Geologic database for digital geology of California, Nevada, and Utah — an application of the North American Data Model

By David R. Bedford[1], Steve Ludington[1], Constance M. Nutt[2], Paul A. Stone[1], David M. Miller[1], Robert J. Miller[1], David L. Wagner[3], and George J. Saucedo[3].

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1 U.S. Geological Survey, 345 Middlefield Road, Menlo Park, CA 94025

2 U.S. Geological Survey, P.O. Box 25046, Denver, CO 80225

3 California Geological Survey, 80-1 K St. MS 12-31, Sacramento, CA 95814

INTRODUCTION

The USGS is creating an integrated national database for digital state geologic maps that includes stratigraphic, age, and lithologic information. The majority of the conterminous 48 states have digital geologic base maps available, often at scales of 1:500,000. This product is a prototype, and is intended to demonstrate the types of derivative maps that will be possible with the national integrated database. This database permits the creation of a number of types of maps via simple or sophisticated queries, maps that may be useful in a number of areas, including mineral-resource assessment, environmental assessment, and regional tectonic evolution.

This database is distributed with three main parts: a Microsoft Access 2000 database containing geologic map attribute data, an Arc/Info (Environmental Systems Research Institute, Redlands, California) Export format file containing points representing designation of stratigraphic regions for the Geologic Map of Utah, and an ArcView 3.2 (Environmental Systems Research Institute, Redlands, California) project containing scripts and dialogs for performing a series of generalization and mineral resource queries.

IMPORTANT NOTE: Spatial data for the respective stage geologic maps is not distributed with this report. The digital state geologic maps for the states involved in this report are separate products, and two of them are produced by individual state agencies, which may be legally and/or financially responsible for this data. However, the spatial datasets for maps discussed in this report are available to the public. Questions regarding the distribution, sale, and use of individual state geologic maps should be sent to the respective state agency. We do provide suggestions for obtaining and formatting the spatial data to make it compatible with data in this report. See section '**Obtaining and Formatting Spatial Data**'.

The only spatial data distributed with this report is a set of points describing stratigraphic region codes for the Geologic Map of Utah. In the original version of that map (Hintze, 1980), there were separate description of map units and correlation of map units for several regions of the state. A small index map was provided to designate the boundaries of each region. The authors of this report have included these regional descriptions in the database, and have provided suggestions for incorporating these regions into the user-supplied geologic map in the section '**Obtaining and Formatting Spatial Data**'. Note that the use of these regional descriptions is not required, but may provide more detailed information to the user.

DATABASE OVERVIEW

This database is distributed as a Microsoft Access 2000 format database. The tables in the database reflect those described in "DIGITAL GEOLOGIC MAP DATA MODEL, Version 4.3" available at: http://geology.usgs.gov/dm/. This Data Model has also been termed the "North American Data Model Version 4.3", and will be referred to in this text as NADM 4.3. While this is a draft document, it represents a set of proposed standards for the structure and content of digital geologic maps. All background information regarding the intent, format, and contents of this data model should be referred to in the document referenced above. More background information can be found at: http://ncgmp.usgs.gov/ngmdbproject/standards/datamodel/datamodelWG.html and indicated links.

This database also contains several Microsoft Jet SQL queries that are intended to provide easy user access to common types of geologic information contained in the database. Many of these queries are general use queries that provide lithologic and age information, often involving manipulation of data hierarchies in the data model. Other queries are specific to mineral resource investigations that represent first-cut efforts to demonstrate the usefulness of the data structure.

DATABASE DESCRIPTION

Database Assumptions

Version 4.3 of the proposed Geologic Data Model is quite complex and flexible. Due to the lack of available datasets in this format, many assumptions have been included in the database. Many tables are blank or contain minimal information to satisfy the spirit of the Data Model. Furthermore, the data requirements for this data have constrained the use of the Data Model to specific usages of tables or fields within tables.

In many cases, there are one-to-one correlations between records in various tables in the database. Where possible, the ID's that serve as primary keys have remained the same. For instance, in this report there is a one-to-one correspondence between records in the **Classification_Object** table and the **COA** table. Matching records between these tables have the same **CLASS_OBJ_ID** and **COA_ID** values. To preserve database integrity, the **Data_Classification** table, which provides for a many-to-many relation between the two tables, is complete.

The NADM 4.3 specifies a compound key between spatial features in a GIS and their attributes in the rest of the database with the **Spatial_Obj_ID** and **Dataset_ID** fields to enable each spatial feature to not need to be uniquely identified outside of that dataset. While a good design feature, many GIS packages do not offer the capability to use a compound key, and thus the user would be required to filter through the correct **Dataset_ID** values before joining or relating to attribute data. This is further complicated by the fact that any spatial feature can belong to multiple classification objects, which essentially creates a three-field compound key based on the **Spatial_Obj_ID**, **Dataset_ID**, and **Class_Obj_ID** fields. What we have done is to uniquely identify each feature in all of the datasets discussed in this report to eliminate the need for further querying. While this is not feasible for very large datasets, users are encouraged to use the same scheme, as discussed below.

Database Tables

A complete listing of database tables and fields is included in Table 1 at the end of this report. For detailed explanations of the structure, relationships, and content descriptions, refer to the NADM 4.3 draft documentation. All of the tables and fields discussed in the data model document are included in this report, including tables that contain no data. This is to facilitate understanding of the complete database structure, future improvements in content, and to support software tools.

Several tables that are not documented in NADM 4.3 have been added to the database. These tables are used by a beta version of a software product being developed named "GeoMatter," which is intended to facilitate the attribution of geologic maps in NADM 4.3, as well as a version of the NADM put forth by the Canadian Geological Survey, informally dubbed NADM 5.2. Geomatter is currently under development, and is not available for release at this time. NADM 5.2 is also a draft standard that is available on-line at http://cordlink.gsc.nrcan.gc.ca/cordlink1/

One more table has been added to this database by the authors that is not included in NADM 4.3. This table is called '**Comp_Values**'. The design of the Data Model allows for multiple rock compositions per a given map unit. The **Rock_Composition** table allows for the map attributer to provide volumetric percentages as well as the accuracy, or quality, of that percentage that each rock composition contributes to the map unit. In many cases, such information is not given in an existing map Description Of Map Units (DMU). However, the typical nomenclature of a DMU is to give a list of rock compositions in a list of descending contributions. Since this list is inherently qualitative, it may be difficult or impossible to infer a percentage of contribution for each composition. What we have done is to use the attribute '**comp_seq**' in the **Rock_Composition** table to store such information. This field is intended to be an identifier for a unique rock_composition for a map unit. We have used the scheme of assigning the first rock composition listed in a DMU a value of 1, and numbering sequential rock compositions in the DMU with sequential comp_seq numbers. In this scheme, one can always retrieve an ordered, relative list of rock_compositions. To facilitate the English language usage of this structure, we have provided the **Comp_Values** table. It contains the range of comp_seq values in the **Rock_Composition** table, and English language *interpretation* of those values. We have adopted the following scheme for descriptions of comp_seq values:

comp_seq	comp_value
1	Primary
2	Secondary
3	Tertiary
4	Quaternary
5	Quinary
6	Senary
7	Septenary
8	Octonary
9	Nonary
10	Denary

This scheme allows a user to retrieve a textural description of a rock composition's contribution to a map unit. Clearly, these are draft values, and can be changed. They are included to provide access to a ranked list of contributions. There are also many instances where these values would not be appropriate. For instance, given a map unit containing two lithologies (rock compositions) it is impossible to tell if each lithology contributes 50% to the map unit, or if one lithology contributes an overwhelming amount to the map unit. Likewise, given a large number of rock compositions, it may be impossible to determine if each contributes roughly equal amounts to a map unit, or if some contribute very minor or accessory amounts.

Database Queries

We have included sets of SQL queries in the database that are meant to be of general geologic usefulness and for particular mineral resource evaluations. These queries are in Microsoft Jet SQL format, which is a variant on the SQL standard. While the datasets for this report are at a smaller scale than most mineral resource assessments, they are included to demonstrate the power of the data structure for that purpose. Care should be taken not to violate the scale constraints on the source data.

Due to the simplicity of classification schemes in this report, the included queries have been separated into component queries. This is due to the fact that there is a one-to-one correspondence between entries in the **Classification_Object** table and entries in the **COA** table for data in this report. Furthermore, for this report, each Spatial Object (GIS feature) only belongs to one **Classification_Object**. This means that there is a static relationship between COAs and Spatial Objects. A query can be made to define which Spatial Objects belong to which COAs, which will not change. A further benefit of this is that it speeds up query performance, especially when dealing with ODBC, since the base query, which may return many thousands of records, is only performed once. All the other queries, which can be joined to the base query, return many fewer records, and therefore are more efficient.

The base component for all queries is the query named '**QryGisRockPolyCOAID**' since it relates polygonal features in the GIS to COAs that describe rock units. This query returns the **Spatial_Obj_ID** field, which identifies all GIS features, and the **COA_ID** field, which identifies all Compound Objects. Because of the numbering scheme of spatial identifiers used in this report, the field **Dataset_ID** field is not needed in this query, but can be quickly added to the query by the user, if needed.

The use of the base query may vary. It may be used inside a DMBS to link with other queries, or it may be retrieved from the DMBS into GIS software, and directly linked to the GIS layers. The latter method is most likely the most efficient. The results of this query can be joined or linked in GIS software to GIS layers, thereby assigning a **COA_ID** value to each feature. Results of other queries, that return **COA_ID** values, can then be joined or linked to the GIS layer or set of features, using the **COA_ID** field as the key.

Obtaining and Formatting Spatial Data

California

A digital version of the Geologic Map of California is available from the California Geological Survey. There are use constraints and a fee for this dataset.

