The following was presented at DMT'12
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The contents are provisional and will be
superseded by a paper in the
DMT'12 Proceedings.

See also earlier Proceedings (1997-2011)
http://ngmdb.usgs.gov/info/dmt/

Migrating Ohio's Geology GIS Datasets to the New NCGMP09 Standard—Progress Report

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INTRODUCTION

A new standard, funded by the National Cooperative Geologic Mapping Program (NCGMP; USGS National Cooperative Geologic Mapping Program, 2010), has been proposed for the creation of new geologic maps. Standard NCGMP09 is designed to focus on the transfer and archiving of map data. The Ohio Department of Natural Resources, Division of Geological Survey (Ohio Geological Survey), has been creating a number of geologic map databases over the last 16 years. Examples include maps for bedrock geology, at 1:500,000-scale and 1:24,000-scale; bedrock topography, at 1:500,000-scale and 1:24,000-scale; glacial geology, at 1:500,000-scale; and three-dimensional surficial geology, at 1:100,000-scale. This poster looks at the migration of three-dimensional surficial-geology maps to the NCGMP09 database standard. This dataset was chosen for three reasons. First, the three-dimensional surficial-geology GIS dataset is very different than a traditional geologic map dataset. Second, three-dimensional surficial-geology currently is being mapped throughout the state of Ohio as part of the STATEMAP program. Third, the three-dimensional surficial-geology dataset is a critical piece of information needed for the evaluation of geohazard risks, such as abandoned-underground mine subsidence claims since areas of mining with thin glacial drift are more prone to collapse of abandoned underground mines. Including this dataset within the Ohio Geological Survey automated applications will assist with geohazards assessments (McDonald, 2012).

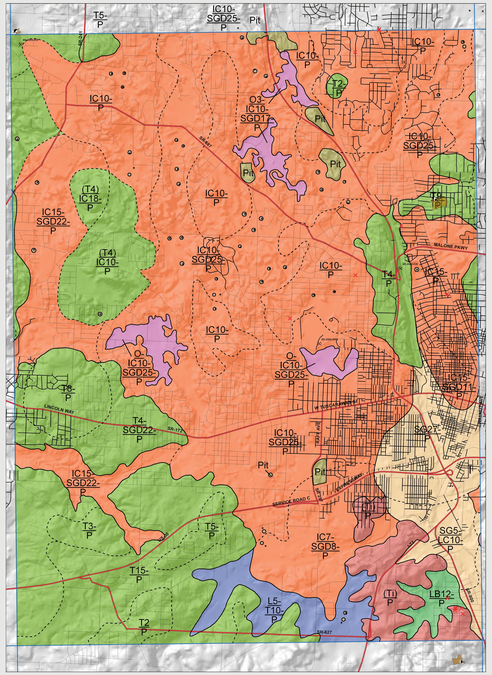


FIGURE 1.—Map showing the three-dimensional surficial geology of the Canton West Quadrangle, Stark County, Ohio (Pavey and others, 2002). Till units (T) are colored in green; ice-contact units (IC) are colored orange; Wisconsinian-age silt and clay (LC) are colored blue; Wisconsinian-age backwater lake deposits (LB) are colored green; organic units (O) are colored purple; sand and gravel units (SG) are colored tan; and Pennsylvanian Pottsville, Allegheny, and Conemaugh Groups (P) are colored brown. Solid lines represent the boundary between map-unit areas in which the uppermost units differ; lower units may or may not differ. Dashed lines represent boundaries between map-unit areas in which the uppermost unit is the same but the underlying units differ in thickness or lithology. Abandoned underground mines are colored brown, while mine subsidence investigation sites are each represented by a red X.

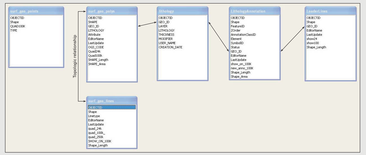


FIGURE 2.—Entity-Relationship diagram for the three-dimensional surficial geology dataset. Note that the surficial-geology polygons have a 1-to-many relationship with the lithology table. Each polygon, while only displaying the unit at the surface, is actually associated with multiple lithologic units from the surface to the bedrock.

