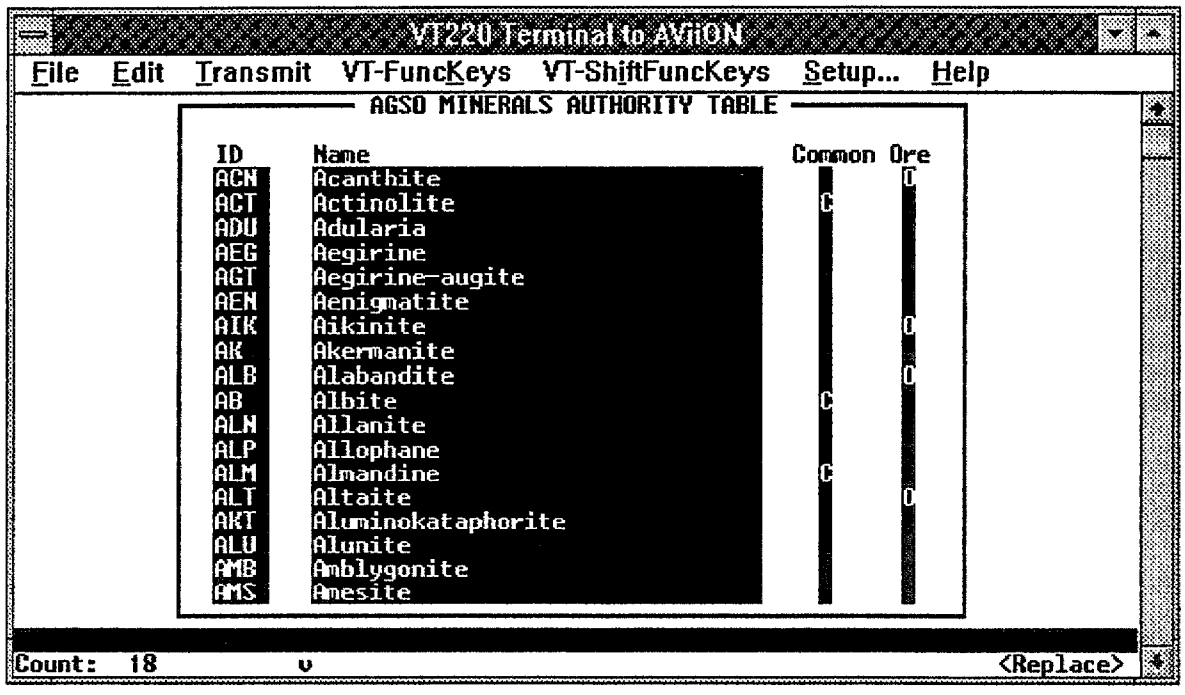

Figure 11. The AGSO Minerals Form.

The AGSO Minerals Form gives access to the NGMA.AGSOMINERALS table, which currently contains an authoritative list of 776 mineral names likely to be encountered in the course of routine (and some not-so-routine) geoscience. This list, combined with that in TSCLASTYPES (see next page), is used to validate entries into the 'Minerals or Clasts' field of the Petrography Form. Although a part of OZROX, this form is of equal or greater value to PETROG, and is appropriately described in this guide. The custodian of the NGMA.AGSOMINERALS table is Morrie Duggan (Xtn 9284).

Mineral ID - (MINABBREV) A mandatory field of up to 4 capital letters for an abbreviation for a mineral name - e.g. 'QZ' for quartz. The abbreviation must be unique, and should be as short as possible, with the shorter IDs going to the more common minerals. Note that this field is of potential benefit in providing abbreviations suitable for use on computer plotted graphs and diagrams - such as phase diagrams.

Mineral Name - (MINNAME) A mandatory field of up to 32 characters for the name of the mineral, e.g., 'Glaucophane'. First letters of all names are in upper case.

Common - (COMMON) An optional one-character field with 'C' for common minerals.

Ore - (ORE) An optional one-character field with 'O' for ore minerals.

