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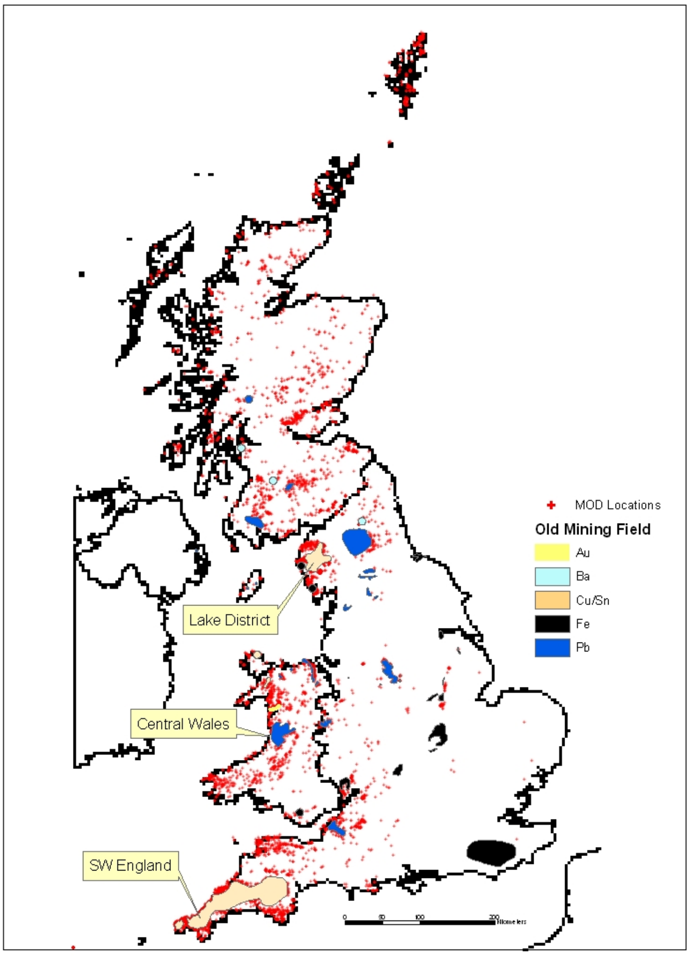
Mineral Occurrence Database suggestions for revision and update 2005

Internal Report IR/05/164



BRITISH GEOLOGICAL SURVEY

INTERNAL REPORT IR/05/164

Mineral Occurrence Database suggestions for revision and update 2005

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Foreword

This report reviews the current status of the Mineral Occurrence Database, examines current problems and suggests improvements to the database structure, the contents of the tables and ease with which it can be updated. It also makes suggestions for the staff input required for this.

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Contents

FIGURES

TABLES

1 Summary

The Mineral Occurrence Database contains over 12000 entries from all parts of Great Britain. It includes mineral occurrences associated with old mines and trials, unexploited more recent discoveries and panned stream sediment concentrates (mainly gold grains). It was developed in Oracle, using an Access interface with the user, in the mid 1990s. The database structure has been unaltered for many years. It now requires a thorough re-examination of all the entries to check their validity as well as a re-examination of the relationships between tables as some of the links have become corrupted and new data entry is either difficult or impossible.

The database has an important role in the future with the increasing interest in mine waste and environmental contamination, as well as to assist any commercial mineral exploration companies if necessary. However, this can only be realised if the database is current, accurate and comprehensive in both coverage and content.

The database has many problems and these are detailed in this report together with possible solutions. In addition, a number of suggestions are made for the update of the database, with estimates for the time required.

2 History of the Mineral Occurrence Database

The Mineral Occurrence Database (MOD) was conceived in the early 1990s as part of the DTI-funded Mineral Reconnaissance Programme (MRP). This was established in 1973 as one of the three BGS programmes to assist mineral exploration in Britain. The others were the Regional Geochemical Reconnaissance Programme (RGRP) – later the Geochemical Survey Programme (GSP) and currently G-BASE - and the Mineral Exploration and Investment Grants Act (1972) (MEIGA). The MOD was designed to capture and make publicly available information on all known mineral occurrences in Great Britain (England, Scotland and Wales).

The MOD was designed as a corporate BGS Oracle relational database by a team of database programmers, assisted by experienced BGS economic geologists. Some work was also completed by MSc or PhD students as part of their dissertations or theses (Fern, Payne and Shah). The design and implementation of the MOD was published in a series of internal reports (Cooper and others, 1994 and 1995; Fern and others, 1994; Payne, 1995 and 1995a). Various areas were assigned blocks of unique numbers, up to 5999, and population of the database was initially the responsibility of a number of experienced BGS economic geologists (see Table 1 for list of responsible staff members).

However, the MOD has since been populated in several small campaigns over a number of years, using the additional numbers as shown in Table 1. These have mainly been in conjunction with MRP or Minerals Programme projects. The data has been input partly by BGS staff and partly by students, including Leonardo placement students. The information for this has been taken partly from field observations by MRP staff, and increasingly from literature searches without associated field checking.

The MOD was designed to hold comprehensive data on metalliferous mineral occurrences and therefore includes locational information plus many additional fields, such as style and type of mineralisation, minerals present, discovery method, quality and reliability of observations etc. There are a large number of fields, including some of very limited utility, such as isotopic observations, which only apply to a very small number of occurrences. This leads to a complex structure for the database (Figure 2). As a result the database has been under-used and not fully populated.

