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Exploration data management on a mineral province scale

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Since the late 1960s, mineral exploration programs have to a large extent covered the exposed portions of the basement geology of Australia's mineral provinces with surface sampling. In more recent times, extensive drilling programs have also investigated the covered areas adjacent to the basement blocks.

All these exploration data eventually come into the public domain, because Australia (unlike many other countries) is blessed with a mining law where this is a requirement of title. The Open File system, which releases the results of previous exploration activities, is no doubt one of the contributory factors to the enviable mineral deposit discovery rate in Australia. However, as the volume of material held in Open File records rapidly expands, the ability to interrogate efficiently by manual methods this valuable, but grossly fragmented, data source, is fast becoming impossible: Almost all of these data are still trapped as hard copy reports, on uncontrolled maps or on outdated technology such as microfiche.

Our estimate is that in the three mineral provinces of North Queensland that Terra Search has had most involvement with, the Mt Isa Inlier, Ravenswood Block and Drummond Basin, there are approximately 200 000 stream sediment samples, 400 000 soil samples, 150 000 rock chip samples and well in excess of 500 000 drillhole samples. Similar sample numbers would apply to other mineral provinces around the country. Until recently this great resource has been locked in a time warp, totally inadequate in its current form, for analysis by state of the art geoscientific information systems (GIS).

Although some major companies are compiling proprietary data sets, historical information is accumulating at a much greater rate than previously. Government agencies are custodians of geoscientific data, but they do not have the hands-on exploration experience, nor have they allocated serious funding to compile the historical open file data into a digital data base. Since the early 1980s, we have the rather bizarre situation that all geochemical data has left assay laboratories in digital form, but virtually no digital geochemical data has reached the open file system.

However, we can now say that we have the technology to improve this underutilization of available data.

The three elements required are:

1) a structured data management system which has to be in place to accept multifaceted new and historical exploration data.

2) geographical information and map-making systems to visualise the data. There are many packages in existence that can achieve this - all they need is good quality, accurately located data.

3) the willingness to wade through the mountain of historical reports to glean the critical data. A good working knowledge of the industry and rigorous persistence is required to successfully produce a standardised data set.

These three elements have in fact come together in North Queensland, for example, in the Mt Isa Block, AMIRA Project P413 on the optimisation of open file data is nearing completion, having realised many of its original objectives. This project is supported by 14 major exploration and mining houses and the Queensland Department of Minerals & Energy. Other major data compilations cover the Ravenswood Block and Drummond Basin.

Terra Search have researched and developed the EXPLORER II Data Management System, which utilises the power of a structured relational database, to capture, record, interrogate and visualise exploration data gleaned from historical reports (Beams, 1994). The first step in the process is the painstaking transfer of samples from uncontrolled hard copy maps to controlled drainage bases and subsequent digitising with AMG coordinates. After conversion to digital form, each sample sits in an interconnected framework accompanied by its essential attributes such as location information, sample collection methods, analytical techniques, assay data, with cross links into existing geoscientific and geographic data bases: eg. drainage bases, tenement information, regional geophysics. Examples of the relational cross links are given in Figures 1 and 2. With drill holes, information such as bedrock lithology, depth of transported cover, pyrite content are all stored and available for interpretation - see Figure 3.

A comprehensive geochemical data set has been built up for several mineral provinces, for example the Ravenswood Block and Drummond Basin regions. To date this set consists of 36 000 stream sediment, 20 000 rock chip, 80 000 soil, and 66 000 drill hole samples. Figure 4 illustrates this sample coverage in terms of 44 000 plus stream sediment samples analysed for bulk cyanide leach extractable gold in stream sediments (BCL's).

The Mt Isa data base currently stands at approximately 75 600 stream sediment, 16 300 rock chip, 55 000 soil, 27 600 drillhole samples; the latter coming from approximately 9 200 drillholes. Figure 5 is a plot of sieved stream sediment locations and gives an indication of the extent of the regional data currently residing in the data base. Figure 6 shows a subset of this data which plots only those samples analysed for Au by BCL or other methods.