13 - THE THIN-SECTION COMPONENTS FORM

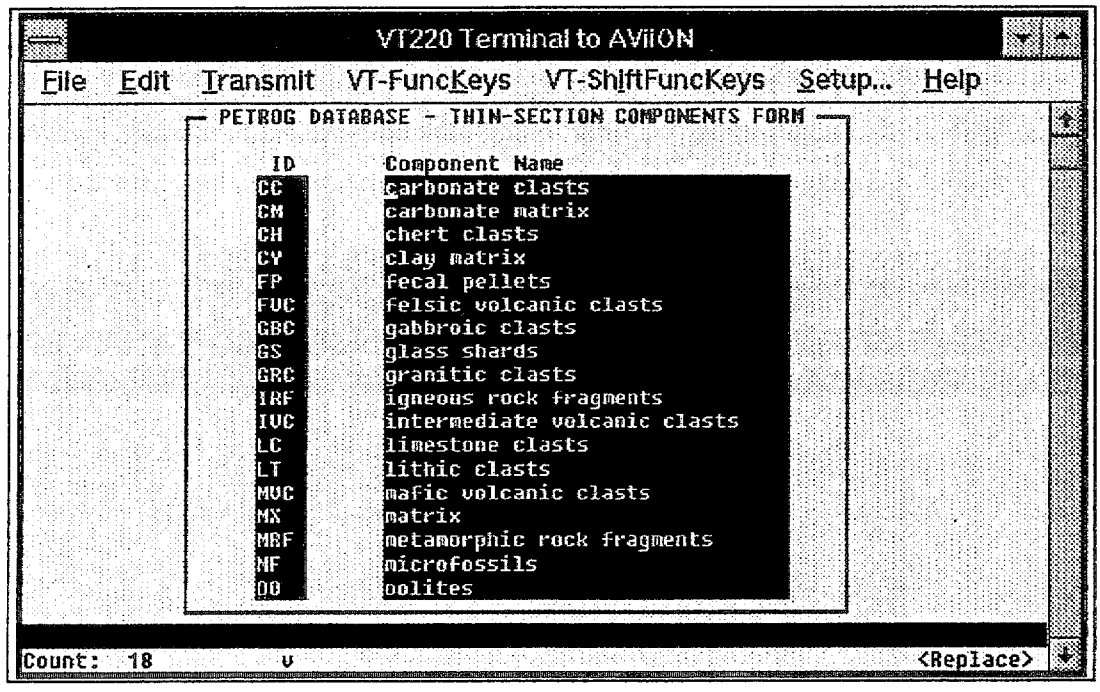

Figure 12. The Thin-Section Components Form.

The Thin-Section Components Form, which correponds to the TSCLASTYPES authority table, contains a list of all thin section components that are ***not*** in the NGMA.AGSO-MINERALS table. Typically these are classes of detrital clasts, but they also include types of matrix or groundmass, and microfossils. The TSCLASTYPES list is united with the list of minerals in NGMA.AGSOMINERALS via a view called TSMINCLASTS, and presented to the Petrography Form as a single list for validating the 'Mineral or Clast' field. When displayed from that form with the ***LIST*** key, the united list has the non-mineral components at the top the list, annotated by the word 'CLAST' in the last column, as opposed to the minerals lower down the list with 'MIN' in the last column. Users wishing to add new components to the TSCLASTYPES table should contact the custodian (Jan Knutson, Xtn 9479).

Component Abbreviation - (CLASTABBREV) A mandatory field of up to 4 capital letters for an abbreviation for a thin-section component - e.g. 'MX' for matrix.

Component Name - (CLASTNAME) A mandatory field of up to 32 characters for the name or description of the thin-section component - e.g., 'intermediate volcanic clasts'.

14 - OCCURRENCE MODES FORM

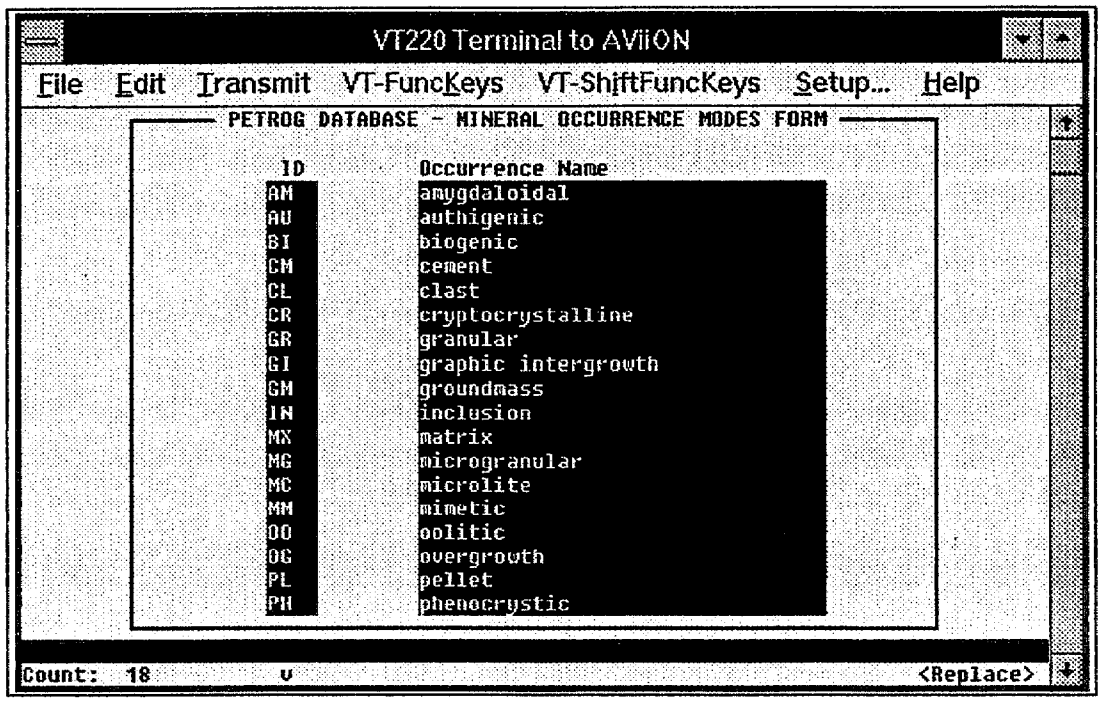

Figure 13. The Mineral Occurrence Modes Form.