California Geological Survey, 2000, GIS data for the Geologic Map of California, California Geological Survey CD 2000-007, $40.

This CD contains a database of geologic units and faults digitized from the 1977 Geologic Map of California by Charles W. Jennings. Files are in both Arc/Info export files (.e00) and MapInfo format. The CD also contains Postscript and Arc/Info plot files, and an Adobe Acrobat image of the map and legend. A planimetric raster base image of the state in TIFF format is included.

The order form is available at:
http://www.consrv.ca.gov/cgs/information/publications/ordering.htm
Or contact:
California Department of Conservation, California Geological Survey
Attn: Publication Sales
1059 Vine Street, Suite 103
Sacramento, CA 95814-0321
Phone: (916) 445-6199
Fax: (916) 324-5644
URL: http://www.consrv.ca.gov/cgs/

Nevada

The digital version of the Nevada State Geologic Map has undergone numerous revisions since it was first published as USGS DDS-2 in 1989. The most recent version is:

Spatial Digital Database for the Geologic Map of Nevada, U.S.G.S. Open-file report 03-066. The map can be downloaded, in Arc-export format, directly from the web at
http://geopubs.wr.usgs.gov/open-file/of03-66/

Utah

The Utah Geological Survey has recently published a digital version of the Geologic Map of Utah, which was used for this report; it is available from the Utah Geological Survey for a fee.

Hintze, L.F., Willis, G.C., Laes, D.Y.M., Sprinkel, D.A., and Brown, K.D., 2000, Digital geologic map of Utah, Utah Geological Survey, in cooperation with U.S. Geological Survey, Map 179DM, CD Rom, $19.95.

Utah Geological Survey
1594 West North Temple
P.O. Box 146100
Salt Lake City, UT 84114-6100
Phone: (801) 537-3300
Fax: (801) 537-3400
Bookstore (801) 537-3320 or 888-UTAH-MAP (882-4627)
Bookstore email: geostore@state.ut.us
URL: http://mapstore.utah.gov/

Once the spatial data is obtained, it must be formatted to be compatible with the database supplied in this report. Following the translation of the spatial data into an appropriate GIS format, the proper attribute table fields (also known as items, or columns) must be created and populated in order to link to the data in this report. The minimum requirement is the **Spatial_Obj_ID** field, which stores a unique numeric identifier for each spatial feature. The NADM 4.3 specifies **Dataset_ID** and **Source_ID** fields as well. The following is the Arc/Info specification for spatial data attribute tables used in this report, although the user may choose to modify these. Most geologic datasets contain both polygon and line type features, which each are attributed. The NADM 4.3 specifies the same fields regardless of the feature type, but since this report only contains polygon type information, these fields only need to be added to the polygon feature class of each dataset.

ITEM NAME	WIDTH	OUTPUT	TYPE
SPATIAL_OBJ_ID	12	12	I
DATASET_ID	12	12	I
SOURCE_ID	12	12	I

Suggested names and specifications for shapefile attribute tables are:

FIELD NAME	Data Type
SPATIAL_OB	Double
DATASET_ID	Double
SOURCE_ID	Double

Users must then populate the **Spatial_Obj_ID** field with unique numeric values. At a minimum, the values must be unique to each dataset, although the authors suggest that users populate the field with values that are unique to all of the spatial datasets. The authors have used a scheme that assembles a code for the state (FIPS Code), a code for the layer type, and a unique value for the feature. The first 2 digits from left are state FIPS codes (CA=06, NV=32, UT=49), the digits in space 3-4 from left are a layer identifier (may be the dataset_id or the following: geology polygons=01 geology arcs=02), and the remaining digits are a unique value with 0's as needed to fill the remaining digits. Because Arc/Info coverages maintain a unique identifier for each feature in the **<coverage_name>#** field, the authors recommend using that field as a source for unique identifiers. For example, the California dataset, named ‘ca-geol’, with under 100,000 features in the geology polygons layer, the following Arc/Info command could be used to calculate unique ID’s:

calculate spatial_obj_id = 060100000 + ca-geol# - 1
Similarly, for the geologic lines in California:
calculate spatial_obj_id = 060200000 + ca-geol#

Dataset_ID values were constructed similarly, using a combination of the FIPS code, and layer code:

CA Geology Polygons: 601
CA Geology Lines: 602
NV Geology Polygons: 3201
NV Geology Lines: 3202
UT Geology Polygons: 4901
UT Geology Lines: 4902

Source_ID values are not required for the datasets or application in this report, but for data integrity, users are encouraged to calculate these values. The authors have used the state FIPS codes, similar to those used for the **Dataset_ID** values, although they do not differ based on the layer code, since both line & polygon feature type layers are created by the same source in this case. Entries for these values are listed below and are included in the **Source** table.

CA Geology Polygons: 601
CA Geology Lines: 601
NV Geology Polygons: 3201
NV Geology Lines: 3201
UT Geology Polygons: 4901
UT Geology Lines: 4901

To complete the process of combining the spatial data and attribute data, the **Spatial_Classification** table in this report's database must be completed. This table links the spatial information with the attribute information.

It is important to note that the following changes have been made to the geologic map unit labels identified in the original geologic maps and those presented here. This is important because the geologic map unit labels will serve as a primary key in connecting the individual state map datasets with the attribute database distributed in this report. The following table documents these changes, and users will need to change these values either in the **Class_label** field of the **Classification_Object** table or in the map unit label field of the individual state map.

Original geologic map unit label	Geologic map unit label in this report
GIS Data For The Geologic Map of California	
No changes	
Geologic Map of Nevada	
OW (may vary with source)	*water*
blank, or unattributed features	*blank*

Digital Geologic Map of Utah	
PP	*PeP*
Jg	*JTr*
blank, or unattributed features	*Blank*

The following steps will guide the users in assembling the **Spatial_Classification** table. Because this report focuses on geologic polygon information, this process is only required for the geologic polygon features.

1) Export the **Classification_Object** table from the database to a format compatible with the user's GIS.
2) Because a map unit code (ie Qal) is being used as a key for joining the two tables, it is important to ensure that the correct values are being joined for datasets from different states that may have the same map unit code. In the event that there are incorrect joins based a map unit code between incorrect states, users can elect to make a selection based on the correct **Dataset_ID** values, or physically remove incorrect state entries based on the **Dataset_ID** field, then proceed to the next step. Which method used depends on the users GIS functionality. Note that if users delete entries from the **Classification_Object** table for a state, they will need to re-export that table from the database in order to retrieve records for the other states.
3) In the user's GIS, join the **Class_Label** field in the **Classification_Object** table to the geologic descriptor field in the attribute table for each dataset. This field may have names such as: formation, ptype, or map_unit. Users are encouraged to scan or query the joined table for **Class_Obj_ID** values from the **Classification_Object** table that do not match the correct state. These values follow the same scheme as the **Dataset_ID** values. If incorrect values are found, variations on Step 2 may be required to ensure that only the records for the correct state polygon dataset are being joined to the records for the correct **Dataset_ID** in the **Classification_Object** table.
4) The user now has all of the values needed to assemble the **Classification_Object** table for that state: **Spatial_Obj_ID** and **Dataset_ID** from the spatial data, and **Class_Obj_ID** from the attribute information in this report.
5) The attribute tables for each state map must now be re-imported into Microsoft Access, or the user's database of choice, and appended into the **Spatial_Classification** table.
    a. Export the joined attribute table into a format suitable for Microsoft Access. DBF format is suggested. Note that only the **Spatial_Obj_ID**, **Dataset_ID**, and **Class_Obj_ID** fields are needed.
    b. Import each attribute file back into Microsoft Access. Users may want to name each file something like 'spatial_classification_CA' or 'spatial_classification_NV' to keep track of which dataset the file came from.
    c. Append each of these tables into the **Spatial_Classification** table with a series of append queries.
6) Users are encouraged to validate this process by exporting the query '**Spatial_Classification_Check**' from Microsoft Access into a format compatible with their GIS. Join the **Spatial_Obj_ID** fields from that query to the

Spatial_Obj_ID field in the spatial data. Then query the user's geologic map unit field (ptype, formation, map_unit) for values that are NOT equal to values in the **Class_label** field from the query.

Utah Region Information

The original Geologic Map of Utah (Hintze, 1980**)** was published with eight separate stratigraphic columns and descriptions for differing regions of the state map. These regions were depicted on a very small scale index map in that report. No previously published digital report has included this information. The authors of this report have included these separate stratigraphic descriptions in the databases, for users who may want to use them. However, users will have to perform some extra GIS operations with the data included in this report to incorporate this information.

The map unit descriptions distributed in this report (encapsulated in **Classification_Object**, **COA**, **Stratigraphic_Age**, and **Rock_Composition** table entries) included all the geologic map units found in the published source map, as well as separate entries for map units that differ regionally. The authors created these map units solely based on the published stratigraphic descriptions. The names of these 'new' map units have been appended with an underscore followed by a code for the region. The following table lists the region codes and their descriptions from the original map.

Region Code	Description
NW	Northwestern Utah
LH	Logan-Huntsville Allocthon
SL	Salt Lake City-Coalville-Randolph
WU	Western Utah
CU	Central Utah
UM	Uintah Mountains-Uintah Basin
SE	Southeastern Utah
SW	Southwestern Utah

For example, unit K1 contains entries that apply to the entire state. There are also separate map units named K1_SE, K1_SL, K1_SW, and K1_UM that are slightly modified versions of the state-wide map unit.