Each one of these thousands of points is able to be queried and visualised on the basis of a host of attributes; eg. element content, sampling method, tenement (EPM) number, Company Report (CR) number, date and technique of analysis, geological unit.

The primary advantage of systematic data compilation such as this, is that the data is now available for analysis and visualization with application programs in a GIS environment. When this occurs, the geologist end user is in a strong position to take full advantage of the data, to establish trends in previously collected samples or historical surveys and integrate these with their own current project data.

As an example, it is easy to subset the data to show all samples in relation to a particular unit eg. the Lawn Hill Formation, then either carry out basic statistical analysis, print out, or plot this sub-population. Alternatively comparisons can be made between BCL samples collected with particular mesh sizes (eg. -20# compared to -9#) or those analysed by particular assay methods (eg. static compared to active leach).

The involvement of the Queensland Department of Minerals & Energy (QDME) has been pivotal, as it has allowed direct integration of the geochemical and geological data with the open file company report system, historical mineral tenement data and geological mapping. Figure 7 is an example of how the historical tenement layer can be interrogated and utilised with other geographical/geological layers. In this instance EPMs 1000 to 2000 have been selected and subsetted. Information such as CR#, date terminated, and title holder are all searchable.

In the not too distant future, geochemical and drillhole data required for statutory technical reports are likely to be requested from the tenement holder in digital format. Collaborative studies by the QDME and Terra Search have shown that relational data bases such as EXPLORER II would be suitable mechanisms for such data storage and transfer.

In the interests of efficient mineral exploration, it is imperative that historical and future exploration data is properly recorded and fully utilised. This requirement is accentuated by the increasing application of sampling procedures emanating from the Yilgarn Block, where CSIRO and AMIRA sponsored research has lead to a greater understanding of the regolith and utilisation of innovative sampling media in mineral exploration (see Anand and Smith, 1993).

Innovative developments such as partial extraction analysis (eg. BCL) or selective sampling media (eg. lateritic pisolites) have meant that raw assay numbers may no longer be directly comparable. Incorrect interpretations based on spurious comparisons are likely, if vital attributes on assay techniques and sampling methods are not recorded with assay data and accessible in a structured data management environment.

Thus, as mineral exploration in the Mt Isa Inlier moves into the next phase of the digital age, it is important to recognise that careful documentation of sample collection methods, analytical procedures and accurate sample location will be as essential in the future as it should have been in the past.

When these exploration data are combined with the other geoscientific data available, such as digital geology, Mineral Occurrence data, multiclient aeromagnetics, TM, Bulk Rock geochemistry, explorers over these mineral provinces will then have tremendously effective multi-layered data sets available to facilitate discoveries.

References:

Anand, R.R. and Smith, R.E., 1993. Regolith distribution, stratigraphy and evolution in the Yilgarn Craton - implications for exploration. In: An International Conference on Crustal evolution, metallogeny and exploration of the Eastern Goldfields (Eds. P.R. Williams and J.A. Haldane). Extended Abstracts. AGSO Record 1993/54

Beams, S.D., 1994. Recent developments in the management of exploration data from North Queensland. In: New Developments in Geology and Metallogeny: Northern Tasman Orogenic Zone (Eds. R.A. Henderson and B.K. Davis), pp. 23-26 EGRU Contribution 50, James Cook University, Townsville.