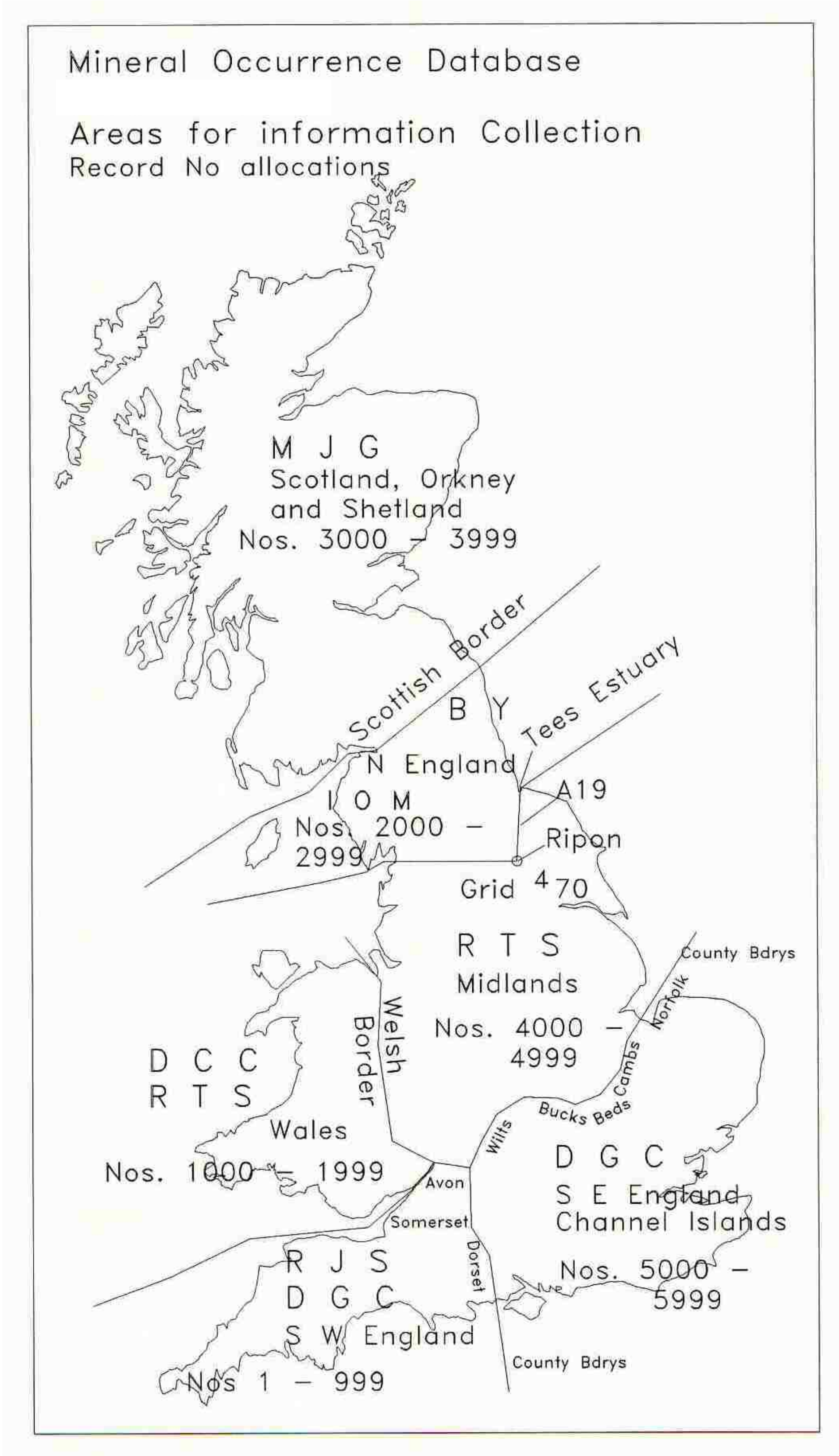


Figure 1. Original MOD regions and numbering system with initials of responsible staff.