This publication is distributed with a spatial dataset containing points that describe the region for each polygon in the user-supplied Digital Geologic Map of Utah (Hintze et al, 2000). These points were created by digitizing the region index map from the original state map, then performing a GIS intersect operation with the map of Hintze, et al. The resulting region boundaries were then removed from the database, resulting in the original state geologic map polygons with a region code. Because the index map was such a small scale, geologic polygons near the region boundaries had to be evaluated and manually assigned a correct region code. Units with ambiguous or indeterminate region assignments were not assigned to a region and therefore are attributed with the state-wide map unit.

The spatial dataset distributed in this report as an Arc/Info Export format (e00) file named 'ut_regions.e00'. When imported into a spatial dataset (coverage, shapefile, etc), this file will represent one point that falls within each of the geologic polygons from Hintze, et al. The following tables give brief descriptions of the projection and attribute information for this dataset. Formal FGDC metadata is included with this report in the file 'ut_regions.met'.

Projection information for the dataset encoded in 'ut_regions.e00'

Projection	Geographic
Units	Decimal degrees

Attribute information for the Arc/Info coverage created from importing 'ut_regions.e00'

Item Name	Width	Output	Type	N. Dec	Description
AREA	4	12	F	3	Not used for point features
PERIMETER	4	12	F	3	Not used for point features
<coverage>#	4	5	B		Unique internal control number
<coverage>-ID	4	5	B		User-assigned identification number
REGION	25	25	C		Region code

Region codes entered into the region field are listed above. Map units or polygons with no regional information are blank.

User's who wish to take advantage of the regional descriptions in this report are suggested to take the following steps to all the regional information to the user-supplied data from Hintze, et al.:

1) Format the dataset of Hintze, et al, using the specifications under section **Obtaining and Formatting Spatial Data** to ensure that the dataset has **Spatial_Object_ID** values for each polygon
2) Convert the Arc/Info Export format file, ut_regions.e00 into a suitable format for the GIS in use. The exact procedure for this operation varies with GIS platforms. Translators for this format are available through the USGS Public Domain Software page: http://edcwww.cr.usgs.gov/doc/edchome/ndcdb/public.html
3) If required, project the resultant dataset from Step 2 into a projection that matches the projection used by data from or derived from Hintze, et al.
4) Perform a point-in-polygon analysis with the points from Step 2 and 3, and the geologic polygon dataset from Hintze, et al. This operation should result in the points from Step 2 and 3 now having the attributes (specifically the map unit designator field, and the **Spatial_Object_ID** field) from polygons from Hintze, et al. Arc/Info Workstation users are suggested to use the *identity* command. ArcGIS (Environmental Systems Research Institute, Redlands, California) has similar

capabilities in ArcMap's Geoprocessing Wizard. Most other GIS have similar functions.

5) Users are suggested to add a new text field to the geologic polygon dataset from Hintze, et al. to serve as a field to store the new map unit name (either the state wide map unit, or the regional map unit designator).
6) Join the attribute table from the point dataset created in Step 4 to the geologic polygon attribute table from Hintze, et al., using the **Spatial_Object_ID** field as the key (common field). The specific techniques vary too widely with GIS platforms to describe, although the technique is commonly called a join. Note that the join need not be a permanent join. This operation will result in the region field from the dataset from Step 2-3 being added to the geologic polygon attribute table.
7) Select features whose **region** field is NOT blank. Calculate the field added in Step 5 for those selected features to be the concatenation of the attributes stored in the geologic map unit field (originally called **formation**), a "_" character, and the attributes in the region field (called **region**). A valid SQL phrase, that mimics what many GIS platforms use would be: [formation] & "_" & [region]
8) Invert the selection from Step 7 so that features with blank regions attributes are selected. Then calculate the field created in Step 5 to be equal to the geologic map unit field (**formation** in Hintze, et al.)
9) Users will then need to update the **Spatial_Classification** table, as described in Steps 1-6 in the above section entitled '**Obtaining and Formatting Spatial Data**' with the new relations between **Spatial_Obj_ID** and **Class_Obj_ID**. This time join the **Class_label** field to the field created in Step 5. If users have previously completed those steps, those entries in the **Spatial_Classification** table for features from the geologic map of Utah will need to be removed prior to updating

ArcView Project Description

This report is distributed with an ArcView version 3.2 project file and an associated stand-alone executable program that will perform a set of mineral resource and generalization queries on any NADM 4.3 formatted dataset. The project file is named 'wr_mrsa.apr'. The dialog designer ArcView extension is required for this project. The stand-alone executable is a Microsoft Windows executable that reads a query out of the database distributed with this report and displays a hierarchical "tree" view of the lithology hierarchy from this report, including the ability to define a lithologic term and the position (**lith_level**) of that lithology in the hierarchy. This is useful to envision the entire hierarchy as well as investigating the level of detail desired when performing a lithology generalization.

One of the primary purposes of the ArcView project (herein called 'the project') is to demonstrate the use of geologic information in a standard data format for mineral resources investigations. The project performs three different sets of queries that may be useful for that purpose, two of which allow the user to make three levels of constraints on the query. The project also performs some general-purpose attribute generalization queries. The general algorithms of each query will be discussed below.

Requirements

The functionality of the ArcView project distributed with this report is based on the avenue scripting language within ArcView GIS. While ArcView 3.x versions exist for PC, Macintosh, and Unix computer systems, the database format distributed in this report is only compatible on computers running Microsoft Windows operating systems. There are translation utilities available to allow the database to be converted to operate under different computing environments. The project was written using ArcView 3.2, and requires the dialog designer extension, which is distributed with ArcView versions 3.1 and higher. Users of ArcView prior to version 3.2 can find utilities to make the project backwards-compatible at the publisher's website, http://www.esri.com

The functionality of the ArcView project in this report also relies on an ODBC connection to the database distributed in this report. The ODBC connection is required to be named 'wr_mrsa'. If this is not an acceptable name, the project can be configured to work with a different name. Two avenue scripts within the project are programmed with the ODBC name. These scripts are named 'sql.fetch' and 'sql.getCOAID'. These two scripts can be edited and re-compiled to connect to a different ODBC connection. The scripts are commented to note the value that needs to be changed. Users are strongly discouraged from editing any other scripts distributed in the project.

The project was written so that any dataset in the NADM 4.3 format can be used. The scripts that perform the queries do some error checking to ensure that only NADM 4.3 datasets are used. To do this, the scripts check for the presence of two fields in the attribute tables of each dataset being queried. The first is the **dataset_id** field. Note that this field only needs to be present in the attribute table of the dataset. The scripts do not perform any operations on values contained, or not contained, in the field. The second required field is the **Spatial_Obj_ID** field. Due to attribute field name limitations in many dataset formats, the scripts check for 'variants' on the Spatial_Obj_ID fieldname. Valid names for the field are: '**spatial_obj_id**', and '**spatial_ob**'. Note that the values in this field are critical to maintain links to the correct map units in the database.

Using the ArcView Project

The ArcView project works on the concept within ArcView of the 'active theme(s)'. Queries will be performed on any and all active (highlighted, or selected) themes that the script can identify as being in the NADM 4.3 format. If no themes are selected, the script will not run. If the script identifies a non-NADM theme in a set of selected themes, then the script will skip that theme. The scripts create a new theme that is a 'virtual copy' of the datasets that it performs a query on. If these virtual datasets are saved within the ArcView project, the queries will be re-run by ArcView when the project is opened again. In order to permanently store the dataset created from a query to a file-based dataset, the theme must manually be written to a shapefile. Consult the ArcView GIS documentation for this procedure.

The project contains two extra menus for view documents. These menus are named 'Minerals Queries' and 'Generalization Queries'. Selecting options in the 'Minerals Queries' menu will bring up a dialog box to perform a variant on the basic query type. For the Potential Skarn and Sediment-Hosted Gold queries, a dialog box will presented that allows the user to specify which subtype of query is desired. Clicking the radio button next to that query description, then pressing the 'Run Query' button will begin the query. Selecting a menu item in the 'Generalization Queries' menu will either bring up a series of dialogs to specify values to generalize with, or will launch the lithology hierarchy browser Windows executable.

The project is distributed with no data in the project. It is up to the user to add and configure the datasets used by the project. Note that in order for the potential skarn queries to function correctly, the map units for the view containing the datasets must be specified.

The project performs quite a bit of error checking, but cannot anticipate every error. The software is distributed as-is, and the U.S. Geological Survey is not responsible for any problems that may occur.

Discussion of the Queries

Potential Skarn Queries.

The basic form of this query is to select all map units from the database that contain carbonate rocks that are adjacent to an intrusive unit. The script run in this query retrieves a query from the database that performs a basic generalization of the primary lithology of all map units and returns those that are carbonate or intrusive (plutonic). The script then selects all of the intrusive rock polygons and performs a GIS 'next to' operation for all units that are immediately next to those intrusive polygons. Finally, all of the carbonate rocks are selected from those polygons next to intrusive rocks, yielding a layer that is all of the carbonate bearing polygons next to an intrusive unit. It is important to note that neither of the queries determines if a plutonic map unit is located next to or near a carbonate unit through depositional or fault contacts.

The second form of this query recognizes the fact that intrusive units do not have to be in immediate contact with carbonate units to produce a skarn deposit. The script performs the same exact query as described above with the exception that units are selected that are within 5 kilometers of any intrusive unit. Views with map units not in meters will use the 5 km distance equivalent in the view's map units.