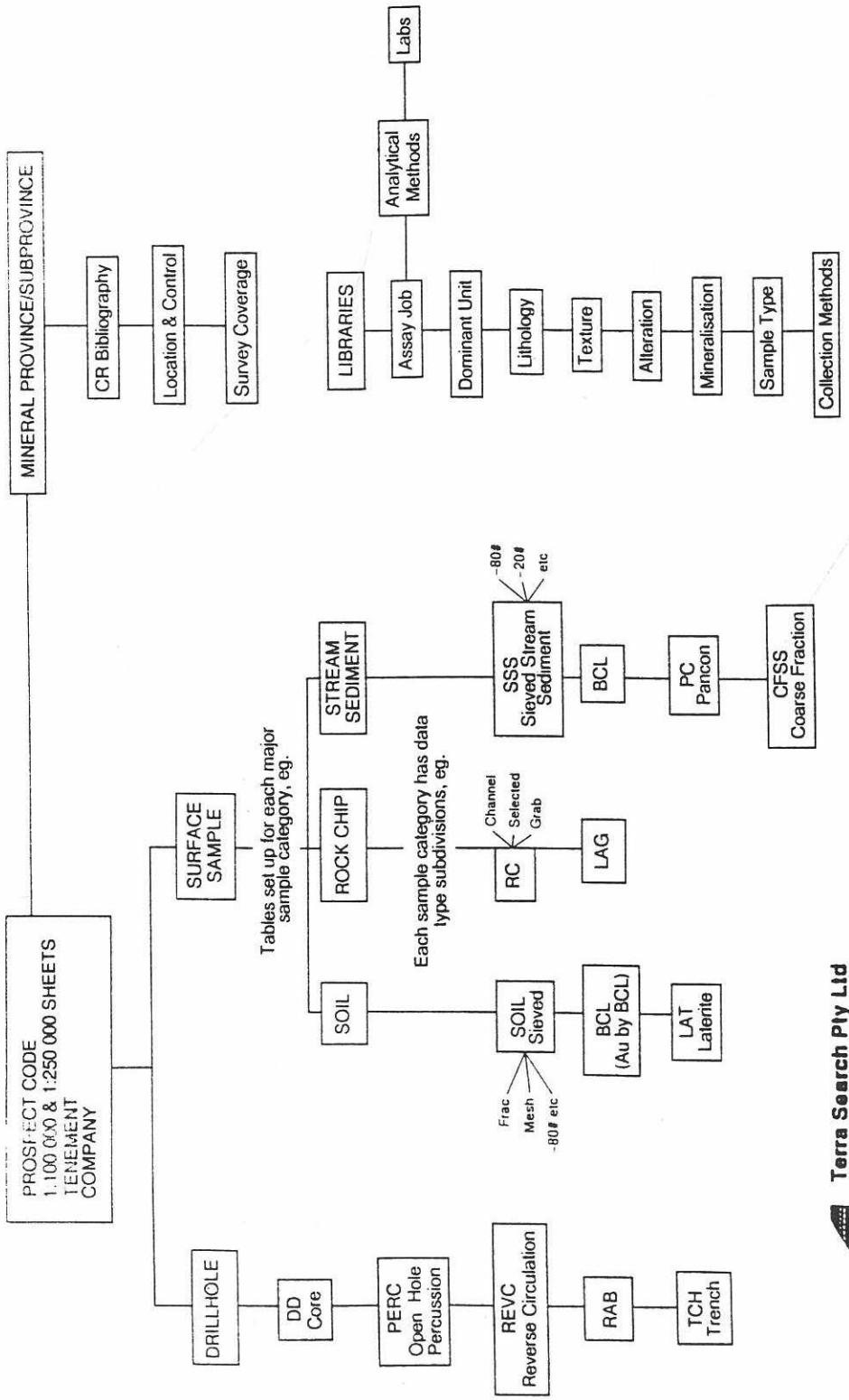

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Figure 1

EXPLORER II.1 DATA BASE MANAGEMENT
Organisational Schema for Major Information Categories

17/02/94 **TERRA SEARCH PTY. LTD. TOWNSVILLE - Explorer-II**

Decoded Rock Chip Ledger Report
Mount Isa Open File
Lake Gregory-Top Camp Prospect

SAMPLE : **17509**

Prospect : **LGTC** : Top Camp (Lake Gregory)
100k sheet : **6955** : Malbon
AMG N: 7670554 Local N:
AMG E: 440154 Local E:

Locality : Top Camp-Black Fort Fault Zone
Data type : Rock Chip sample
Dominant Unit : Overhang Jaspilite
Occurrence :Outcrop Method :Continuous Channel - 1.00 m
Sample Type :Alteration Zone

Photo Ref. : Run : Frame : :

Lode : Width : 4.00 m Length: 250.00 m
Strike: 40.0 deg. Dip : deg. Dir :

Lithology :
(SST)Sandstone
(QVN)Quartz Vein

Texture :
(STV)Stockwork Veining

Alteration :
Strong Sericite
Strong Silica

Mineralisation :
Vein 2% - 5% Quartz

Sulphide Content :