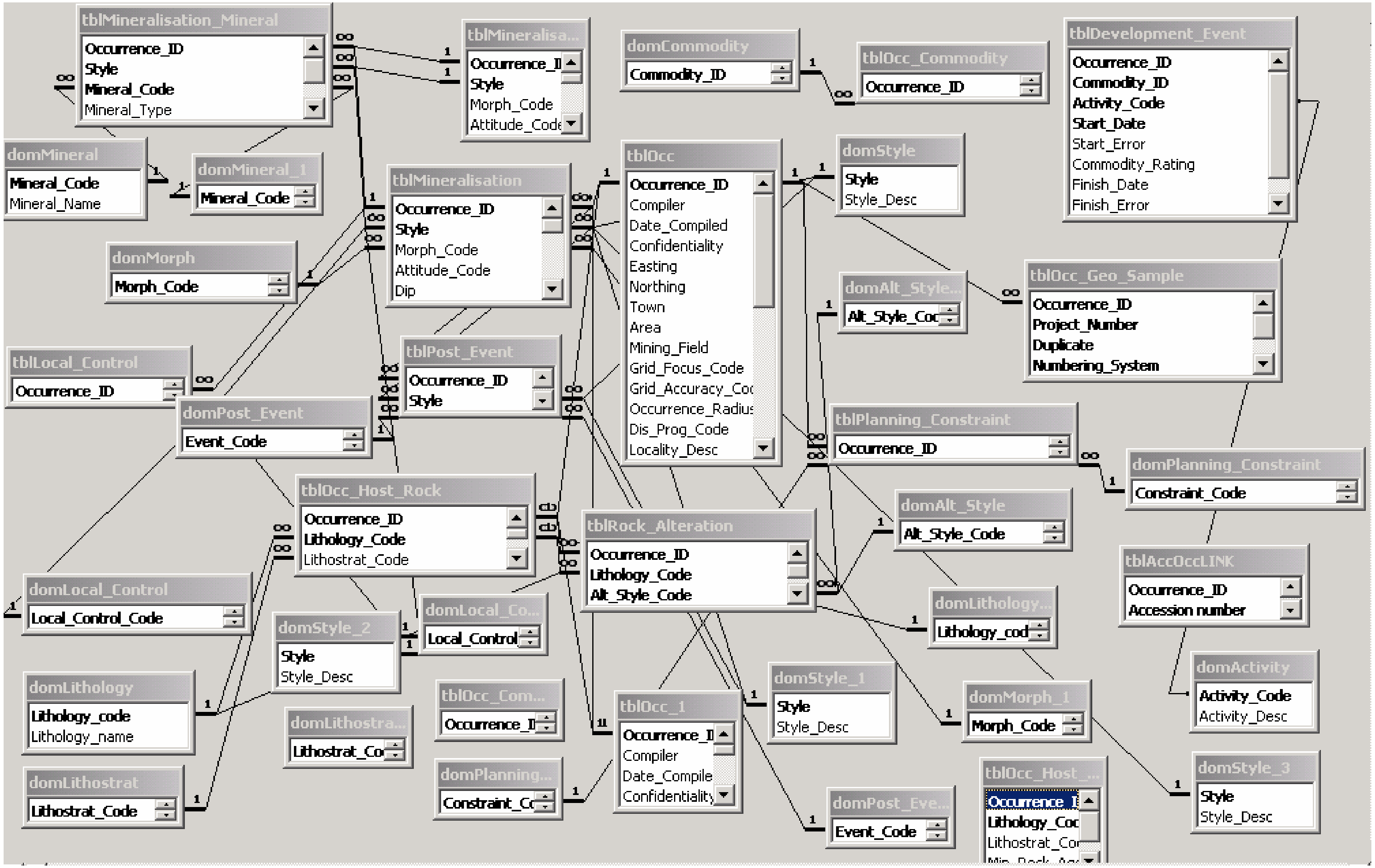


Figure 2 Entity-Relationship Diagram for the Mineral Occurrence database

3 Current position

The MOD currently contains 12551 records throughout Great Britain (Figure 3). Some of these are multiple entries of different minerals for the same locality, so the total number of unique localities is less than this.

The database was designed to hold information on mineral occurrences, though in practice it has concentrated on mines, as most mineral occurrences are found in and around mines. However, a number of occurrences, particularly those of alluvial gold, are recorded from panned concentrate observations during stream sediment sampling by the MRP and G-BASE. There is a single field for ‘mine tip’, as a location for a mineral occurrence. However, there is no associated table for information associated with mine tips; such as size, location, volume, condition, contained minerals, proximity to watercourses, houses etc and other useful data. This could be useful with the imminent implementation of the EU Mine Waste Directive.

The MOD is now also used, along with the Ove Arup dataset of areas potentially affected by mine subsidence, as part of the BGS GeoHazard project to indicate where metalliferous mining activity has taken place. The recent G-BASE Tamar survey used the MOD to locate old mines (Rawlins and others, 2003).

Unique occurrence numbers above 5999 have been assigned in blocks as population of the database continued. The current position is shown in Table 1.

Number Range	Area	Original compilers 1995
1 – 502	SW England	RJS / DGC
1000 – 1366	Wales – mainly stream locations	DCC / RTS
2000 – 2199	N England / IOM (north Cumbria and North Pennines)	BY
2700 - 2900	N England / IOM (Northern Pennines)	BY
3000 – 3842	Scotland (Mainly stream locations after 3075)	MJG
4000 – 4015	English Midlands	RTS
5000 – 5015	SE England – generalised gold locations	DGC
5100 – 5764	Scotland (variety of locations)	
6000 – 6694	N England	

7000 – 7315	Southern Pennine and East Midlands	
10000 – 11072	Wales	
11075 – 11112	Shropshire	
15000 - 15108	N England / Southern Scotland	
20000 - 25721	S W England mines	
25801 - 28738	SW England shafts by 10K map square	
28741 – 29215	Weardale adits and shafts	
30000 - 30349	Southern and northern Scotland	
30350 – 30377	Cheshire Basin	
30400 - 30402	Cheshire Basin, Yell and Weardale	
Initials	Staff member	
MJG	Mike Gallagher	
RJS	Richard Scrivener	
RTS	Rod Smith	
DGC	Don Cameron	
DCC	Derek Cooper	
BY	Brian Young	

Table 1. Unique numbering system

3.1 Related activity outside BGS

In Wales the Environment Agency has already constructed a list of around 1000 mines (without consulting BGS) and selected a 'top 50' for further research under its 'Metal Mine Strategy for Wales' project (Environment Agency, 2002). Ben Klinck is in touch with the EA and has carried out a pilot exercise on five mine tips in the Cwm Rheidol area to determine the bioavailability of heavy metals contained within them. BGS also completed a small contract for English Nature in 2004 to carry out a desk study of mines on 90 designated sites in England and Wales to determine the potential hazards under Part IIA legislation (Klinck and others, 2004). Many local authorities are also concerned about the potential liability and pollution issues associated with abandoned mines and their associated waste tips. For example, South Shropshire District Council has surveyed all the mine shafts in the Shropshire mining district. A number of councils in Southwest England and the Southern Pennine Orefield have inspected and capped shafts. The forthcoming implementation of the EU Mine Waste Directive may also require information on mine tips that could be held in the MOD.

It is clear that there is an increasing demand for information about the environmental effects of former mining activities. There may therefore be an increasing, and diverse, call for information from the MOD and it is important that this database is as comprehensive and up-to-date as possible.