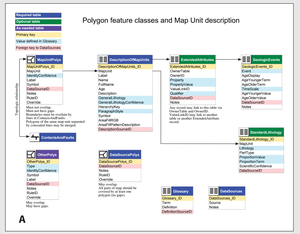
Surf_Geo_Polys (polygon feature class)

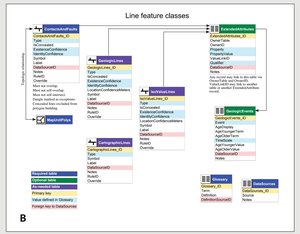
Fields	
OBJECTID	*ESRI assigned ID for the attribute table*
SHAPE	*ERSI field containing the pointer to the geometry*
GEO_ID	*Primary key for the polygon*
LITHOLOGY	*Plain text field containing the map unit abbreviation*
Attribute	
EditorName	*Person who attributed the polygon*
LastUpdate	*Last edit date*
OGS_CODE	*7.5-minute quadrangle code*
Quad24k	*7.5-minute quadrangle name*
Quad100k	*1:100,000-scale quadrangle name*
SHAPE_Length	*ESRI calculated polygon perimeter length*
SHAPE_Area	*ESRI calculated polygon area*

MapUnitPolys (polygon feature class)

Fields	
MapUnitPolys_ID	*Primary key. Example Values = MUP1, MUP2, MUP3, etc. Values must be unique in database as a whole*
MapUnit	*Short plain-text key (identifier) for the map unit. Example values: Qal, Tg, Kit, water, Trc3, etc. Foreign key to DescriptionOfMapUnits table. Null values not permitted—a mapped polygon must have an assigned map unit*
IdentityConfidence	*How confidently is this polygon identified as MapUnit? Value is usually "certain", "questionable", or "unspecified". Null values not permitted. Suggest setting default value to 'certain'*
Label	*Calculated from MapUnit:/Label and IdentityConfidence: if IdentityConfidence = "questionable", then append "?" to MapUnit:/Label. Allows for subscripts and special characters. Null values OK*
Symbol	*References an area fill symbol (background color + optional pattern). Area fill symbols must be defined in an accompanying style file. If cartographic representations are used to symbolize map units, the value may be null or blank. Null values permitted*
RuleID	*Data type = integer. If Cartographic Representations are used, this field is required; otherwise it is not included in the table (see* Symbolization *section, below)*
Override	*Data type = blob. If Cartographic Representations are used, this field is required; otherwise it is not included in the table (see* Symbolization *section, below)*
Notes	*Null values OK. Free text for additional information specific to this polygon*
DataSourceID	*Foreign key to DataSources table, to track provenance of each data element. Null values not permitted*

FIGURE 4.—Comparison of the **Surf_Geo_Poly** feature class and **MapUnitPolys** feature class. The field **GEO_ID** easily translates into the **MapUnitPolys_ID** field. In addition, the **LITHOLOGY** field easily translates into the **MapUnit** field. There are issues with using the **IdentityConfidence** field, since a map polygon can represents both a surface and subsurface map unit. All other fields can be used with the **Surf_Geo_Polys** feature class.





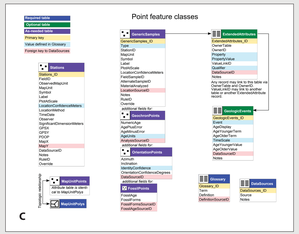


FIGURE 3 A, B, and C.—Entity-Relationship diagrams for the NCGMP09 database (USGS National Cooperative Geologic Mapping Program, 2010)

Surf_Geo_Lines (line feature class)

Fields	
OBJECTID	*ESRI assigned ID for the attribute table*
SHAPE	*ERSI field containing the pointer to the geometry*
Attribute	
EditorName	*Person who attributed the polygon*
LastUpdate	*Last edit date*
Quad24k	*7.5-minute quadrangle name*
Quad100k	*1:100,000-scale quadrangle name*
Quad250k	*1:250,000-scale quadrangle name*
SHOW_ON_100K	*Field used for displaying contact lines on 100K quadrangle maps*
SHAPE_Length	*ESRI calculated polygon perimeter length*