Assay Job details
Job Date : 1/3/89 Company Report #: 21072
Laboratory : Pilbara Laboratories AtoP/EPM : 3917

Geochem. results :

Au (ppm)	Au(r) (ppm)	Cu (ppm)	Pb (ppm)	Zn (ppm)	Ag (ppm)	As (ppm)	Mo (ppm)
0.010	0.015	75	<5	10	<1		

Bi (ppm)	Hg (ppm)	F (ppm)

Notes :

ELEMENT	UNITS	DET.LIMIT	PREPARATION & ANALYTICAL TECHNIQUE
Au	ppm	0.005	crush,weigh with flux (W/FLUX) 50g fire assay/Pb collection/AAS finish (313)
Au repeat	ppm	0.005	crush,weigh with flux (W/FLUX) 50g fire assay/Pb collection/AAS finish (313)
Cu	ppm	2	Dry,crush,split,pulverise (DCSP) Perchloric acid digest AAS finish (101)
Pb	ppm	5	Dry,crush,split,pulverise (DCSP) Perchloric acid digest AAS finish (101)
Zn	ppm	2	Dry,crush,split,pulverise (DCSP) Perchloric acid digest AAS finish (101)
Ag	ppm	1	Dry,crush,split,pulverise (DCSP) Perchloric acid digest AAS finish (101)

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Figure 2. Example of relational links between data and relevant libraries as shown by decoded rock chip ledger Terra Search EXPLORER II Data Base Management