The third form of the Potential Skarn Query is a quite complex query and can take significant amounts of computation time. The goal of the query is to ensure that any igneous unit polygon is younger than the carbonate unit polygon that it is within 5 kilometers of. In order for this script to work, it must create 3 temporary datasets in the project's working directory, which is usually the user's 'temp' directory. The script downloads a similar query as describe above from the database, with the exception that the query also returns age information for each map unit. The script then creates a shapefile of all the intrusive bearing polygons, and a shapefile containing all of the carbonate bearing polygons. The script then loops through every feature in the intrusive rocks shapefile, selects all of the polygons in the carbonate shapefile that is within 5 kilometers of that polygon. A comparison of the age of each polygon is performed and a running tally of all features that are older than the intrusive polygon is kept. After all of the polygons in the intrusive shapefile have been analyzed, the script outputs those features that met all of the requirements to a shapefile in the user's working directory. This shapefile will have a 'base' name of 'skarn', followed by a number.

Sediment-hosted Gold Queries

The general form of the sediment-hosted gold queries is to select map units that contain both mudstones and carbonates, in any amount. A general term for this kind of map unit is 'dirty carbonate.' The query generalizes the lithology hierarchy for both mudstones and carbonates. Mudstones in the hierarchy distributed in this report, which is the standard hierarchy for the datamodel, include the following lithologies: argillite, black shale, claystone, mudstone, oil

shale, shale, and siltstone. Carbonate lithologies include: carbonate, dolostone (dolomite), and limestone. This is an attributes-based query and does not perform any spatial analysis

The second form of the sediment-hosted gold queries recognizes the prevalence of these deposits in pre-Mesozoic age rocks. The query includes the minimum age of the map unit and only returns those map units that have a minimum stratigraphic age of pre-Mesozoic (250 million years or greater).

The third form of the sediment-hosted gold queries is a further refinement of the knowledge of these deposits in the western United Sates, in that the majority of these deposits are found in dirty carbonates that younger than Ordovician and older than Carboniferous. The query uses minimum stratigraphic age names and their numeric equivalents to return only those map units that have an age range of 360-440 million years.

Acid Neutralization Potential Query

This query builds on the fact that bedrock can be very important in mitigating problems related to acidic groundwater, and that carbonate rocks can react with acidic waters to increase their pH to more near-normal values. This query is a first step in determining where that might occur by identifying map units containing carbonate and determining the proportion and type of carbonate in that map unit. The query returns those map units that have either limestone or dolomite as the primary lithology. It also returns those map units that have either limestone or dolomite in any amount except as the primary lithology. The query creates 2 layers for every theme selected, the first containing the primary limestone or dolomite map units, and the other containing the secondary limestone or dolomite map units. Each theme created contains attributes about the type of carbonate contained (limestone or dolomite), which may be useful to determine the relative reactivity of each map unit. This query does not generalize the lithology hierarchy for carbonate rocks, but rather directly selects either limestone or dolomite lithologies. This is by design, recognizing that many map units are attributed simply as ‘carbonate’, and in many cases it may be necessary to know the type of carbonate.

Generalization Queries

The ArcView project also contains two general-purpose generalization queries. These queries are demonstrations of typical queries that may be performed on a geologic map database.

Generalization with Age

Querying for the general age of map units is often a first step in any map preparation or analysis. This query presents the user with the opportunity to quickly generalize a geologic map based on the stratigraphic age information encoded in the database. The query retrieves a specific query from the database that generalizes the stratigraphic age base on two user specifications.

The first choice presented to the user is which age designator to generalize on. Map units in the database have both a minimum and maximum age encoded. For many map units, this choice may have significant effects on the results. Many map units may span significant lengths of time, as well as having varying degrees of accuracy of either knowledge or encoding in either of the ages encoded in the database.

The second choice for the user in this query is the detail in geologic age to generalize to. The choices currently presented to the user are: eon, era, period, subperiod, and epoch. This choice determines the level of detail in age information retrieved from the database. Stratigraphic ages are filtered through the **Stratigraphic_Time_Scale** and the **Stratigraphic_Tree** tables,

which compose the stratigraphic age hierarchy. It is important to note that many map units are encoded with only a basic amount of detail in the stratigraphic age. Queries made on a stratigraphic age classification that are more detailed than what is encoded in the database will return empty, or 'no data' values. While this may be undesirable, it may also be used to qualitatively represent the level of knowledge about a map unit.

Regardless of the choices made by the user, the queries return both the encoded minimum and maximum age names for each map unit. The query also returns the generalized age as specified by the user's choices. This is to aid in the use of this query for further analysis.

Generalization with Lithology

Another important piece of information in any geologic map analysis is determining what lithologies are present in a given map unit. This query allows the user to retrieve from the database the primary lithology of all map units, generalizing those lithologies to a given **lith_level**, which is an indicator of the position of the lithology in the lithology hierarchy. The user is presented with a list of lith_level values, and query returns both the original map unit primary lithology (in the **lith_class** field) and the generalized lithology (in the **lithology** field) at the specified lith_level. As with the Stratigraphic Age generalization query, map units with lith_class values that are lower (more general) than the specified lith_level will return no data (empty) values.

To help visualize the lithology hierarchy, as well as to provide definitions and lith_level values for those terms, the authors have included a 32-bit MS Windows executable program (lithtree.exe) with this report. This program reads the hierarchy from the database and presents it to the user in a 'tree' form similar to that of a directory structure. User's may click on a lithology term and view the definition and lith_level by clicking on the 'define' button. The program can be run by its self, and is also available from the 'Generalization Queries' menu in the ArcView project. When used in conjunction with the ArcView project, the user may wish to explore the lithology hierarchy in order to determine a suitable lith_level to perform a lithology generalization query with.

Table 1: Description of tables contained in the database for this report

Name	Type	Width	Usage For This Publication	Description
Cartographic_Object	Table	N/A	Minimally used to support GeoMatter	The Cartographic Object Table symbolizes map objects that are defined in the Classification Object Table.
class_obj_id	Long Integer	4		A unique identifier for each object or category of objects described and symbolized in a map legend
class_seq	Long Integer	4	Default Value of 0	A number representing the drawing sequence of the individual patterns which make up a symbol, a value of 1 is the bottom pattern, 2 is the next up, etc.
cart_desc	Text	255	same value as class_label that it supports in the Classification_Object Table	Description of the pattern
cart_sym_type	Text	50	Default Value of Polygon	Specifies the type of symbol as: area, line, or point
cart_sym_table	Text	50	Default Value of Standard	Name of a symbol table
cart_sym	Long Integer	4	All values 1001	The symbol number from the table specified in cart_sym_table
cart_color_table	Text	50	Default Value of <Symbol table>	Name of a color table
cart_color	Long Integer	4	same value as class_obj_id	The color number from the table specified in cart_color_table
Class_Tree	Table	N/A	Minimally used, no hierarchical information stored, one entry for each Class_obj_id	The Class Tree Table is used to store information about parent-child relationships between units that occur in the Classification Object Table.
scheme_id	Long Integer	4		Identification number, unique to a classification scheme, used to link a classification scheme with its name and source
class_obj_id	Long Integer	4	class obj_id = class_obj_parent	A unique identifier for each category of objects described and symbolized in the map legend. It is the link to the Classification Object Table
class_obj_parent	Long Integer	4	class obj_id = class_obj_parent	A unique identifier for a second record in the Classification Object Table which is the parent of the Classification identified in class_obj_id
Classification_Name	Table	N/A	Minimally used, one entry per state	The Classification Name Table is used for naming classification schemes and tying them back to an original source.
class_scheme_id	Long Integer	4		Identification number; unique to a classification scheme; used to link all objects in a classification scheme with a name and source
class_scheme_name	Text	255		Descriptive name for the classification scheme
source_id	Long Integer	4		Unique identification number of an information source
Classification_Object	Table	N/A	Fully Used	The Classification Object Table is used to define the objects that are to appear on a map and therefore, on the map legend.

class_obj_id	Long Integer	4	stores classification number	A unique identifier for each object or category of objects described and symbolized in a map legend
class_group	Text	50	default value of 1	Used to group similar objects within the map legend. On paper maps these terms are the headings for various sections of the legend
class_label	Text	50	label as appears on map (ie 'Jgr')	The character symbol for the item on the legend. For a rock unit, this would be the unit label, such as TKgr
class_name	Text	255	label as appears on map (ie 'Jgr')	The name assigned to this legend item. For a rock unit, this might be the unit name, such as Pike's Peak Granite, or alluvium. For a structural unit, it might be a formal name, such as San Andreas Fault, or an informal name, such as normal fault.
class_desc	Text	255	Description of Map Unit	An English language description of the legend object or group of objects. For objects or groups of objects which are not defined in the Compound Object Archive, this is the descriptive text which would appear on a map legend
Classification_Scheme	Table	N/A	Minimally used, one scheme per state	The Classification Scheme Table provides the correlation between the Source Table and the Legend's Classification Object Table.
source_id	Long Integer	4		Unique identification number of an information source
class_obj_id	Long Integer	4		A unique identifier for each category of objects described and symbolized in the map legend. It is the link to the Classification Object Table
class_scheme_id	Long Integer	4		Identification number, unique to a classification scheme, used to link a classification scheme with its name and source
class_seq	Long Integer	4	Default Value of 0	A number defining the sequential position of the object in the legend, within its classification group (see Classification Object Table)
disp_priority	Long Integer	4	Default Value of 0	A priority number, which allows the user to specify the order in which objects are drawn when the map is displayed. Objects with larger numbers are drawn on top of , and may hide, objects with smaller numbers
disp_visibility	Text	1	Default Value of T	A toggle, which indicates whether the object is displayed in the legend or remains hidden from view when the legend is displayed
COA	Table	N/A	Fully Used	COA Table is the central table used to describe Compound Objects. Primary use of the COA Table is to specify which type of unit is being described, therefore, which additional tables should be consulted for the remainder of the description of the unit
coa_id	Long Integer	4	unique COA number	Unique identification number of a unit in the Compound Object Archive
coa_name	Text	50	label as appears on map (ie 'Jgr')	The name of the unit in the Compound Object Archive
coa_type	Text	50	value defined in COA_Type table	Type of Compound Object (Rock Unit, Structure, etc.)
coa_desc	Text	255	General description of the map unit	A text description of the Compound Object
source_id	Long Integer	4	Source Identifier	Unique identification number of an information source
COA_Relation	Table	N/A	Not Used	The COA Relation Table is used to store information about the relationships between objects that occur in the COA Table.