This form corresponds to the TSMINOCCMODES authority table, housing occurrence modes of thin section minerals (more correctly, thin section components, as occurrence modes of clasts and matrix are included). Mineral species often occur in more than one form - K-feldspar may occur both as phenocrysts and in the groundmass, or quartz can occur as clasts and as cement. In such cases, different modes of mineral occurrence should be recorded and quantified in the Petrography Form as different components of the same thin section. Similarly, glaucophane can be a metamorphic indicator or a detrital mineral, and it is important to distinguish between the two modes of occurrence in a manner that promotes reliable retrieval of information. To illustrate, we do not want occurrences of detrital glaucophane being used to map blueschist facies domains in a GIS system. For this reason the 'clast' mode of occurrence should always be added in the Petrography Form to mineral components that represent as a class of detrital grains. The list contained in the TSMINOCCMODES table will undoubtedly need to extended at regular intervals. The venerable art of petrography is peppered with esoteric terms applying to modes of mineral occurrence. Contact the custodian (Jan Knutson, Xtn 9479) if you wish to add more terms.

Occurrence Abbreviation - (OCCABBREV) A mandatory field of up to 4 capital letters for an abbreviation for an occurrence mode - e.g. 'PH' for phenocrystic.

Occurrence Name - (OCCNAME) A mandatory field of up to 32 characters for the name or description of the mode of occurrence - e.g., 'groundmass'.

15 - THE PETROGRAPHY REPORT PROGRAM

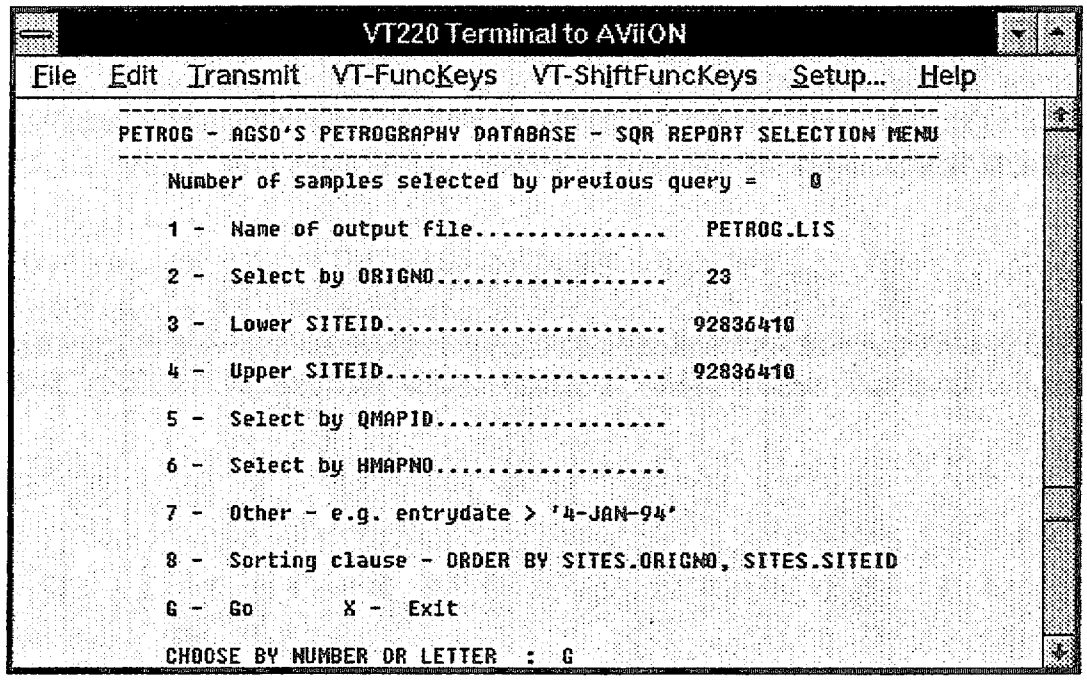

Figure 14. The Selection Menu from the SQR Petrography Report Program.

This comprehensive reporting program is engaged from item 9 in the Petrography Database Menu. Written in the SQR reporting language, the program is designed to print all PETROG information on a site-by-site basis. An example of the program's output resulting from the selection criteria shown in Figure 14 is given in Appendix B.