ContactsandFaults (line feature class)

Fields	
ContactsAndFaults_ID	*Primary key for database record. Example values = COF1, COF2, … Values must be unique in database as a whole*
Type	*Specifies the kind of feature represented by the line. Values could be, for example, 'contact,' 'fault,' 'waterline,' 'glacier boundary,' 'map boundary.' Values must be defined in Glossary. Null values not permitted*
IsConcealed	*Values = "N"/"Y". This is a flag for contacts and faults covered by an overlying map unit. Null values not permitted*
LocationConfidenceMeters	*Data type = float. Half-width in meters of positional uncertainty envelope; position is relative to other features in database. Null values not permitted. Recommend value of -9 if value is not available*
ExistanceConfidence	*Values='certain','questionable','unspecified'. Null values not permitted. Suggest setting default value='certain'.*
IdentityConfidence	*Values='certain','questionable','unspecified'. Null values not permitted. Suggest setting default value='certain'.*
Symbol	*References a symbol in the accompanying style file. Calculated from Type, LocationsConfidenceMeters, ExistanceConfidence, IdentityConfidence, and expected map display scale. Null values OK*
RuleID	*Data type = integer. If Cartographic Representations are used, this field is required; otherwise it is not included in the table (see* Symbolization *section, below)*
Override	*Data type = blob. If Cartographic Representations are used, this field is required; otherwise it is not included in the table (see* Symbolization *section, below)*
Label	*Can be used to store fault name, or human-readable name for a line feature. To group line segments into a specific structure trace, e.g."San Andreas Fault", use Extended Attributes. Typically null*
Notes	*Free text for additional information specific to this feature. Null values OK.*
DataSourceID	*Foreign key to DataSources table, to track provenance of each data element. Null values not permitted*

FIGURE 5.—Comparison of the **Surf_Geo_line** feature class and the **ContactAndFaults_ID** feature class. The map unit boundaries currently do not conform to the definitions associated with the NCGMP09 database standard, as used in the **Type** field. The map unit boundaries will need to be added to NCGMP09 Glossary. The Ohio Geological Survey also will need to assign unique ID numbers to all the **Surf_Geo_Lines** features.