rel_id	Long Integer	4		Unique identification number for a record in this table
coa_id	Long Integer	4		Unique identification number of a unit in the Compound Object Archive
rel_coa_id	Long Integer	4		Unique identification number of a second unit in the COA Table to which the first object is related in some fashion
rel_desc	Text	50		Text description of the relationship
relation	Text	50		A broad category of temporal and structural relationships between units. This information may allow for refinement of age, structural, or spatial relationships
Coa_Relation_Type	Table	N/A	Not Used	(DM 5.2)The COA Rel Type table is a lookup table for containing possible types of relations between COAs; e.g. overlies, contemporaneous, etc.
coa_relation	Text	50		A broad category of temporal, structural or other relationships between units.
rel_type_desc	Text	50		A text description of the relationship type.
COA_Tree	Table	N/A	Minimally used, each COA is a child of 'Universe' and to itself	The COA Tree Table is used to store information about parent-child relationships between units that occur in the COA Table.
coa_id	Long Integer	4		Unique identification number of a unit in the Compound Object Archive
parent_id	Long Integer	4		Unique identification number of a second unit in the COA Table which is the parent of the unit identified in coa_id
COA_Type	Table	N/A	Standard Domain	(DM 5.2) The COA Type table is a lookup table which contains a list of the valid COA table types
coa_type	Text	50		The type of COA
coa_type_desc	Text	50		A text description of the COA type.
coa_table	Text	50		The name of the table corresponding to a coa type: e.g. for rock_unit its 'Rock Unit', for 'meta_facies' its 'Meta. Facies'.
COA_Valid_Desc	Table	N/A	Standard Domain	(DM5.2)The COA Valid Desc table contains a list of valid descriptions for each COA table: e.g. a rock unit may be described by 'Struc Type' or 'Rock Comp' or 'Geochron Age' or 'Strat Age'.
coa_type	Text	50		The type of COA
desc_type	Text	50		The desc_type identifies a type of description table
Color	Table	N/A	Minimally used to support GeoMatter	The Color Table is a compilation of definitions of symbol colors.
cart_color_table	Text	50	Default value of <Symbol table>	Name of a color table
cart_color	Long Integer	4	same as class_obj_id it supports	The unique number for a specific color within a color table
CMYK	Text	50	not used	Definition of color in cyan-magenta-yellow-black coordinates
RGB	Text	50	used	Definition of color in red-green-blue coordinates
color_desc	Text	255	same as class_label that it supports	Description of the color and suggested uses

Comp_Values	**Table**	**N/A**		Added Table to support a ranked qualitative list of a rock compositions contribution to a rock unit COA.
comp_seq	**Long Integer**	**4**		A numeric comp_seq value as found in the Rock_Composition Table
comp_value	**Text**	**50**		An English Language definition of a comp_seq number.
Data_Classification	Table	N/A	Fully Used, most COA_ID = CLASS_OBJ_ID	The Data Classification Table is a correlation table that joins the Classification Object Table to the Compound Object Archive (COA Table).
class_obj_id	Long Integer	4		A unique identifier for each object or category of objects described and symbolized in the map legend
coa_id	Long Integer	4		Unit identifier which is the key attribute of the COA Table
vol_percent	Integer	2	Default Value of 100	Estimated volume percent an individual unit in the Compound Object Archive comprises of the entire Classification Object
vol_quality	Integer	2	Default Value of 100	Quality of the volume percent estimate (entered as: +- nn %)
data_seq	Long Integer	4	Default Value of 0	Specifies the order in which individual units in the Compound Object Archive should appear in a composite map legend item (a classification object that includes more than one COA unit)
Dataset	Table	N/A	System table used by GeoMatter	(DM 5.2) The dataset table contains information about a specific encapsulated set of data. In most GIS this will correspond to a map layer
dataset_id	Long Integer	4		A unique numeric id for the dataset. In most GIS systems the dataset will be a layer and this id would represent a unique number for a layer.
dataset_name	Text	100		The name for the dataset.
dataset_type	Text	50		The type of dataset = { "point", "line", "polygon", "raster" }
dataset_filename	Text	100		The full path and filename location of the dataset.
dataset_soid_field	Text	50		The name of the attribute in the dataset containing the spatial object id.
dataset_dsid_field	Text	50		The name of the attribute in the dataset containing the dataset id.
subj_id	Long Integer	4		The id of a subject best associated with the dataset (map layer).
Dataset_Query	Table	N/A	System table used by GeoMatter	(DM 5.2) The Dataset Query table lists and describes the queries that can be applied to a map layer within a web module.
dataset_id	Long Integer	4		Unique id for the dataset to which a query applies.
query_name	Text	100		The name of query as it appears in the database system.
query_title	Text	50		The title of the query.
query_desc	Memo	0		A text description of the query as it is to be displayed to a user.
query_heading	Text	50		A heading under which the query is grouped; for constructing a list that contains two levels: the headings at one level and associated queries under them at another level.
query_type	Text	50		The type of query. Queries are applied to at most one layer and one web site module. Query types include: map_reclass, map_select, map_text, map_image, etc.

Desc_Type	Table	N/A	System table used by GeoMatter	(DM 5.2) The Desc Type table is a lookup table which contains a list of the valid Description table types
desc_type	Text	50		The description table type
desc_type_desc	Text	50		Description
desc_table	Text	50		The name of the description table represented by the desc_type.
Form	Table	N/A	Standard Domain, Not Used	None
form	Text	100		None
Form_id	Long Integer	4		None
form_level	Long Integer	4		None
form_desc	Text	255		None
Form_Tree	Table	N/A	Standard Hierarchy Table, Not Used	None
Form_id	Long Integer	4		None
parent_id	Long Integer	4		None
Formal_Unit	Table	N/A	Not Used	The Formal Unit Table is used to store information about the formal definition of a unit.
Coa_id	Long Integer	4		Unique identification number of a unit in the Compound Object Archive
name	Text	255		Formal name of the compound object
type_section	Text	255		Location of a defining type section or area
Fossil	Table	N/A	Not Used	The Fossil Table is another example of the type of table that could be built into the archive to store non-structural information collected from a single site.
fossil_id	Long Integer	4		A unique identifier for a single record in the Fossil Table
Spatial_obj_id	Long Integer	4		A unique identifier for each object in an individual data set, or layer
dataset_id	Long Integer	4		Unique identification number for each data set or layer in a GIS
site_name	Text	50		Name or field number associated with the sample site.
fossil_name	Text	50		Name of the identified fossil
site_label	Text	50		A label to associate with the map symbol, if it is different than the site_name
min_strat_name	Text	50		The minimum time-stratigraphic age selected from the Stratigraphic Time Scale Table.
max_strat_name	Text	50		The maximum time-stratigraphic age selected from the Stratigraphic Time Scale Table.
comment	Text	255		A text description of the fossil
source_id	Long Integer	4		Unique identification number of an information source

Geochronological_Age	Table	N/A	Not Used	The Geochronologic Age Table is used for storing geochronologic age data for rock units.
Coa_id	Long Integer	4		Unique identification number of a unit in the Compound Object Archive
Chron_seq	Long Integer	4		Record identifier for a specific age determination for the unit identified by the coa_id.
chron_method	Text	255		Analytical method used to obtain the age
sample_material	Text	255		A description of the material sampled
Chron_date	Double	8		Geochronologic age, in millions of years
chron_err_plus	Double	8		The positive error for the geochronologic age, in millions of years
chron_err_minus	Double	8		The negative error for the geochronologic age, in millions of years
comment	Text	255		Additional comments concerning this age determination
source_id	Long Integer	4		Unique identification number of an information source
LithoForm	Table	N/A	Not Used	(DM 5.2) Contains form or morphology terms.
Litho_form	Text	50		A form or morphology term.
Form_desc	Text	255		A text description of the form.
source_id	Long Integer	4		A reference to the source (in the metadata) of the lithologic term. This could refer to a specific map, report or author.
Lithology	Table	N/A	Standard Domain, 'Version 6.0'	The Lithology Table is used as a look-up table for lithologic terms used in the Rock Composition Table.
lith_class	Text	255		A predefined hierarchical list of lithologic terms used for classifying rock compositions.
Lith_id	Long Integer	4		A unique identifier for the lithologic term which is used in the Lithology Tree table to store parent-child relations
lith_level	Long Integer	4		A numeric value for the level in the hierarchy of lithologic terms.
lith_desc	Text	255		An English language definition of the lithologic term.
Lithology_Tree	Table	N/A	Standard Hierarchy Table, 'Version 6.0'	The Lithology Tree Table is used to store information about parent-child relations between lithologies that occur in the Lithology Table.
Lith_id	Long Integer	4		A unique identifier for a lithologic term from the Lithology Table
parent_id	Long Integer	4		A unique identifier for a second lithologic term from the Lithology Table which is the parent of the first term
Metamorphic_Facies	Table	N/A	Not Used	The Metamorphic Facies Table is used to store information about metamorphic facies units
coa_id	Long Integer	4		Unique identification number of a unit in the Compound Object Archive
Meta_grade	Text	50		The metamorphic grade of the metamorphic facies, which should be selected
Organization	Table	N/A	Not Used	The Organization Table is used to provide a full, formal name for organizations (such as U.S. Geological Survey) in addition to the shorter, abbreviated identifier (USGS) that is used in the Source Table.