To post a selection criterion in the above Report Selection Menu, enter the appropriate number indicated in the menu and type in the required value as prompted. Enclosing quotes are not required. Note that item 7 allows you to enter a variety of SQL selection criteria - exactly as you do following the 'where' keyword in a SQL select statement (but without the terminating semicolon). When all the selection criteria are in place, enter *G* to proceed with the report to the UNIX file indicated at item 1 of the above menu. Note that this file is written to your current UNIX directory (the one you were in when you typed the word ***ngma***), and that any prior file with the same name in the same directory will be overwritten. If you want to produce several output files you must change the output file name each time you generate a new report.

As soon as the report has finished, the menu is redisplayed with the number of thin section retrieved indicated at the top of the menu. If this is not according to expectations, revise your selection criteria and try again. Large reports take some time to generate. When finished, enter *X* to exit the report program and return to the Petrography Database Menu. The output files from this program can be printed with the UNIX 'lp' command (e.g., ***lp PETROG.LIS***), or transferred to your PC with File Express (in LAN Workplace for DOS).

16 - ACKNOWLEDGMENTS

The development of AGSO's Petrography Database has been a team effort, and has benefited from the input of a number of AGSO staff members. In particular we wish to mention Lynton Jaques for the initial concept of the geological field and laboratory database system, and Phil O'Brien, John Sheraton, Peter Southgate, Peter Stuart-Smith, David Wallace and Lesley Wyborn for various contributions during the planning prototyping of PETROG.

This Record has benefited greatly from peer reviews by Gladys Warren and John Sheraton.