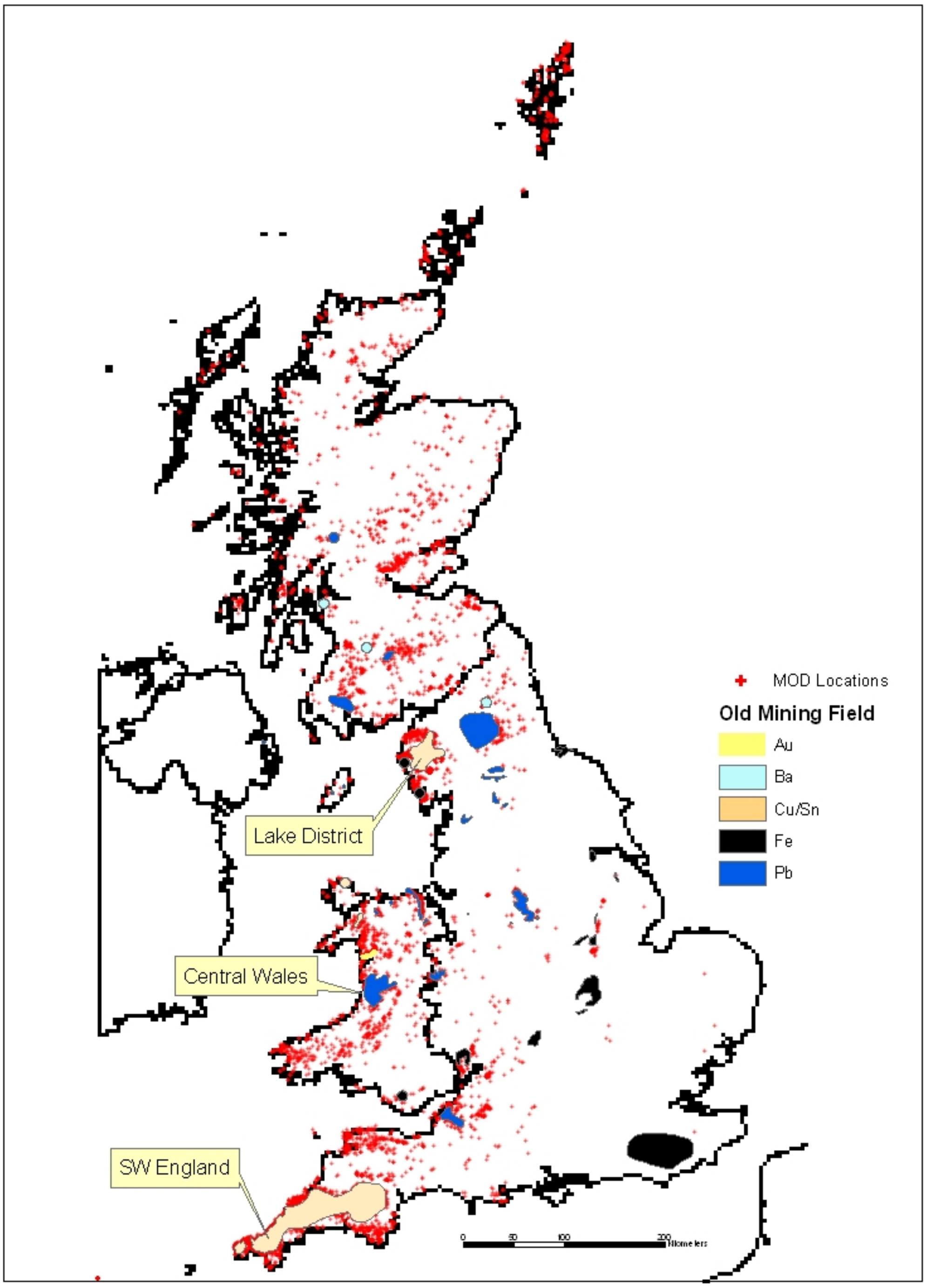


Figure 3. Current location of MOD records

The MOD tables are populated to varying degrees as shown in Table 2 below. Some of the tables, for example the Activity table, just hold the relevant lookup table (in this case just 7 stages of activity from no recorded activity at a site (Code = 0) to currently producing (Code = 7)). Others, which include links to the Occurrence Number list, have more records. However, it can be seen that many tables contain very little information.

Table	Records	Table listing
BGS_MGS_ACTIVITY	7	Activity and Code
BGS_MGSCOMMODITY_DOMAIN	155	Commodity and Code
BGS_MGS_DEVELOPMENT_EVENT	365	Occ No Commodity(ies) and Start/Finish dates
BGS_MGS_GENETIC_AFFINITY	92	Genetic Affinity and Code
BGS_MGS_LITHOLOGY	86	Lithology and Code
BGS_MGS_LOCAL_CONTROL	29	Occ No, Style Code and Local Control Code
BGS_MGS_LOCAL_CONTROL_DOMAIN	17	Local Control and Code
BGS_MGS_MINERAL	196	Mineral Code, Petmin Code LD Mineral Code and Mineral Name
BGS_MGS_MINERALISATION	4222	Occ no and Style Code
BGS_MGS_MINERALISATION_MINERAL	6131	Occ No, Style Code and Mineral Code
BGS_MGS_MIN_STYLE	18	Style Code and Style Description
BGS_MGS_OCCURRENCE	12551	Occ No, Compiler, Date, NGR, Mining Field, Occ Description and Occ Name
BGS_MGS_OCCURRENCE_COMMODITY	6368	Occ No and Commodity Name
BGS_MGS_OCCURRENCE_HOST_ROCK	202	Occ No and Lithology Code
BGS_MGS_OCCURRENCE_TYPE	28	Occ Type code and Occ Type Description
BGS_MGS_PLANNING_CONSTRAINT	2	Occ No and Constraint Code

BGS_MGS_RANK	4	Abundance Code and Abundance Description
BGS_MGS_ROCK_ALTERATION	0	Occ No, Lithology Code, Alteration Code
BGS_PETMIN_CODE	60297	BGS Petmin code

Table 2. Current population of MOD tables

3.2 The ideal mineral occurrence database

The Mineral Occurrence Database should have the following characteristics:

- Capable of holding information on all mineral occurrences in Britain
- Designed for full compliance with BGS data standards
- Designed for ease of data entry, manipulation, retrieval and export
- Full integration with accompanying bibliographic database
- User-friendly front-end system for entering, interrogating and retrieving information
- Rapid and simple operation with easy maintenance
- Capable of connection to, and interaction with, other BGS corporate databases

It is suggested that the MOD meets the majority of these requirements, but some problems remain as documented in Section 4.