Org_id	Text	50		Unique organization identifier
org_name	Text	255		Full organization name
Projection	Table	N/A	Fully Used	The Projection Table is used to store all of the parameters necessary to fully specify the map projection for each source of information.
Prj_id	Text	50		A unique identification code assigned to a projection record
prj_type	Text	50		Type of projection; e.g. UTM, TM, Mercator, etc.
zone	Integer	2		The grid zone specification for a UTM projection
ellipsoid	Text	50		The name of the ellipsoid used
Scale_factor	Double	8		The scale factor for the projection
units	Text	50		The units; e.g. feet, survey feet, meters, etc.
origin_lat	Double	8		The latitude of the origin of the projection in decimal degrees
Origin_long	Double	8		The longitude of the origin of the projection in decimal degrees
False_east	Double	8		The offset in the x direction in projection units.
False_north	Double	8		The offset in the y direction in projection units.
parallel_1	Double	8		The first standard parallel for a Lambert projection in decimal degrees
parallel_2	Double	8		The second standard parallel for a Lambert projection in decimal degrees
radius	Double	8		The radius associated with some polar-type projections, in kilometers
cen_meridian	Double	8		The longitude of the central meridian of the projection in decimal degrees
RelatedSource	Table	N/A	Not Used	The Related Source Table is used to document relationships between various sources of information.
Source1_id	Long Integer	4		Unique identification number of an information source
Source2_id	Long Integer	4		Unique identification number of a second information source
Source_relation	Text	50		Specifies the type of relationship source1 has with source2
Rock_Composition	Table	N/A	Fully Used	The Rock Composition Table is used to define a single composition within a rock unit.
Coa_id	Long Integer	4		Unique identification number of a unit in the Compound Object Archive
Comp_seq	Long Integer	4	1 = primary, 2 = secondary, 3 = tertiary, etc in Description of Map Units	Unique ID of a composition within a rock unit. Also indicates the sequence number for displaying descriptive information about this composition within a rock unit description. Compositions are normally sequenced from most abundant to least abundant
rock_name	Text	255	name of rock as it appears in Description of Map Units	A free-text attribute for storing the map author's preferred complete name for the rock composition
lith_class	Text	50	value of equivalent lithology from Lithology Table	A lithologic classification term selected from those available in the Lithology Table
lith_form	Text	50	Not Used (empty field)	A form or morphology classification term selected from those available in a Form Table

vol_percent	Integer	2	Default Value of 0, see comp_seq for assumed volumetric contribution	An estimate of the volume percent of the composition within the rock unit
vol_quality	Integer	2	Default Value of 0	Quality of the volume percent estimate (entered as: +- nn %)
mineralogy_desc	Text	255	Not Used (empty field)	A mineral modifier associated with the rock name, or description of the mineralogy of the composition
Color_desc	Text	255	Not Used (empty field)	A description of the color or colors of the composition
Texture_desc	Text	255	Not Used (empty field)	A description of the texture of the composition
alteration_desc	Text	255	Not Used (empty field)	A description of any alteration associated with the composition
description	Text	255	Not Used (empty field)	A text description of this composition. Intended to be read by people, this is where a long, detailed map legend description would be stored.
Rock_Unit	Table	N/A	Not Used	The Rock Unit Table is central to organization of the description of rock map units. The table is used to assign a rank to each unit and as a correlation table between the COA Table and descriptive records in the Age and Composition Table
coa_id	Long Integer	4		Unique identification number of a unit in the Compound Object Archive
rock_rank	Text	50		A keyword defining the lithostratigraphic level or rank of the defined unit
min_thick	Long Integer	4		Minimum thickness of the rock unit, in meters
max_thick	Long Integer	4		Maximum thickness of the rock unit, in meters
typ_thick	Long Integer	4		Typical, or average thickness of the rock unit, in meters
thick_qual	Long Integer	4		Quality of the typical thickness estimate as a percent of the typical thickness (entered as: +- nn %)
Rock_Unit_Rank	Table	N/A	Not Used	The Rock Unit Rank Table is used as a look-up table to correlate the rank, given in the Rock Unit Table as a word, with a numeric level number.
rock_rank	Text	50		A keyword defining the lithostratigraphic level or rank of the defined unit
rock_level	Long Integer	4		A number indicating the relative rank.
SOA	Table	N/A	Not Used	The SOA (Singular Object Archive) associates a specific spatial feature (from the GIS) to the description specific to its occurrence.
spatial_obj_id	Long Integer	4		A unique identifier of each feature in an individual GIS data layer/coverage/file.
dataset_id	Long Integer	4		The unique id of the specific GIS dataset: layer/file/coverage.
desc_type	Text	50		The description table
desc_id	Long Integer	4		The unique identifier of a description within a specific description table.
SOAValidDesc	Table	N/A	System table used by GeoMatter	(DM5.2)The SOA Valid Desc table contains a list of valid descriptions for each SOA table

desc_type	Text	50		The desc_type identifies a type of description table
Source	Table	N/A	Fully Used	The Source Table contains reference information for all maps that are original sources for geologic objects in the map archive.
source_id	Long Integer	4		Unique identification number
org_id	Text	50		Unique organization identifier for an information source
source_author	Text	255		List of information source authors
source_date	Medium Date	8		Year of information source publication or creation
source_title	Text	255		Title of information source
pub_edition	Text	255		Publication edition of a published information source
pub_series	Text	255		Publication series name of a published information source
pub_issue	Text	255		Issue identification of a published information source
pub_place	Text	255		Place of publication
pub_contact	Text	255		Contact for information about the source
source_scale	Long Integer	4		Scale of source map (denominator of scale fraction)
source_resolution	Long Integer	4		Resolution of digital source map, in meters
prj_id	Text	50		An identification code linking to the projection definition in the projection table
max_lat	Double	8		Northern limit of map in decimal degrees
min_lat	Double	8		Southern limit of map in decimal degrees
max_long	Single	4		Eastern limit of map in decimal degrees
min_long	Double	8		Western limit of map in decimal degrees
url	Text	255		World Wide Web address for the organization that published the source
comment	Text	255		Additional information about the source
source_contribution	Text	255		The contribution made by this source to an object referencing this source; e.g. if the source is documenting a change to a geologic object on a map, then this field would record the nature of the modification
SourceDataset	Table	N/A	System table used by GeoMatter	(DM 5.2) The SourceDataset table correlates sources to datasets, usually for 'Map' sources.
source_id	Long Integer	4		The unique id of the source.
dataset_id	Long Integer	4		The unique id of the dataset.
disp_priority	Long Integer	4		An integer representing the display sequence priority of a dataset -- usually for 'layer' datasets where feature level display priority cannot be assigned.
disp_visibility	Long Integer	4		An integer representing the visibility of a dataset= on/OFF.
SourceType	Table	N/A	System table used by GeoMatter	A lookup table containing the types of possible sources: map, image, project and text.
source_type	Text	50		The type of source: 'map', 'image', 'text' or 'project'.
source_type_desc	Text	150		A text description of the source type.

Spatial_Classification	Table	N/A	Fully Used	The Spatial Classification Table is a correlation table that joins the GIS tables of the Spatial Object Archive to the Classification Object Table of the map Legend.
spatial_obj_id	Long Integer	4		A unique identifier for each object in an individual data set, or layer
dataset_id	Long Integer	4		Unique identification number for each data set or layer in a GIS
class_obj_id	Long Integer	4		A unique identifier for each object or category of objects described and symbolized in a map legend
Spatial_Object	Table	N/A	Not Used	None Given
spatial_obj_id	Long Integer	4		A unique identifier for each object in an individual data set, or layer
dataset_id	Long Integer	4		Unique identification number for each data set or layer in a GIS
source_id	Long Integer	4		Unique identification number of an information source
Spatial_Object_Age	Table	N/A	Not Used	The Spatial Object Age Table is used to attach geochronologic ages to individual spatial objects.
spatial_obj_id	Long Integer	4		A unique identifier for each object in an individual data set, or layer
dataset_id	Long Integer	4		Unique identification number for each data set or layer in a GIS
coa_id	Long Integer	4		Unit identifier which is the key attribute of the COA Table
chron_seq	Long Integer	4		Record identifier for a specific age determination within the Geochron Age Table for the unit identified by the coa_id.
site_name	Text	50		Name or field number associated with the sample site.
Spatial_Object_Composition	Table	N/A	Not Used	The Spatial Object Composition Table is used to define the composition breakdown of individual map objects, where it is known.
spatial_obj_id	Long Integer	4		A unique identifier for each object in an individual data set, or layer
dataset_id	Long Integer	4		Unique identification number for each data set or layer in a GIS
coa_id	Long Integer	4		Unit identifier which is the key attribute of the COA Table
comp_seq	Long Integer	4		Identification number of a single composition description within a rock unit (see Rock Composition Table) or zero to indicate entire unit
vol_percent	Integer	2		Estimated volume percent that the individual unit or composition in the Compound Object Archive comprises of the single spatial object
vol_quality	Integer	2		Quality of the volume percent estimate (entered as: +- nn %)
source_id	Long Integer	4		Unique identification number of an information source
Spatial_Object_Name	Table	N/A	Not Used	The Spatial Object Name Table is used to apply names (or any other text) to a single map object.
spatial_obj_id	Long Integer	4		A unique identifier for each object in an individual data set, or layer