17 - REFERENCES

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APPENDIX A- DATABASE DEFINITIONS

```
REM  THE PRIMARY AND FOREIGN KEY ('REFERENCES') DEFINITIONS IN
REM  CREATE-TABLE STATEMENTS ARE A FEATURE OF ORACLE VERSION 7
REM  AND ARE IGNORED BY ORACLE VERSION 6 -  DOCUMENTATION ONLY

REM ************************************************************************
REM ***  THE FOLLOWING TABLES, VIEWS AND INDEXES BELONG TO NGMA (OZROX) ***
REM ************************************************************************

REM  SITES IS FOR GROUND POINT LOCATIONS + ACCURACY & LINEAGE

CREATE TABLE SITES (
        ORIGNO        NUMBER (5)    NOT NULL  REFERENCES ORIGINATORS,
        SITEID        CHAR   (16)   NOT NULL,
        FIELDID       CHAR   (16),
        OBSDATE       DATE,
        OBSTIME       NUMBER (4,2),
        COUNTRYID     CHAR   (3)    NOT NULL  REFERENCES AGSOCOUNTRIES,
        STATE         CHAR   (3)              REFERENCES AGSOSTATES,
        GEOPROVNO     NUMBER (5)              REFERENCES STRATA.GEOPROVS,
        SUBPROVNO     NUMBER (5)              REFERENCES STRATA.GEOPROVS,
        DOMAINNO      NUMBER (5)              REFERENCES STRATA.GEOPROVS,
        GEOGAREA      CHAR   (64),
        LOCDESC       CHAR   (64),
        HMAPNO        NUMBER (4)              REFERENCES HMAPS,
        QMAPID        CHAR   (6)              REFERENCES QMAPS,
        EASTING       NUMBER (8,2),
        NORTHING      NUMBER (9,2),
        ACCURACY      NUMBER (4)    NOT NULL,
        HEIGHT        NUMBER (5,0),
        HEIGHTACC     NUMBER (3,0),
        DLAT          NUMBER (8,6),
        NS            CHAR   (1),
        DLONG         NUMBER (9,6),
        EW            CHAR   (1),
        METHOD        NUMBER (3)    NOT NULL  REFERENCES LOCMETHODS,
        BIBREF        CHAR   (9)              REFERENCES GEOREF.AGSOREFS,
        AIRPHOTO      CHAR   (36),
        OC            CHAR   (1),             /* OUTCROPS    TABLE    */
        RO            CHAR   (1),             /* ROCKS       TABLE    */
        ST            CHAR   (1),             /* STRUCTURE   TABLE    */
        PE            CHAR   (1),             /* PETROGRAPHY DATABASE */
        RC            CHAR   (1),             /* ROCKCHEM    DATABASE */
        OZ            CHAR   (1),             /* OZCHRON     DATABASE */
        OM            CHAR   (1),             /* OZMIN       DATABASE */
        SC            CHAR   (1),             /* STREAMCHEM  DATABASE */
        RT            CHAR   (1),             /* REGOLITH    DATABASE */
        RP            CHAR   (1),             /* ROCKPROPS   DATABASE */
        SP            CHAR   (1),             /* SPECPROPS   DATABASE */
        ENTEREDBY     CHAR   (8)    NOT NULL,
        ENTRYDATE     DATE          NOT NULL,
        LASTUPDATE    DATE,
        PRIMARY KEY (ORIGNO,SITEID) );

GRANT SELECT ON SITES TO PUBLIC;
```

```
GRANT SELECT ON SITES TO PETROG WITH GRANT OPTION;

CREATE UNIQUE INDEX SITESUNIQUE   ON SITES ( ORIGNO, SITEID );
CREATE         INDEX SITESIDS     ON SITES ( SITEID );
CREATE         INDEX SITESUSERS   ON SITES ( ENTEREDBY );
CREATE         INDEX SITESPROVS   ON SITES ( GEOPROVNO );
CREATE         INDEX SITESSUBPROVS ON SITES ( SUBPROVNO );
CREATE         INDEX SITESHMAPS   ON SITES ( HMAPNO );
CREATE         INDEX SITESQMAPS   ON SITES ( QMAPID );
CREATE         INDEX SITESDLATS   ON SITES ( DLAT );
CREATE         INDEX SITESDLONGS  ON SITES ( DLONG );
CREATE         INDEX SITESSTRUC   ON SITES ( ST );
CREATE         INDEX SITESSC      ON SITES ( SC );
CREATE         INDEX SITESRP      ON SITES ( RP );
CREATE         INDEX SITEOZCHRON  ON SITES ( OZ );
CREATE         INDEX SITESOZMIN   ON SITES ( OM );
CREATE         INDEX SITESRTMAP   ON SITES ( RT );

REM  USITES IS THE INSERT/UPDATE VIEW OF THE SITES TABLE

CREATE VIEW USITES AS SELECT * FROM SITES WHERE ENTEREDBY = USER;

GRANT SELECT, INSERT, UPDATE, DELETE ON USITES TO PUBLIC;


REM  ROCKS IS FOR DATA ON LITHOLOGIES AND SAMPLES

CREATE TABLE ROCKS (
        ROCKNO       NUMBER (6)    NOT NULL  PRIMARY KEY,
        ORIGNO       NUMBER (5,0)  NOT NULL  REFERENCES ORIGINATORS,
        SITEID       CHAR   (16)   NOT NULL,