4 Problems

The MOD was designed so that each occurrence could be populated with as much information about the occurrence as possible. However, many of the fields remain empty due to lack of information. These fields include many aspects of the locality, as well as details such as isotopic data and history of production and development.

The definition of an occurrence and whether it should be entered into the MOD are poorly defined. An occurrence has been previously defined as anything from a geochemical anomaly identified during a field survey, to a former, or currently working mine. The lack of a clear definition devalues the database and makes interpretation of the occurrence records difficult. A number of the occurrences in the MOD are relatively minor and constitute a rare or obscure mineral identified by a collector that is only of interest to mineralogists. This would imply it is also a ‘Topographic Mineralogy’ database in a similar fashion to the www.mindat.org database.

When the MOD was originally designed it was created so that limited numbers of people could enter occurrences to ensure quality of data entry was maintained. Once occurrences had been entered into the database, a database management team would “be responsible for all aspects of maintenance and development of the database, input and control (including validation, confidentiality and quality assurance) of the data and physical security of the system”.

Unfortunately, this database management team has been depleted since the MOD started and the quality of occurrence entries into the MOD is very variable. Many entries are incorrectly spelt or incomplete and some do not contain any details of the mineral that is actually present at the occurrence. Other problems with the MOD data entry screen are discussed below.

4.1 Entry screen

Currently, there are only two mandatory fields for the population of each occurrence: *grid reference* and *occurrence ID*. The occurrence number does not have to be sequential and records are stored in the order that they are entered in the database and not in numerical order. It would be useful if there were other mandatory fields so that fewer fields would be incomplete when each occurrence is entered. Suggestions for mandatory fields are listed in Section 6.2 below.

4.2 Grid accuracy code

Problem: The options for this drop-down box are 100 km, 1 km, 100 m, 10 m and 1 m. Any occurrence where the grid reference is not known within at least 1 km, if not 100 m, will not be accurate enough to be useful and could be misinterpreted as evidence for other occurrences in the area.

Solution: The only options in the drop-down menu should be for 1 m, 10 m and 100 m. Any occurrence where the grid accuracy is not known within 100 m should not be entered into the database.

4.3 Discovery programme

Dis_Prog_Code	Dis_Prog_Desc
0	Undifferentiated
A00	BGS Programmes
AA0	(Core/Science vote)
AAA	Geological mapping
AB0	PES Transfer
ABA	Geochemical Survey Programme
AC0	EC Project
B00	DTI Programme
BA0	DTI/BGS Commission
BAA	MRP
BB0	Other DTI funded Programmes
C00	DoE Programme
CA0	DoE/BGS Commission
D00	Other Central Government Programmes(inc QUANGOS)
E00	Other Public Funded Programmes
EA0	Local Authorities
F00	Company Programme
FA0	MEIGA Supported (1971-84)
FAA	EVL, NE Scotland
FAB	Noranda, North Wales
FAC	Goldfields
FAD	Southwest Consolidated Mins.
FB0	Others
FBA	RTZ and subsids.
FBB	Navan Resources
FBC	Ennex International
FBD	Britcan Minerals

Problem: Only relatively few mineral occurrences have been found in recent times. Most are located around old mines and are therefore historical occurrences. The MOD was originally designed when mineral exploration in Britain was still at a significant level. Where it has entries, the Discovery Programme part of the entry screen is therefore populated predominantly with exploration company names such as Rio Tinto or Noranda, but does not give the option for entering "amateur find" or "historical occurrence" – see below. The field is also very similar to the *Discovered By* drop-down box, and this could be a source of confusion.

Solution: Add "historical" and "amateur find" to the drop-down options and make the field mandatory.

4.4 Occurrence type

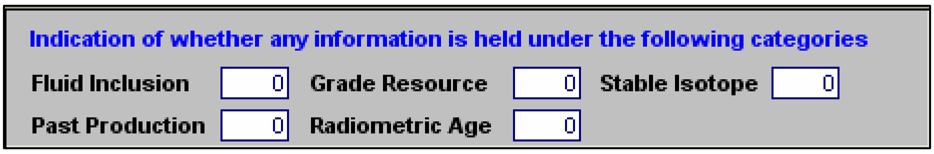
Problem: The criteria that determine what an occurrence is and whether it should be entered into the MOD are poorly defined. This field also contains the expression "geological occurrence" which is a confusing term and is not defined anywhere. There may be duplication of some records in the MOD in other databases such as the GBASE database and BRITPITS until the criteria of what constitutes an occurrence are more clearly defined.

OCC_TYPE_CODE	OCC_TYPE_DESC
000	Geological
A00	In situ
AA0	In rock
AAA	Primary
AAB	Supergene
AAC	Gossan
AB0	Residual
ABA	In soil
AC0	Precipitate (forming at present)
ACA	Springs
ACB	Seafloor
ACC	Lakefloor
B00	Transported (Placer)
BA0	In glacial deposits
BB0	In alluvial deposits
BBA	Stream sediment (active)
BBB	Terrace/overbank
BBC	Fan
BBD	Lake sediment
BBE	Estuarine sediment
BBF	Marine sediment
BC0	In beach deposit
BD0	In float blocks
BDA	In walls
BE0	In talus/head (eluvial)
BF0	In windblown (dune) deposits
BG0	In tipped material
BGA	Mine tip

Solution: Either remove "geological occurrence" from the list of drop-down options or define what this means. Provide a clear definition for the term "mineral occurrence".