Fields	
DescriptionOfMapUnits_ID	*Primary key: DMU1, DMU2, DMU3; Extended Attributes table OwnerID is a foreign key using this value. Null values not permitted*
MapUnit	*Short ASCII string that identifies map unit: Qal, Tec, Qvt. Unit abbreviations must be unique in the database. Values in this field are the link (foreign key) between this table and the MapUnitPolygon table. Null values OK, and are commonly associated with headings or headnotes. Use of special characters is not recommended in this field*
Label	*Text string used to place label in map display; includes graphic elements such as special fonts and formatting for subscripts. For example, Triassic Newark Formation might be "<font=FGDCGeoAge>#n". Null values OK for units that do not appear on map or are not labeled, e.g., headings, headnotes, water, glacier, some overlay units*
Name	*Boldface name in traditional DMU, identifies the unit within its hierarchical context. Examples: 'Chinle Formation', 'Shnabkaib Member'. These names should be verified in the U.S. Geologic Names Lexicon (GEOLEX); if your usage does not agree with GEOLEX's, notification should be submitted to the Lexicon website. Null values OK*
FullName	*Full name of unit, including identification of containing higher rank units, e.g., 'Shnabkaib Member of Moenkopi Formation'. This is the text you would like to see as fly-out when cursor lingers over polygon in an electronic map display. See Lexicon-related note in "Name", above. Null values OK (e.g., for headings, headnotes, geologic units not shown on map)*
Age	*As shown in bold within parentheses in traditional DMU. Null values may be used for map units that inherit Age from a parent unit, or for headings, headnotes, or overlay units. To designate age with more resolution than permitted by DMU standards, or to record multiple ages (e.g., deposition and metamorphism) for a unit, create entries in* ExtendedAttributes *and* GeologicEvent *tables*
Description	*Free-format text description of map unit. Commonly structured according to one or more accepted traditions (e.g., lithology, thickness, color, weathering and outcrop characteristics, distinguishing features, genesis, age constraints) and terse. Allows markup (e.g., HTML) specification of new paragraphs, superscripts and subscripts, and geologic-age font (sans-serif and with special characters). Null values OK*
HierarchyKey	*Has form nn-nn-nn, nnn-nnn, or similar. Numeric, left-padded with zeros, dash-delimited. Each HierarchyKey fragment of each row MUST be the same length to allow text-based sorting of the DMU entries. These strings are useful for resolving queries involving hierarchical relationships, e.g., 'find all members of formation x,' 'what is the parent unit of map unit y.' Null values not permitted. Table 1* ***Error! Reference source not found.****, below, illustrates the use of HierarchyKey to describe the structure of a complex Description of Map Units*
ParagraphStyle	*Values are Heading1st, Heading2nd, Heading3rd, …, Headnote, DMU1, DMU2, DMU3, or similar. Formatting associated with a paragraph style should be explained with a definition of the style in the glossary. Null values not permitted*
AreaFillRGB	*(Red, Green, Blue) tuples that specify the suggested color (e.g., '255,255,255','124,005,255') of area fill for symbolizing this MapUnit. Use of consistent syntax is important to enable computer programs to read this field and display intended color. Each color value is an integer between 0 and 255; values are zero-padded so that there are 3 digits to each R, G, and B value; and color values are separated by commas with no space: NNN,NNN,NNN. Especially important to non-ESRI users unable to use the .style file. Null values OK (e.g., headings, headnotes)*
AreaFillPatternDescription	*Text description (e.g., 'random small red dashes') provided as a convenience for users who must recreate symbolization. Especially important to non-ESRI users unable to use the .style file. Null values OK (e.g., headings, headnotes, unpatterned map units)*
Symbol	*References an area fill symbol in the accompanying style file that is used for symbolizing the unit on the map.*
DescriptionSourceID	*Foreign key to DataSources. Identifies source of DescriptionOfMapUnits entry. Null values not permitted*
GeneralLithology	*Term to categorize the map unit based on lithologic and genetic character, from NGMDB standard term list (Appendix A); see also discussion in "Extensions to traditional geologic map content", above. Null values OK for headings and unmapped units*
GeneralLithologyConfidence	*Describes appropriateness of GeneralLithology term for describing the map unit (Appendix A). Null values OK for headings and unmapped units*

FIGURE 6.—Description of Map Units table definitions (USGS National Cooperative Geologic Map Program, 2010).

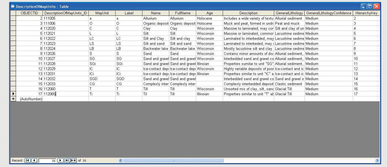


FIGURE 7.—Example of the Description of Map Units table populated with the map units from the Surficial Geology of the Canton 30 x 60 Minute Quadrangle (Pavey and others, 2002). All map units currently appear to translate well into the Description of Map Units table. But the requirement that the glacial map units correspond to Geolex records cannot be obeyed, since the glacial map units correspond to a combination of textural descriptions and processed-based classifications.

SUMMARY

Initial testing of the migration of the three-dimensional surficial geology map data to the NCGMP09 database standard appears to show promise, despite the complexity of mapping geology in three dimensions. The master 1-to-many lithology table and the stacked annotation are critical components to the Ohio Geological Survey surficial-geology maps. The lithology table and the stacked annotation feature class will need to be added to the NCGMP09 database as a non-standard component.

REFERENCES

McDonald, James, 2012, Evaluating mine subsidence using a GIS software application, *in* Digital Mapping Techniques '10—Workshop Proceedings, Sacramento, Calif., May 16–18, 2010: U.S. Geological Survey Open File Report, 25 p., <http://ngmdb.usgs.gov/Info/dmt/docs/DMT10_Draft_McDonald.pdf>.

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