dataset_id	Long Integer	4		Unique identification number for each data set or layer in a GIS
name	Text	50		Name to be attached to an individual point, line, or polygon. For example the name of a pluton or a fault
source_id	Long Integer	4		Unique identification number of an information source
Stratigraphic_Age	Table	N/A	Fully Used, one entry per appropriate COA	The Stratigraphic Age Table is used for storing information about the time-stratigraphic age of the unit.
coa_id	Long Integer	4		Unique identification number of a unit in the Compound Object Archive
strat_seq	Long Integer	4		Record identifier for a specific time interval for the unit identified by the coa_id.
Min_strat_name	Text	50		The minimum time-stratigraphic age selected from the Stratigraphic Time Scale Table
max_strat_name	Text	50		The maximum time-stratigraphic age selected from the Stratigraphic Time Scale Table
min_source_id	Long Integer	4		Unique identification number of an information source for the minimum age reference
max_source_id	Long Integer	4		Unique identification number of an information source for the maximum age reference
Stratigraphic_Rank	Table	N/A	Not Used	The Stratigraphic Rank Table is a look-up table, which provides a numeric value for the time-stratigraphic rank key words used in the Stratigraphic Time Scale Table.
Strat_rank	Text	50		A keyword representing the rank of the time-stratigraphic term.
strat_level	Long Integer	4		A numeric value for the level in the hierarchy of time-stratigraphic terms.
Stratigraphic_Time_Scale	Table	N/A	Standard Domain, slightly modified for missing Ages	The Stratigraphic Time Scale Table is used as a look-up table for time-stratigraphic intervals which are used to define the maximum and minimum stratigraphic age of units defined in the Rock Unit Table.
strat_id	Long Integer	4		A unique identifier for the strat_name
strat_name	Text	255		The time-stratigraphic name for the time interval
Strat_rank	Text	10		A keyword representing the rank of the time-stratigraphic term. Must be defined in the Stratigraphic Rank table
min_strat_age	Double	8		Minimum numerical age, in millions of years
max_strat_age	Double	8		Maximum numerical age, in millions of years
min_source_id	Long Integer	4	Values of 1 signify values added for this report	Unique identification number of an information source for the minimum age reference
max_source_id	Long Integer	4	Values of 1 signify values added for this report	Unique identification number of an information source for the maximum age reference
Stratigraphic_Tree	Table	N/A	Standard Hierarchy Table, slightly modified for missing Ages	The Stratigraphic Tree Table is used to store information about parent-child relationships between time-stratigraphic intervals that occur in the Stratigraphic Time Scale Table.

strat_id	Long Integer	4		A unique identifier for a time-stratigraphic interval from the Stratigraphic Time Scale table
parent_id	Long Integer	4		A unique identifier for a second time-stratigraphic interval from the Stratigraphic Time Scale table which is a parent of the first interval
Structural_Measurement	Table	N/A	Not Used	The Structural Measurement Table represents an example of a table for storing information generally depicted on a map as point objects.
struct_id	Long Integer	4		A unique identifier for a record in the Structural Measurement Table
Spatial_obj_id	Long Integer	4		A unique identifier for each object in an individual data set, or layer
dataset_id	Long Integer	4		Unique identification number for each data set or layer in a GIS
site_name	Text	50		Name or field number associated with the sample site.
feature_type	Text	50		The type of structural measurement (bedding, fold axis, foliation, etc.)
Strike_trend	Integer	2		The azimuth direction of the strike or trend of the structural measurement, in degrees (for planar features use the right-hand rule for strike direction; for linear features, the trend is down the plunge direction)
dip_plunge	Integer	2		The dip or plunge angle of the structural measurement, in degrees
dip_direction	Integer	2		The azimuth direction of the dip of a planar feature projected to the horizontal, in degrees. This direction is equal to the strike direction plus 90 degrees
planar_linear	Text	1		A toggle, which indicates whether the measurement is for a planar or a linear feature
comment	Text	255		A text description of the structural measurement.
source_id	Long Integer	4		Unique identification number of an information source
Structural_Type	Table	N/A		The Structural Type Table contains the attributes of various types of structural features.
struct_typ_id	Long Integer	4		Unique identifier for each combination of type and modifier
type	Text	50		A major category of types of geologic structures
modifier	Text	50		A modifier to the major structure type specifying the specific type of structure
struct_type_desc	Text	255		A short description defining the structure type
Structure	Table	N/A		The Structure Table links the COA Table to the Structural Type Table.
coa_id	Long Integer	4		Unique identification number of a unit in the Compound Object Archive
struct_typ_id	Long Integer	4		Unique identification number of a record in the Structural Type table
loc_accuracy	Text	50		Locational or positional accuracy of the structure
confidence	Text	50		A measure of confidence that the geologic feature exists in the field or has been identified correctly in the field (i.e. Matti and others, 1997)
Symbol	Table	N/A	Standard Domain	The Symbol Table represents the various symbol tables that are used within each individual GIS.

cart_sym_type	Text	50		Specifies the type of symbol as: area, line, or point
cart_sym_table	Text	50		Name of a symbol table
cart_sym	Long Integer	4		The number of a specific symbol pattern within a symbol table
symbol_desc	Text	255		Description of the symbol pattern and suggested uses
SYSALIAS	Table	N/A	System table used by GeoMatter	(DM 5.2) SYSALIAS contains a list of tables and fields whose contents are to be substituted by the contents of an alias table and field in the display of data
TABLENAME	Text	50		The name of the table containing the field to be aliased.
FIELDNAME	Text	50		The name of the field whose contents are to be aliased; i.e. displayed in text vs. numeric form.
ALIASTABLE	Text	50		The name of the table containing the alias field.
ALIASFIELD	Text	50		The name of the field whose value will be used as the alias in the display.
KEYFIELD	Text	50		None Given
SYSCARTO	Table	N/A	System table used by GeoMatter	(DM 5.2) Documents the system specific symbolization parameters; in this case oriented to ESRI's MapObjects.
cart_sym_table	Text	50		The name of the symbol library that the symbol belongs to.
cart_sym	Long Integer	4		The index of the symbol within the symbol library.
cart_sym_type	Text	10		None Given
cart_MOdesc	Memo	0		An implementation specific description of the symbol; in this case, for ESRI's MapObjects software.
cart_MOvers	Text	10		The version number of ESRI's MapObjects software.
SYSDIX	Table	N/A	System table used by GeoMatter	(DM 5.2) The Tree Manager manages look-up tables that are lists and hierarchies. A general mechanism is introduced that allows a hierarchy (or a list) to be built from the database, and an item(s) to be selected from a hierarchical list and returned
TABLENAME	Text	50		TableName: the name of the table containing a field linked to a look-up list.
FIELDNAME	Text	100		FieldName: the names of the fields linked to the look-up table.
DIXTABLE	Text	100		DixTable: the name of the look-up table. If one more than one table is listed then the tables are (outer) joined on primary key (DixKey).
DIXKEY	Text	100		DixKey: the primary key(s) for the dix lookup tables; used to (outer) join the DixTables.
DIXDISPLAYFIELD	Text	100		DixDisplayField: the names of dictionary fields whose values are displayed in the interface
DIXRETURNFIELD	Text	100		DixReturnField: the names of the dictionary fields whose values are returned from the look-up into the FieldName.
DIXEDIT	Text	10		DixEdit: yes/no toggle indicating whether the dictionary can be edited
DIXVALIDATION	Text	10		DixValidation: a yes/no toggle that determines whether the FieldName contents MUST come from the look-up.
DIXRANKFIELD	Text	100		DixRankField: the name of field(s) that specifies the rank (hierarchical level) of the item. If the specified field is not numeric then its numeric value is found in the RankTable.

DIXSEQFIELD	Text	50		DixSeqField: the name of the field that provides a sorting scheme for the dictionary: the items of the dictionary are sorted on this column.
TREETABLE	Text	50		TreeTable: the name of the table that organizes the lookup table (DixTable) into a hierarchy.
TREEPARENT	Text	50		TreeParent: the name of the field containing the parent item.
TREECHILD	Text	50		TreeChild: the name of the field containing the child item
RANKTABLE	Text	50		RankTable: the name of the table that provides numeric values for qualitative ranks
RANKFIELD	Text	50		RankField: the name of the field that contains the qualitative rank name and which corresponds with the DixRankField.
RANKVALUE	Text	50		RankValue: the name of the field in the RankTable that contains the numeric rank value.
SYSKEY	Table	N/A	System table used by GeoMatter	SYSKEY manages the incrementing of key attributes; upon insertion of a new record in a table, SYSKEY is consulted for the next key value.
KEYTABLE	Text	50		The name of the table containing the key attribute.
KEYFIELD	Text	50		The name of the field containing the key attribute.
LASTKEY	Long Integer	4		The last value used in the key field.