        SAMPLEID     CHAR   (16),
        ROCKTYPE     NUMBER (2,0)            REFERENCES ROCKTYPES,
        QUALIFIER    CHAR   (20)             REFERENCES LITHNAMES,
        LITHNAME     CHAR   (32)             REFERENCES LITHNAMES,
        GROUPING     CHAR   (50),
        STRATNO      NUMBER (5,0)            REFERENCES STRATA.STRATLEX,
        INFORMAL     CHAR   (64),
        AGE          CHAR   (54),
        STRATHEIGHT  NUMBER (8,3),
        HOLEDEPTH    NUMBER (8),
        HOLEDEPTH2   NUMBER (8),
        DESCRIPTION  CHAR   (64),
        OTHERINFO    CHAR   (64),
        ENTEREDBY    CHAR   (8)      NOT NULL,
        ENTRYDATE    DATE            NOT NULL,
        FOREIGN KEY (ORIGNO,SITEID) REFERENCES SITES(ORIGNO,SITEID) );

GRANT SELECT ON ROCKS TO PUBLIC;
GRANT SELECT ON ROCKS TO PETROG WITH GRANT OPTION;

CREATE UNIQUE INDEX ROCKROCKNOS   ON ROCKS ( ROCKNO );
CREATE         INDEX ROCKORIGSITES ON ROCKS ( ORIGNO, SITEID );
CREATE         INDEX ROCKSITES    ON ROCKS ( SITEID );
CREATE         INDEX ROCKORIGSAMPS ON ROCKS ( ORIGNO, SAMPLEID );
CREATE         INDEX ROCKUSERS    ON ROCKS ( ENTEREDBY );

REM  UROCKS IS THE INSERT/UPDATE VIEW OF THE ROCKS TABLE
```

```
CREATE VIEW UROCKS AS SELECT * FROM ROCKS WHERE ENTEREDBY = USER;

GRANT SELECT, INSERT, UPDATE, DELETE ON UROCKS TO PUBLIC;


REM  LITHDATA IS THE EXTENDABLE ATTRIBUTES TABLE FOR ROCKS

CREATE TABLE LITHDATA (
        ROCKNO       NUMBER (5,0)  NOT NULL  REFERENCES ROCKS,
        DATATYPE     CHAR   (4)    NOT NULL  REFERENCES LITHDATATYPES(DATATYPE),
        SUBTYPE      CHAR   (4)              REFERENCES LITHDATATYPES(SUBTYPE),
        DESCRIPTION  CHAR   (64),
        ENTEREDBY    CHAR   (8)    NOT NULL,
        ENTRYDATE    DATE          NOT NULL,
        PRIMARY KEY (ROCKNO, DATATYPE, SUBTYPE) );

GRANT SELECT ON LITHDATA TO PUBLIC;

CREATE INDEX LDLITHNO ON LITHDATA ( ROCKNO );
CREATE INDEX LDUSERS  ON LITHDATA ( USER );

REM  ULITHDATA IS THE INSERT/UPDATE VIEW OF THE LITHDATA TABLE

CREATE VIEW ULITHDATA AS SELECT * FROM LITHDATA WHERE ENTEREDBY = USER;

GRANT SELECT, INSERT, UPDATE, DELETE ON ULITHDATA TO PUBLIC;


REM  ORIGINATORS IS THE AUTHORITY TABLE FOR ORIGINATORS

CREATE TABLE ORIGINATORS (
        ORIGNO       NUMBER (5,0)  NOT NULL  PRIMARY KEY,
        ORIGINATOR   CHAR   (22)   NOT NULL,
        OWNER        CHAR   (8) );

GRANT SELECT ON ORIGINATORS TO PUBLIC;

CREATE UNIQUE INDEX ORIGNOS ON ORIGINATORS ( ORIGNO );


REM  AGSO AUTHORITY TABLE OF MINERAL NAMES & THEIR ABBREVIATIONS

CREATE TABLE AGSOMINERALS (
        MINABBREV    CHAR   (4)    NOT NULL  PRIMARY KEY,
        MINNAME      CHAR   (32)   NOT NULL,
        COMMON       CHAR   (1),
        ORE          CHAR   (1) );

CREATE UNIQUE INDEX AGSOMINABBREVS ON AGSOMINERALS ( MINABBREV );
CREATE UNIQUE INDEX AGSOMINNAMES   ON AGSOMINERALS ( MINNAME );
CREATE         INDEX AGSOMINCOMMONS ON AGSOMINERALS ( COMMON );
CREATE         INDEX AGSOMINORE     ON AGSOMINERALS ( ORE );

GRANT SELECT ON AGSOMINERALS TO PUBLIC;
GRANT SELECT ON AGSOMINERALS TO PETROG WITH GRANT OPTION;
```

```
REM ************************************************************************
REM ***     THE FOLLOWING TABLES, VIEWS AND INDEXES BELONG TO PETROG      ***
REM ************************************************************************


REM  THINSECTIONS IS THE MASTER DATA TABLE FOR PETROG

CREATE TABLE THINSECTIONS (
        ORIGNO        NUMBER (5)   NOT NULL  REFERENCES NGMA.ORIGINATORS,
        SITEID        CHAR   (16)  NOT NULL  REFERENCES NGMA.SITES(SITEID),
        SAMPLEID      CHAR   (16)  NOT NULL  REFERENCES NGMA.ROCKS(SAMPLEID),
        THINSECTID    CHAR   (16),
        TSNO          NUMBER (6)   NOT NULL  PRIMARY KEY,
        ROCKNAME      CHAR   (32),
        COMMENTS      CHAR   (64),
        ENTEREDBY     CHAR   (16)  NOT NULL,
        ENTRYDATE     DATE         NOT NULL );

GRANT SELECT ON THINSECTIONS TO PUBLIC;

CREATE UNIQUE INDEX TSNOS       ON THINSECTIONS(THNO);
CREATE         INDEX THINSECTIDS ON THINSECTIONS(THINSECTID);
CREATE         INDEX TSORIGSITES ON THINSECTIONS(ORIGNO, SITEID);
CREATE         INDEX TSSITES     ON THINSECTIONS(SITEID);