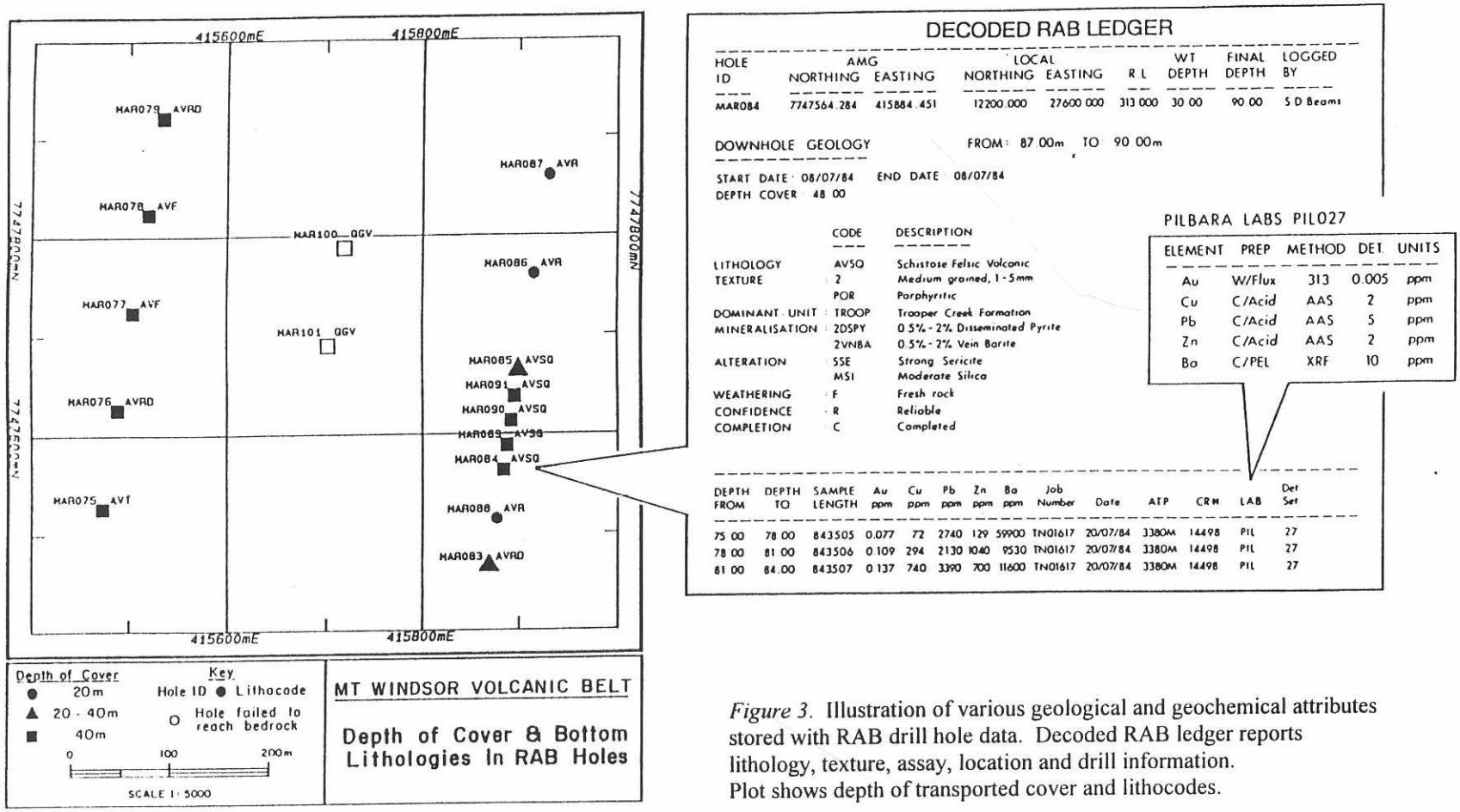

Figure 3. Illustration of various geological and geochemical attributes stored with RAB drill hole data. Decoded RAB ledger reports lithology, texture, assay, location and drill information. Plot shows depth of transported cover and lithocodes.

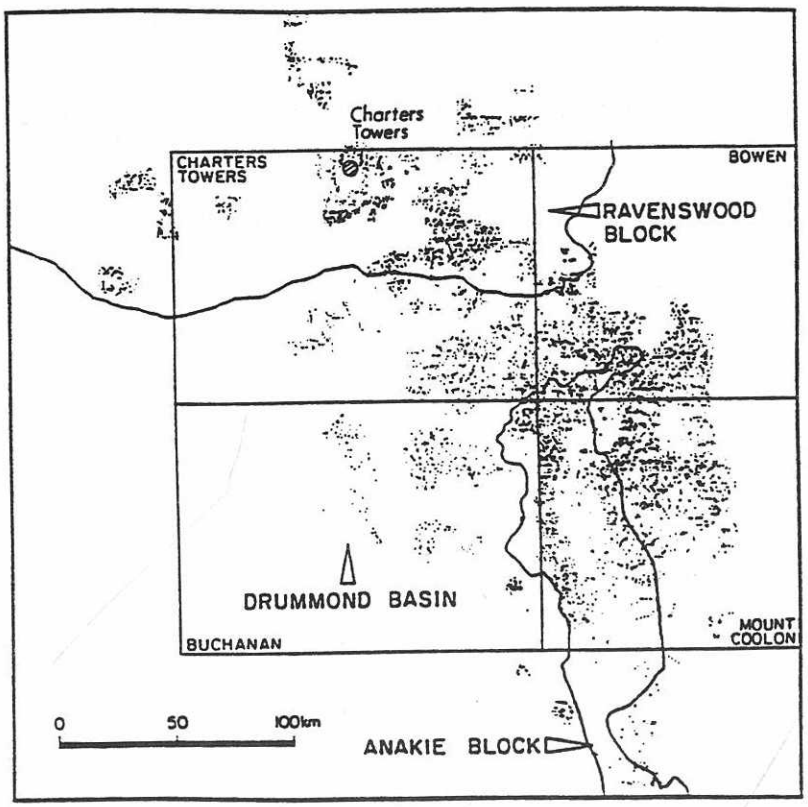

Figure 4. Distribution of BCL Stream Sediment sample data Drummond Basin and Ravenswood Block. 1:250 000 sheet boundaries shown. 14 000 points plotted.