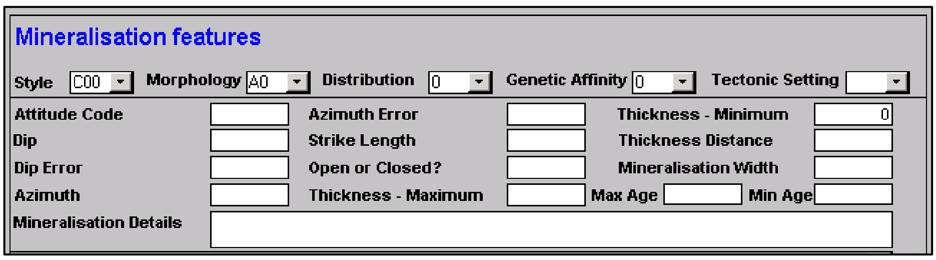
4.5 "Any additional information in the following categories?" section

Problem: There are many boxes in this section that were originally designed to be populated with "yes" or "no" depending on whether there is information held about certain subjects e.g. fluid inclusion data and radiometric age. These are rarely populated and their use is therefore limited. This part of the database is also in an inappropriate prominent position on the entry screen considering its low importance.



Solution: Move these boxes to a less prominent position on the data entry screen, such as the bottom of the form.

4.5 Mineralisation features

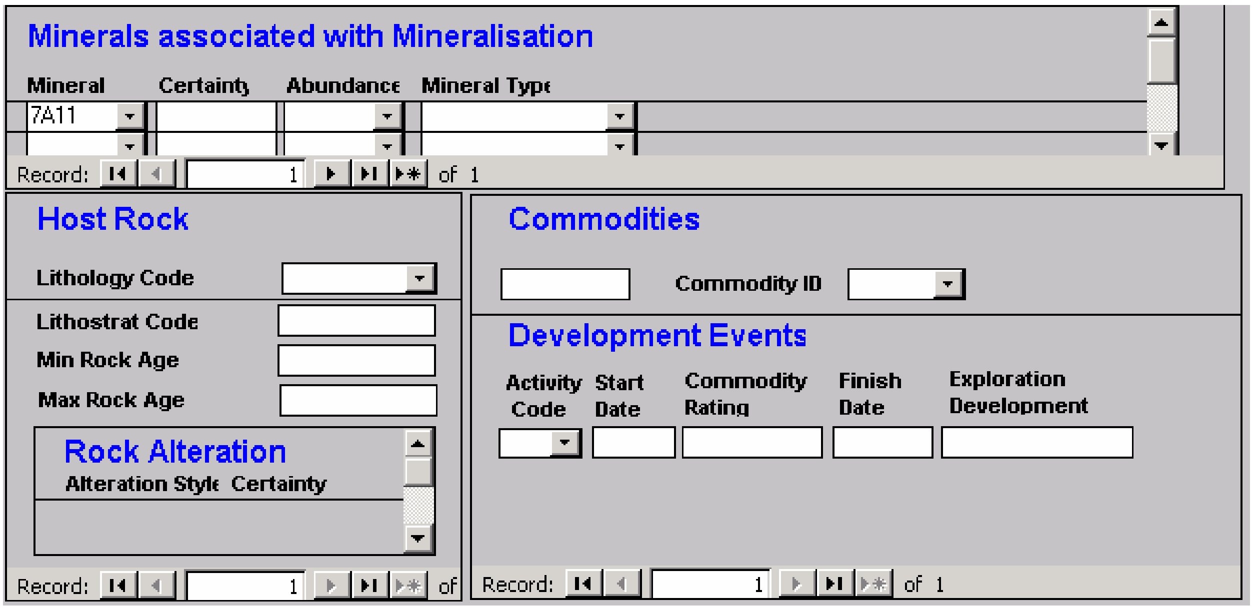


Problem: This section was developed to indicate predominantly metalliferous minerals, typically associated with veins. It does not allow sufficient flexibility to allow it to be populated with minerals where the origin of the mineral is uncertain. This section is also too prominent and takes preference over the actual mineral occurrence.

Solution: This section could be moved to a lower position on the form below details of the mineral. Many of the boxes could be deleted for clarity.

4.6 Commodity

Problem: The *commodity* field is one of the most useful features of the database as it enables a search on ‘all gold localities’ or ‘all copper mines’. This is the criteria used by mining companies and others, particularly with the development of GIS-based mineral potential mapping techniques. However, in strict database terms the commodity field should not be used unless the location has actually produced the commodity(ies) in question. This is very difficult to achieve in practice as it is impossible to define what ‘production’ actually consists of, especially when many of the localities have no known history of production. There is an excellent series of books produced by Roger Burt and co-workers from Exeter University (see for example Burt and others, 1987), which detail mineral (metal) production from numerous mines throughout Britain. However, there are still many notable occurrences, such as Gairloch (Cu-Zn-Au) and Littlemill (Cu-Ni) that are important occurrences, but have never produced any of the commodities they contain. If the commodity is not listed, for the reasons stated above, then many important localities would not be picked up on a ‘commodity’ search. Searching using the mineral name would not be helpful as a copper locality may contain numerous copper minerals (chalcopyrite, covellite, cuprite, malachite, azurite etc). The search would be much more difficult than just using ‘copper’. There are also a number of localities which do not have any minerals listed.