CREATE VIEW UTHINSECTIONS AS SELECT * FROM THINSECTIONS WHERE ENTEREBY = USER;

GRANT SELECT, INSERT, UPDATE, DELETE ON UTHINSECTIONS TO PUBLIC;


REM  MAXTSNO IS A ONE-ROW TABLE FOR KEEPING TRACK OF THE CURRENT HIGHEST TSNO

CREATE TABLE MAXTSNO (
        MAXNO         NUMBER(6) );

GRANT SELECT, UPDATE ON MAXTSNO TO PUBLIC;


REM  TSATTRIBS IS THE EXTENDABLE ATTRIBUTES TABLE FOR THINSECTIONS

CREATE TABLE TSATTRIBS (
        TSNO          NUMBER (6)   NOT NULL  REFERENCES THINSECTIONS,
        DATATYPE      CHAR   (4)   NOT NULL  REFERENCES TSDATATYPES(DATATYPE),
        SUBTYPE       CHAR   (4)             REFERENCES TSDATATYPES(SUBTYPE),
        DESCRIPTION   CHAR   (64),
        ENTEREDBY     CHAR   (16),
        ENTRYDATE     DATE );

GRANT SELECT ON TSATTRIBS TO PUBLIC;

CREATE INDEX PATTRIBSNOS ON TSATTRIBS(TSNO);

CREATE VIEW UTSATTRIBS AS SELECT * FROM TSATTRIBS WHERE ENTEREBY = USER;

GRANT SELECT, INSERT, UPDATE, DELETE ON UTSATTRIBS TO PUBLIC;
```

```
REM  TSDATATYPE IS THE AUTHORITY TABLE FOR TSATTRIBS EXTENDABLE ATTRIBUTES TABLE

CREATE TABLE TSDATATYPES (
        DATATYPE      CHAR    (4)    NOT NULL,
        TYPEDESC      CHAR    (32),
        SUBTYPE       CHAR    (4)    NOT NULL,
        SUBDESC       CHAR    (32) );

GRANT SELECT ON TSDATATYPES TO PUBLIC;

CREATE UNIQUE INDEX TSDATATYPES1 ON TSDATATYPES(DATATYPE,SUBTYPE);
CREATE UNIQUE INDEX TSDATATYPES2 ON TSDATATYPES(DATATYPE);


REM  TSMINERALS IS THE TABLE FOR A THIN SECTION'S COMPONENT MINERALS OR CLASTS

CREATE TABLE TSMINERALS (
        TSNO          NUMBER (6)    NOT NULL  REFERENCES THINSECTIONS(TSNO),
        MINERAL       CHAR    (4)   NOT NULL  REFERENCES TSMINCLASTS(MINABBREV),
        PERCENT       NUMBER (3,1),
        OCCMODE       CHAR    (4)             REFERENCES TSMINOCCMODES,
        COMMENTS      CHAR    (64),
        ENTEREDBY     CHAR    (16),
        ENTRYDATE     DATE );

GRANT SELECT ON TSMINERALS TO PUBLIC;

CREATE INDEX PETMINNOS ON TSMINERALS(TSNO);

CREATE VIEW UTSMINERALS AS SELECT * FROM TSMINERALS WHERE ENTEREDBY = USER;

GRANT SELECT, INSERT, UPDATE, DELETE ON UTSMINERALS TO PUBLIC;


REM  TSCLASTYPES IS THE VALIDATION TABLE FOR CLAST TYPES (AND MATRIX)

CREATE TABLE TSCLASTYPES (
        CLASTABBREV     CHAR    (4)  NOT NULL,
        CLASTNAME       CHAR    (32) NOT NULL );

GRANT SELECT ON TSCLASTYPES TO PUBLIC;


REM  TSMINCLASTS IS A VIEW OF A UNION BETWEEN NGMA.AGSOMINERALS AND TSCLASTYPES
REM  THIS IS THE VALIDATION VIEW FOR ENTRIES IN THE TSMINERALS TABLE

CREATE VIEW TSMINCLASTS AS
        SELECT MINABBREV, MINNAME, 'MIN' MIN_OR_CLAST FROM NGMA.AGSOMINERALS
    UNION
        SELECT CLASTABBREV, CLASTNAME, 'CLAST' FROM PETROG.TSCLASTYPES;

GRANT SELECT ON TSMINCLASTS TO PUBLIC;
```

```
REM  TSMINOCCMODES IS THE VALIDATION TABLE FOR MINERAL OCCURRENCE MODES

CREATE TABLE TSMINOCCMODES (
        OCCABBREV     CHAR    (4)  NOT NULL,
        OCCNAME       CHAR    (32) NOT NULL );

GRANT SELECT ON TSMINOCMODES TO PUBLIC;


REM  ROCKMINSITES IS A VIEW COMBINING SITE, ROCK, THIN-SECTION & MINERAL DATA
REM  MAY BE USED FOR ARCINFO PLOTTING OF ROCK TYPES AND THIN-SECTION MINERALS
REM  YEILDS ONE RECORD PER MINERAL, OR ONE PER THIN SECTION IF NO MINERALS NOTED

CREATE VIEW ROCKMINSITES AS SELECT
        SITES.ORIGNO ORIGNO,
        SITES.SITEID SITEID,
        SITES.COUNTRYID,
        SITES.STATE,
        SITES.GEOPROVNO,
        SITES.SUBPROVNO,
        SITES.DOMAINNO,
        SITES.HMAPNO,
        SITES.QMAPID,
        SITES.EASTING,
        SITES.NORTHING,
        SITES.ACCURACY,
        SITES.DLAT,
        SITES.DLONG,
        ROCKS.SAMPLEID SAMPLEID,
        ROCKS.ROCKTYPE,
        ROCKS.QUALIFIER,
        ROCKS.LITHNAME,
        ROCKS.GROUPING,
        ROCKS.STRATNO,
        ROCKS.AGE,
        THINSECTIONS.THINSECTID,
        THINSECTIONS.ROCKNAME,
        TSMINERALS.MINERAL,
        TSMINERALS.PERCENT,
    FROM NGMA.SITES, NGMA.ROCKS, PETROG.THINSECTIONS, PETROG.TSMINERALS
    WHERE SITES.ORIGNO      = ROCKS.ORIGNO
    AND   SITES.SITEID      = ROCKS.SITEID
    AND   ROCKS.ORIGNO      = THINSECTIONS.ORIGNO
    AND   ROCKS.SAMPLEID    = THINSECTIONS.SAMPLEID
    AND   THINSECTIONS.TSNO = TSMINERALS.TSNO (+);

GRANT SELECT ON ROCKMINSITES TO PUBLIC;
```