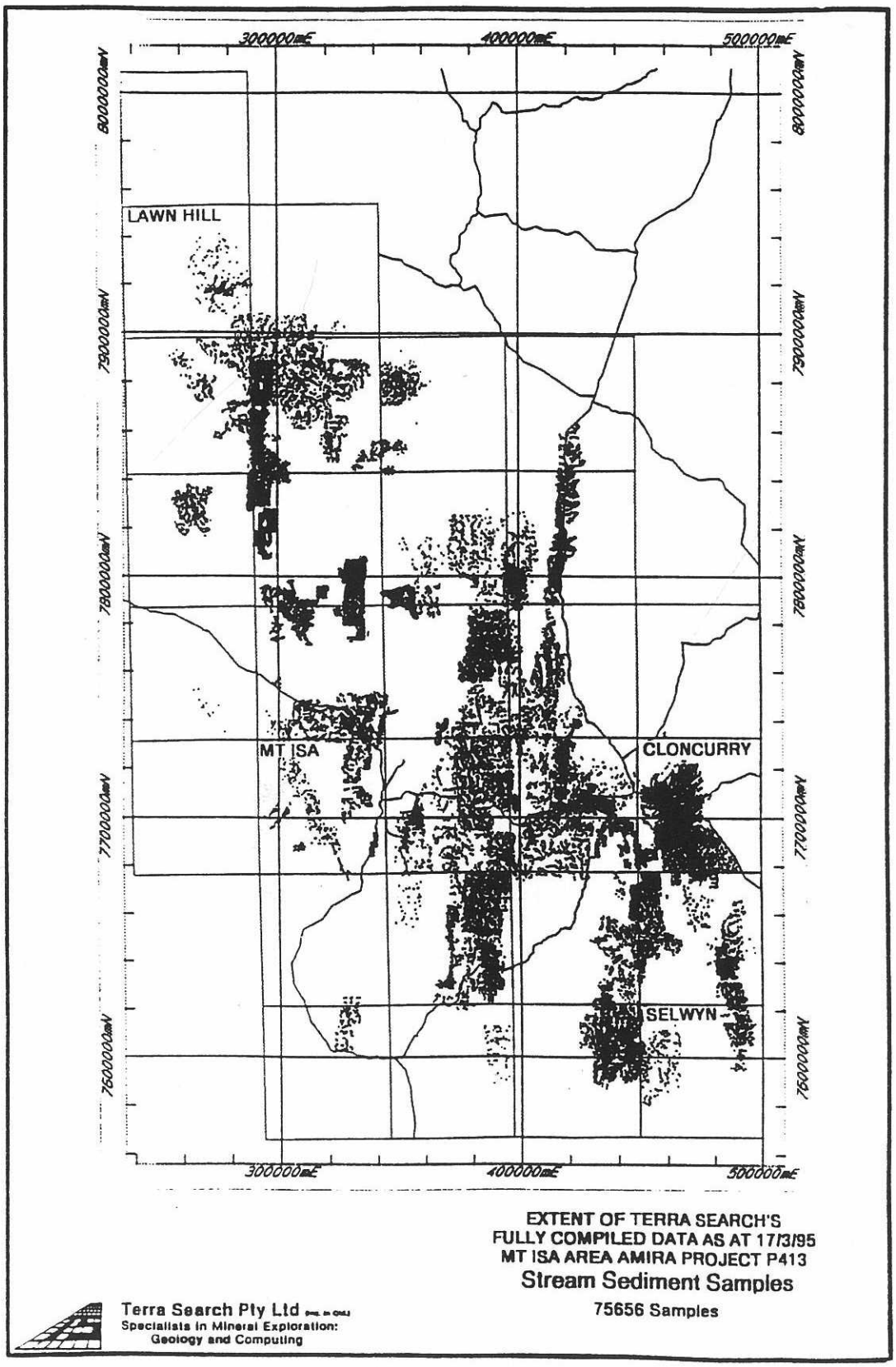
300000mE
400000mE
500000mE
8000000mN
7900000mN
7800000mN
7700000mN
7600000mN
LAWN HILL
MT ISA
CLONCURRY
SELWYN
EXTENT OF TERRA SEARCH'S
FULLY COMPILED DATA AS AT 17/3/95
MT ISA AREA AMIRA PROJECT P413
Stream Sediment Samples
75656 Samples
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Figure 5