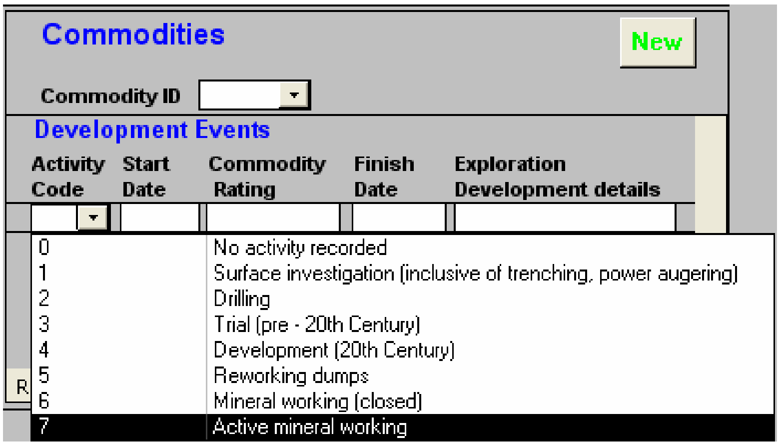


Solution: The *commodity* field should be filled, if possible, with names of commodities that have been, or could be, produced from the locality. There will be some occurrences of, for example, silicate minerals where there can be no commodity. These will only be of interest to mineralogists who may search for individual mineral species anyway.

The definition of what a commodity is should be written clearly next to the entry box to avoid confusion and to ensure the box is populated correctly. It is suggested that the name ‘**Commodities’** be changed to ‘**Elements of interest’** to reflect the actual nature of the field.

4.7 Development events

Problem: This section of the form should contain information concerning the development history of the occurrence (if known) if the occurrence was worked in the past. Unfortunately, the section does not often work and error messages are recorded when data is entered.



Solution: This needs further investigation into determining why these error messages occur.

4.8 Accession/Occurrence

Problem: This section of the form should contain a link to further information about the occurrence if a reference has been used in its description. Unfortunately, this link does not work as it is trying to look on the M drive where the data no longer exists.

Solution: The correct drive and location where the bibliographic details are located needs to be updated here.

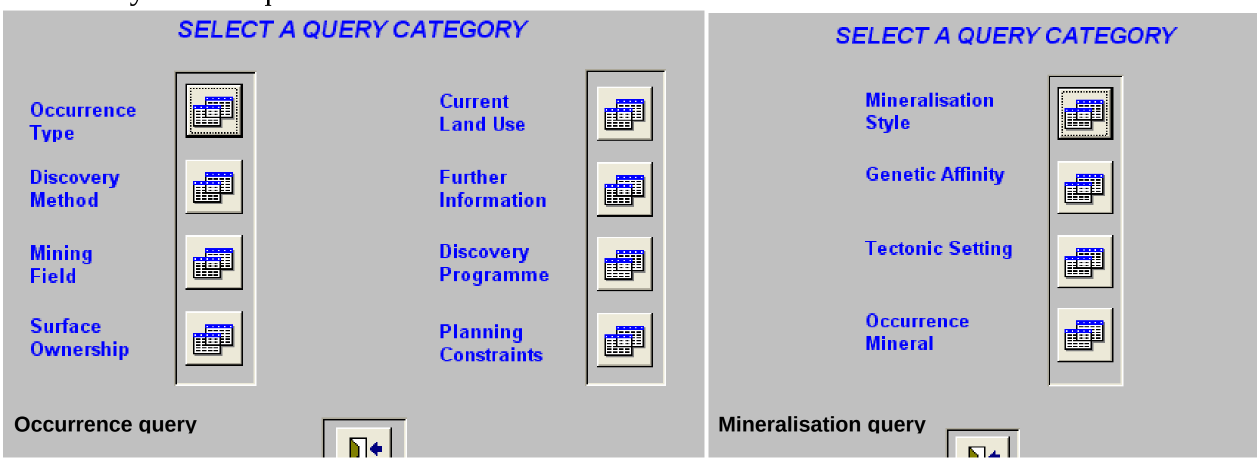
4.9 Other redundant tables

Problem: The *Land Use* and *Planning Constraint* domains are redundant following the development of GIS for display of spatial datasets. These corporate datasets allow the continuous updating of the land use around any mineral occurrence and this information should not be locked in a static database. The *Owner Type* domain is also redundant as a) the owner is generally not known and b) the owner can change and is irrelevant to the mineral occurrence.

Solution: All these fields should therefore be removed from the MOD.

4.10 Searching

A good database structure should enable the storage and rapid retrieval of data using a search function. User-defined parameters are entered and all entries matching those parameters are selected in the retrieval process. This allows multiple entries to be extracted simultaneously and then analysed as required.



The MOD has been designed to allow searches to be made on all entries in the database for many commonly requested fields. For example, the ability to select occurrences based on mineral type allows all occurrences to be selected for the mineral(s) to be displayed within defined coordinates. Unfortunately, due to data entry errors in the database, the search function part of the MOD does not always display all the occurrences in the database that may be present. For example, if a search on “mining field” were undertaken, only those occurrences that had been populated with a mining field would be extracted but not those that were not assigned a mining field.

The current query selection (above) just has two menus for occurrence and for mineralisation. The occurrence query menu does not have an ‘occurrence name’ request and the mineralisation query menu does not have a ‘mineral name’ request. The requests listed on the menus are not of much use for most enquirers, apart from the mining field request. These menus require modification. Most of the requests could be removed but Occurrence Name and Mineral Name should be added.

5 Potential uses of the MOD

The MOD has many potential uses that could range from identifying former (or current) mine workings, to identifying sources of contamination in the environment, to assisting commercial mineral exploration companies.