Table 2: Description of queries contained in the database for this report

Name	Type	Width	Description
QryAcidBuff	Query	N/A	A composite query that assembles the queries 'QryPrimLithologyCarb' and 'QrySecLithologyCarb' resulting in a single query that contains COA_ID's that have a carbonate rock in either a primary component or secondary (all other amounts beside primary). The type of carbonate is specified in the primary_lith and second_lith fields
coa_id	Long Integer	4	Unique identification number of a unit in the Compound Object Archive
coa_name	Text	50	The name of the unit in the Compound Object Archive
Primary_lith	Text	50	A lithologic classification term selected from those available in the Lithology Table
second_lith	Text	50	A lithologic classification term selected from those available in the Lithology Table
QryCarbAndMuds	Query	N/A	Returns COA's that contain any amount of carbonate AND mudstone in the same unit. Generalizes lithologies to include specific type of carbonates and mudstones
coa_id	Long Integer	4	Unique identification number of a unit in the Compound Object Archive
coa_name	Text	50	The name of the unit in the Compound Object Archive

QryCarbAndMudsAge	Query	N/A	Returns COA's that contain any amount of carbonate AND mudstone in the same unit, along with the Minimum age of that unit. Generalizes lithologies to include specific type of carbonates and mudstones
coa_id	Long Integer	4	Unique identification number of a unit in the Compound Object Archive
coa_name	Text	50	The name of the unit in the Compound Object Archive
age_name	Text	50	The minimum time-stratigraphic age selected from the Stratigraphic Time Scale Table
min_age	Double	8	Minimum numerical age, in millions of years
QryCarbonates	Query	N/A	Selects COA's with any amount of a carbonate (limestone or dolomite)
coa_id	Long Integer	4	Unique identification number of a unit in the Compound Object Archive
coa_name	Text	50	The name of the unit in the Compound Object Archive
QryGenToLith	Query	N/A	Selects the Primary lithology from a COA and traverses the Lithology_Tree for all parent lithologies. Returns multiple records for each lithology in a COA, depending on what the hierarchy level. Returns the lith_level so that it may be selected on for a specific lithology detail
coa_id	Long Integer	4	Unique identification number of a unit in the Compound Object Archive
lith_class	Text	255	A predefined hierarchical list of lithologic terms used for classifying rock compositions.
lithology	Text	255	A predefined hierarchical list of lithologic terms used for classifying rock compositions.
lith_level	Long Integer	4	A numeric value for the level in the hierarchy of lithologic terms.
QryGenToMaxEon	Query	N/A	Selects COAs from the Stratigraphic_Age table and traverses the Stratigraphic_Time_Scale hierarchy for a Maximum parent age with a rank of 'eon'
coa_id	Long Integer	4	Unique identification number of a unit in the Compound Object Archive
min_age	Text	50	The minimum time-stratigraphic age selected from the Stratigraphic Time Scale Table
max_age	Text	50	The maximum time-stratigraphic age selected from the Stratigraphic Time Scale Table
max_parent_age	Text	255	The time-stratigraphic name for the time interval
QryGenToMaxEpoch	Query	N/A	Selects COAs from the Stratigraphic_Age table and traverses the Stratigraphic_Time_Scale hierarchy for a Maximum parent age with a rank of 'epoch'
coa_id	Long Integer	4	Unique identification number of a unit in the Compound Object Archive

min_age	Text	50	The minimum time-stratigraphic age selected from the Stratigraphic Time Scale Table
max_age	Text	50	The maximum time-stratigraphic age selected from the Stratigraphic Time Scale Table
max_parent_age	Text	255	The time-stratigraphic name for the time interval
QryGenToMaxEra	Query	N/A	Selects COAs from the Stratigraphic_Age table and traverses the Stratigraphic_Time_Scale hierarchy for a Maximum parent age with a rank of 'era'
coa_id	Long Integer	4	Unique identification number of a unit in the Compound Object Archive
min_age	Text	50	The minimum time-stratigraphic age selected from the Stratigraphic Time Scale Table
max_age	Text	50	The maximum time-stratigraphic age selected from the Stratigraphic Time Scale Table
max_parent_age	Text	255	The time-stratigraphic name for the time interval
QryGenToMaxPeriod	Query	N/A	Selects COAs from the Stratigraphic_Age table and traverses the Stratigraphic_Time_Scale hierarchy for a Maximum parent age with a rank of 'period'
coa_id	Long Integer	4	Unique identification number of a unit in the Compound Object Archive
min_age	Text	50	The minimum time-stratigraphic age selected from the Stratigraphic Time Scale Table
max_age	Text	50	The maximum time-stratigraphic age selected from the Stratigraphic Time Scale Table
max_parent_age	Text	255	The time-stratigraphic name for the time interval
QryGenToMaxSubperiod	Query	N/A	Selects COAs from the Stratigraphic_Age table and traverses the Stratigraphic_Time_Scale hierarchy for a Maximum parent age with a rank of 'subperiod'
coa_id	Long Integer	4	Unique identification number of a unit in the Compound Object Archive
min_age	Text	50	The minimum time-stratigraphic age selected from the Stratigraphic Time Scale Table
max_age	Text	50	The maximum time-stratigraphic age selected from the Stratigraphic Time Scale Table
max_parent_age	Text	255	The time-stratigraphic name for the time interval
QryGenToMinEon	Query	N/A	Selects COAs from the Stratigraphic_Age table and traverses the Stratigraphic_Time_Scale hierarchy for a Minimum parent age with a rank of 'eon'
coa_id	Long Integer	4	Unique identification number of a unit in the Compound Object Archive
min_age	Text	50	The minimum time-stratigraphic age selected from the Stratigraphic Time Scale Table
max_age	Text	50	The maximum time-stratigraphic age selected from the Stratigraphic Time Scale Table
min_parent_age	Text	255	The time-stratigraphic name for the time interval

QryGenToMinEpoch	Query	N/A	Selects COAs from the Stratigraphic_Age table and traverses the Stratigraphic_Time_Scale hierarchy for a Minimum parent age with a rank of 'epoch'
coa_id	Long Integer	4	Unique identification number of a unit in the Compound Object Archive
min_age	Text	50	The minimum time-stratigraphic age selected from the Stratigraphic Time Scale Table
max_age	Text	50	The maximum time-stratigraphic age selected from the Stratigraphic Time Scale Table
min_parent_age	Text	255	The time-stratigraphic name for the time interval
QryGenToMinEra	Query	N/A	Selects COAs from the Stratigraphic_Age table and traverses the Stratigraphic_Time_Scale hierarchy for a Minimum parent age with a rank of 'era'
coa_id	Long Integer	4	Unique identification number of a unit in the Compound Object Archive
min_age	Text	50	The minimum time-stratigraphic age selected from the Stratigraphic Time Scale Table
max_age	Text	50	The maximum time-stratigraphic age selected from the Stratigraphic Time Scale Table
min_parent_age	Text	255	The time-stratigraphic name for the time interval
QryGenToMinPeriod	Query	N/A	Selects COAs from the Stratigraphic_Age table and traverses the Stratigraphic_Time_Scale hierarchy for a Minimum parent age with a rank of 'period'
coa_id	Long Integer	4	Unique identification number of a unit in the Compound Object Archive
min_age	Text	50	The minimum time-stratigraphic age selected from the Stratigraphic Time Scale Table
max_age	Text	50	The maximum time-stratigraphic age selected from the Stratigraphic Time Scale Table
min_parent_age	Text	255	The time-stratigraphic name for the time interval
QryGenToMinSubperiod	Query	N/A	Selects COAs from the Stratigraphic_Age table and traverses the Stratigraphic_Time_Scale hierarchy for a Minimum parent age with a rank of 'subperiod'
coa_id	Long Integer	4	Unique identification number of a unit in the Compound Object Archive
min_age	Text	50	The minimum time-stratigraphic age selected from the Stratigraphic Time Scale Table
max_age	Text	50	The maximum time-stratigraphic age selected from the Stratigraphic Time Scale Table
min_parent_age	Text	255	The time-stratigraphic name for the time interval
QryGisRockPolyCOAID	Query	N/A	Traverses the Spatial_Classification, Classification_Object, Data_Classification, and COA tables for all features that are 'Rock_Unit' COA types

spatial_obj_id	Long Integer	50	A unique identifier for each object in an individual data set, or layer
coa_id	Long Integer	4	Unique identification number of a unit in the Compound Object Archive
QryIntrusiveCarbonates	Query	N/A	Returns COA_ID's of all units that contain any amount of Carbonate or Plutonic rock. Traverses the lithology_tree table to generalize subtypes of carbonates and plutonics. Returns both the rock type (lith_class) and the generalized type (parent_class)
lith_class	Text	255	A predefined hierarchical list of lithologic terms used for classifying rock compositions.
Parent_class	Text	255	A predefined hierarchical list of lithologic terms used for classifying rock compositions.
coa_id	Long Integer	4	Unique identification number of a unit in the Compound Object Archive
QryIntrusiveCarbonatesAge	Query	N/A	Returns COA_ID's of all units that contain any amount of Carbonate or Plutonic rock. Traverses the lithology_tree table to generalize subtypes of carbonates and plutonics. Returns both the rock type (lith_class) and the generalized type (parent_class). Also returns Minimum and Maximum Age information for determining if a carbonate predates a plutonic rock
lith_class	Text	255	A predefined hierarchical list of lithologic terms used for classifying rock compositions.
coa_name	Text	50	The name of the unit in the Compound Object Archive
Parent_class	Text	255	A predefined hierarchical list of lithologic terms used for classifying rock compositions.
coa_id	Long Integer	4	Unique identification number of a unit in the Compound Object Archive
min_strat_name	Text	50	The minimum time-stratigraphic age selected from the Stratigraphic Time Scale Table
max_strat_name	Text	50	The maximum time-stratigraphic age selected from the Stratigraphic Time Scale Table
min_age	Double	8	Minimum numerical age, in millions of years
max_age	Double	8	Maximum numerical age, in millions of years
QryPrimLithologyCarb	Query	N/A	Returns COA_ID's of all units that contain a carbonate in Primary abundance.
coa_id	Long Integer	4	Unique identification number of a unit in the Compound Object Archive
comp_seq	Long Integer	4	Unique ID number of a composition within a rock unit. Also indicates the sequence number for displaying descriptive information about this composition within a rock unit description. Compositions are normally sequenced from most abundant to least abundant
lith_class	Text	50	A lithologic classification term selected from those available in the Lithology Table

QrySecLithologyCarb	Query	N/A	Returns COA_ID's of all units that contain a carbonate in any of the Non-primary abundance.
coa_id	Long Integer	4	Unique identification number of a unit in the Compound Object Archive
lith_class	Text	50	A lithologic classification term selected from those available in the Lithology Table

References

Hintze, L.F., 1980, Geologic map of Utah: Utah Geological and Mineral Survey, scale 1:500,000.