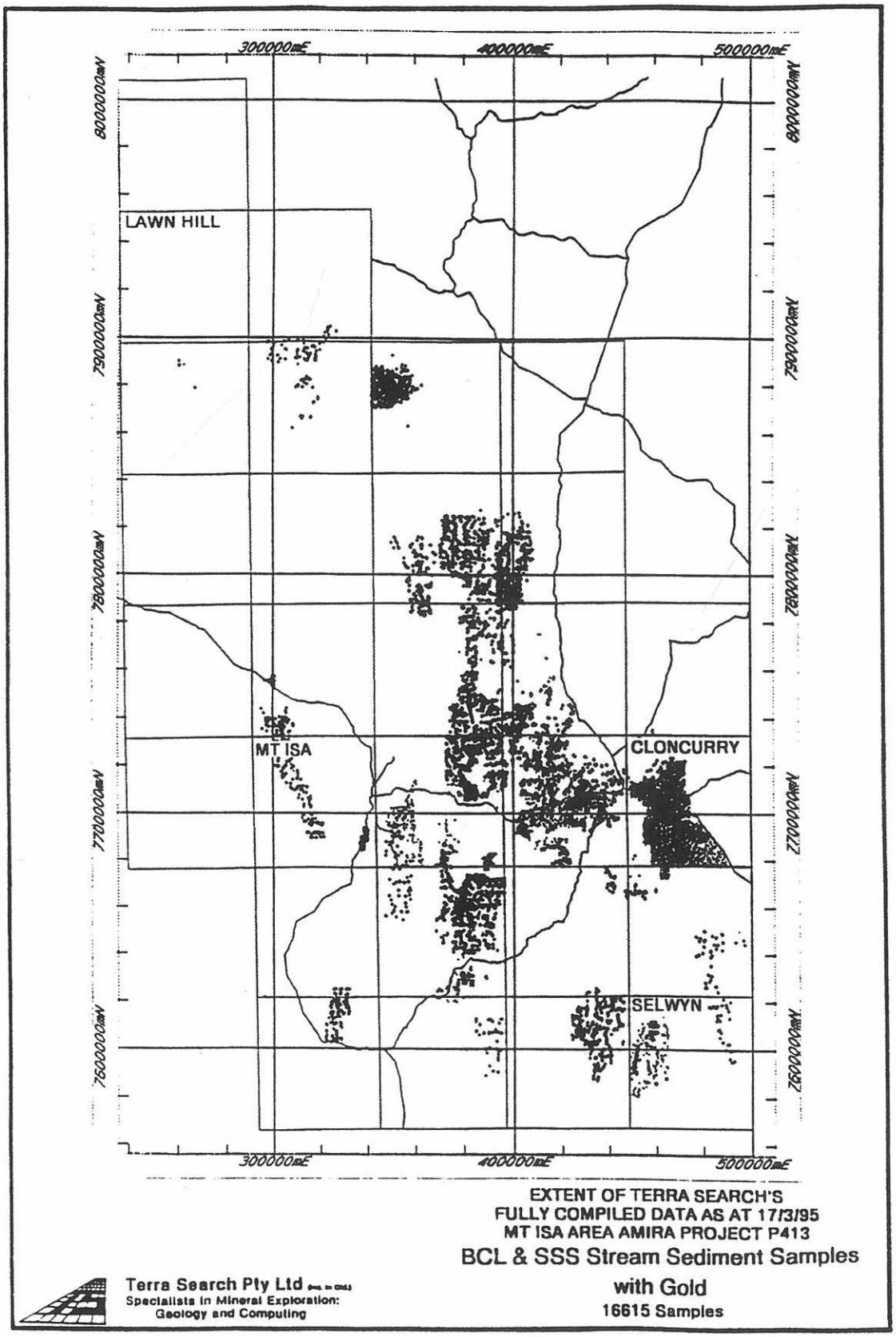
300000mE
400000mE
500000mE
8000000mN
7900000mN
7800000mN
7700000mN
7600000mN
LAWN HILL
MT ISA
CLONCURRY
SELWYN
EXTENT OF TERRA SEARCH'S
FULLY COMPILED DATA AS AT 17/3/95
MT ISA AREA AMIRA PROJECT P413
BCL & SSS Stream Sediment Samples
with Gold
16615 Samples
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Figure 6