APPENDIX B - EXAMPLE REPORT

The following hard-copy output was generated by the Petrography Database report program PETROG.SQR - accessed at item 9 in the Petrography Database Menu. All thin section data from Site ID 92836410 were selected via the PETROG Report Selection Menu. The report output does not yet include references - just Reference IDs.

```
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                **********************************************
                PETROGRAPHY DATABASE - Thin Section Descriptions
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                **********************************************

                    Selection criteria are as follows -
                    Origno       = 23
                    Lower siteid = 92836410
                    Upper siteid = 92836410
                    250K Map     =
                    100K Map     =
                    Other where  =
                    Sort clause  = ORDER BY SITES.ORIGNO, SITES.SITEID
```

ORIGNO: 23 SITEID: 92836410 DATE: 18-MAY-92 STATE: QLD
LOC DESC: Northern Queen, NQD-2, Iron Range
PROV: 22 SPROV: DOMAIN:
100K MAP: 7572 AMGEAST: 749950 AMGNORTH: 8594950
LOC METHOD: 0 ABS ACC: 100 AIRPHOTO:
ELEVATION:

SAMPLEID: 92836410A ROCK NO: 14 LITH NAME: schist
NAME: L_QUAL:
DESC: graphitic schist
STRAT UNIT: Sefton Metamorphics

TS NO: 15
ROCK NAME: Graphite schist
COMMENTS: Sefton Metamorphics, Iron Range

DATA TYPE	SUBTYPE	DESCRIPTION
Metamorphic Tex	crenulated	
Grain Size	very fine	
Metamorphic Tex	schistose	
Metamorphic Gra	chlorite	

MINERAL NAME	VOL%	COMMENTS
Quartz	30	fine grained, sutured boundaries
Muscovite	30	finely laminated
Graphite	20	finely laminated
Carbonate	10	
Opaque Mineral	2	

SAMPLEID: 92836410B ROCK NO: 15 LITH NAME: schist
NAME: L_QUAL: graphitic
DESC: fine-grained, crenulated, banded graphitic schist
STRAT UNIT: Sefton Metamorphics

TS NO: 16
ROCK NAME: Graphite Schist
COMMENTS: Drillhole sample from Iron Range area

DATA TYPE	SUBTYPE	DESCRIPTION
Alteration	sericitic	pervasive in feldspar
Alteration	carbonate	minor
Grain Size	very fine	quartz up to 0.3 mm across in coarser lamellae
Metamorphic Tex	crenulated	defined by mica and graphite
Alteration	hematitic	associated with graphite and pyrite, minor

MINERAL NAME	VOL%	COMMENTS
Sericite	25	replacing feldspar
Quartz	20	interlocking grains in quartz-rich lamellae
Graphite	20	crenulated and intergrown with muscovite and sericite
Plagioclase	15	some alteration to sericite and carbonate
Muscovite	10	crenulated
Carbonate	3	replacing feldspar

```
Carbonate          2    infilling stringer veins
Pyrite             1    minor
  - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
```

(page break)


```
SAMPLEID: 92836410C      ROCK NO: 16       LITH NAME: schist
NAME:                                 L_QUAL:
DESC: graphitic schist, minor iron staining
STRAT UNIT:  Sefton Metamorphics
  - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
TS NO:   17
ROCK NAME: Graphite Schist
COMMENTS: Sefton Range Metamorphics
  - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 DATA TYPE         SUBTYPE                DESCRIPTION
Alteration        hematitic           associated with graphite
Alteration        sericitic
Grain Size        fine
Metamorphic Tex   crenulated
  - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 MINERAL NAME     VOL%      COMMENTS
Hematite                 associated with graphite and pyrite
Quartz            30
Sericite          20     crenulated and interleaved with graphite
Muscovite         20     crenulated and interleaved with graphite
Graphite          15
Carbonate         10     secondary
Pyrite            1      closely associated with graphite
  - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
SAMPLEID: 92836410D      ROCK NO: 17       LITH NAME: schist
NAME:                                 L_QUAL:
DESC: chlorite-rich rock with abundant iron staining
STRAT UNIT:  Sefton Metamorphics
  - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
TS NO:   19
ROCK NAME: Chlorite Schist
COMMENTS: Sefton Metamorphics
  - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 DATA TYPE         SUBTYPE                DESCRIPTION
Metamorphic Tex   foliated
Metamorphic Tex   boudinaged          carbonate
Grain Size        medium              fine-grained quartz,
                                      carbonate up to 1-2 mm
Alteration        hematitic           minor iron staining
Metamorphic Gra   chlorite
  - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 MINERAL NAME     VOL%      COMMENTS
Quartz            30     fine-grained, grading into strongly
                         deformed and sutured
Chlorite          30     foliated, wrapping around carbonate
Carbonate         25     boudinaged,
Pyrite            5      foliated
  - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
```