An important future use of the MOD is likely to involve the determination of mineral waste dumps and environmental contamination that may be required as a result of the ratification of the EU Mine Waste Directive. In its current form it may require the identification and classification of all abandoned mine waste facilities within 3 years. It is not entirely clear whether this will only apply to the larger waste tips, or include all with potentially hazardous materials within them. In any case, you have to know where the tips are before you can classify them in terms of their size or potential toxicity. Thus the MOD could be used as a suitable host for additional tables concerned with mine waste.

6 Recommendations

6.1 General

The entire MOD requires a thorough examination and checking against the GDI to make sure all locations are in the right place. Any cursory examination of any area shows serious discrepancies between the MOD location and the ‘actual’ location as plotted by the Ordnance Survey, whether on a current map or historic map. Many more locations are shown on some OS sheets (for example in the Snowdon area) than are listed in the MOD. Some areas, such as the Craven Basin, are devoid of MOD locations, although there are numerous small localities known and recorded from the area.

Another suggestion is that the MOD is completely re-designed from the start in a user-friendlier format. This would involve the extraction of all existing data, to prevent the loss of any information, and the complete re-design of a new database structure where the data could be entered. In the short term this would require the most time, however, considering the problems with the MOD discussed above, this may be the best option in the long term as the end result would be a much more friendly entry and query screen from which to extract information.

The Scan and Shaft project is capturing every single shaft and level and contact needs to be maintained with this project to ensure that data locations are consistent, although the two project do have different aims and objectives.

6.2 Entry screen

The format of the data entry screen is too complex and not user-friendly. There is too little emphasis placed on the actual mineral occurrence and many data entry boxes that are unlikely to be populated.

In order to avoid confusion as to what the different data entry boxes mean and what information they should contain, the definition of each box should be stated next to each box. This could be achieved by placing a question mark symbol that can be clicked to reveal the definition of the box, or to display the definition when the cursor is hovered over the question mark symbol or the actual box.

There should be a number of fields that are mandatory as discussed in Section 4.1. These relate to the location and discovery method for the occurrence that enables the occurrence location to be verified and accurately plotted on a map.

- Occurrence ID
- Compiler
- Date compiled
- Easting
- Northing
- Occurrence name
- Locality description
- Grid focus code
- Grid accuracy code
- Discovered by
- Occurrence type
- Discovery method
- At least one mineral included per occurrence containing
    - Abundance (trace, minor, major)
    - Mineral type
    - Commodity (Element of interest)

Where a commodity has also been entered, the following field should also be compulsory

- Activity code

6.3 Queries

There are a number of queries in the MOD. Many of these are for specific questions no longer required, or are variants of one main query. The queries should be investigated and any redundant or duplicate queries should be deleted.

6.4 Geochemical anomalies

Determine whether any records of geochemical anomalies are recorded as occurrences. These should be listed only in the GBASE database and not in the MOD.

6.5 GPS location

A box should be added to the data entry form stating whether the occurrence location has been identified using a GPS

6.6 Occurrence size

A box could be added containing the size of occurrence (trace, small, medium or large). Definitions of these will have to be decided. This could, however, cause problems as an occurrence could contain major quantities of pyrite, for example, but only traces of galena.

7 Timescale for updating MOD

If the database is kept in its existing format and the problems detailed above are solved, an estimated timescale for correcting the MOD would be as shown in the Table below. This figure is based on the assumption that no significant problems other than those indicated are discovered, and also that the problems listed can be corrected without serious difficulty. Should major problems be encountered, the staff time needed to correct and update the MOD would increase. It would also exclude the addition of new tables to the database, such as those that may be required for work in connection with the proposed EU Mine Waste Directive. A similar timescale would be required if the MOD were to be completely re-designed.

Staff type	Responsibility	Days required
Geologist	Data correction and new entry	60
Database manager	Checking current database structure, correcting any broken links, changing main entry forms, maintaining database	40 (Band 6)

It is suggested that the Lake District be used as the priority area to update and complete the MOD in that area. There is the existing Lake District mineral glossary (Young, 1985) which has been digitised as an Excel spreadsheet LDMINOCCS.xls. This can be compared with the MOD localities, using the GDI as shown in Figure 4, and existing MOD entries edited, or new localities added, as appropriate.

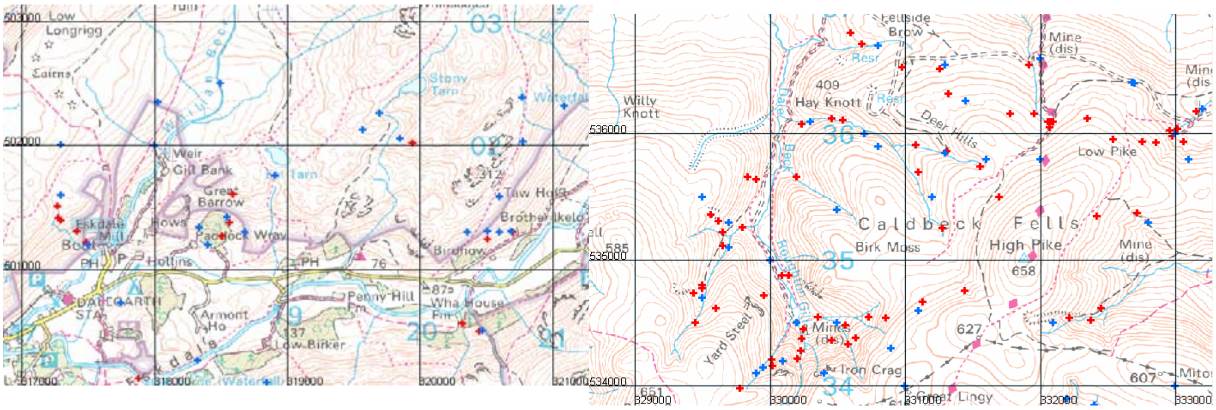


Figure 4. Two Lake District areas showing MOD (red) and LDMINOCCS (blue) locations.

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