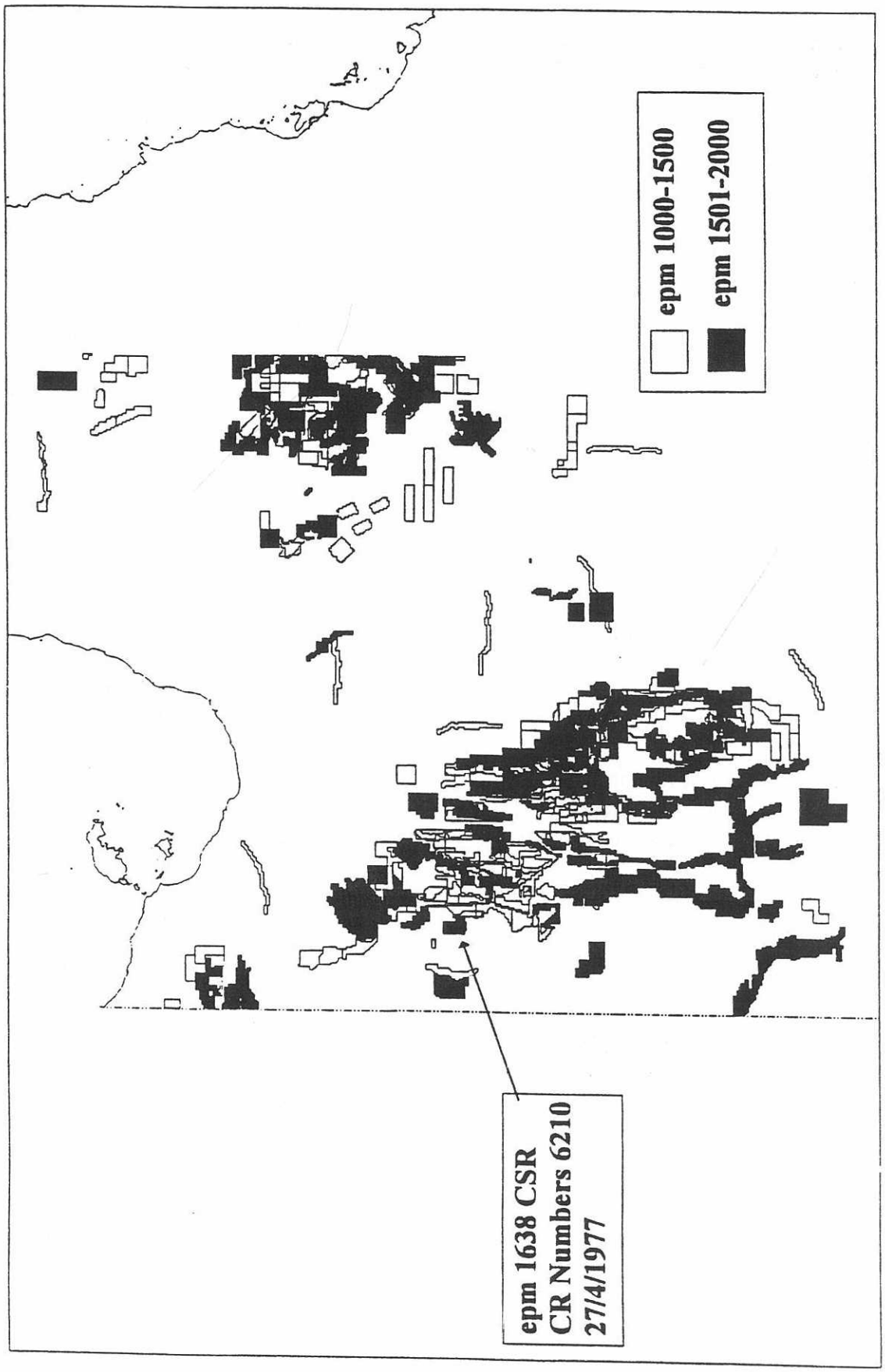

Figure 7. EPMs 1000 to 2000 for north west Queensland subsetted on EPM Number.