Geologic map standards

Harvey Thorleifson Ph.D.
Director, Minnesota Geological Survey

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Much effort in mapping goes toward depicting land-surface features.
Some mappers look up, to construct meteorological charts.
Some mappers look down
The first subsurface layer is bathymetry
Next, soil mapping by agricultural agencies
Then, geological mapping
Spatial data infrastructure

National Spatial Data Infrastructure Strategic Plan 2014–2016

A-16 NGDA Portfolio

NGDA Theme

NGDA Datasets

Geology is one of the National Geospatial Data Assets

National Geospatial Data Asset Management Plan

- Biota
- Cadastre
- Climate & Weather
- Cultural Resources
- Elevation
- Geodetic Control
- Geology
- Governmental Units
- Imagery
- Land Use – Land Cover
- Real Property
- Soils
- Transportation
- Utilities
- Water – Inland
- Water – Oceans & Coasts

Federal Geographic Data Committee
December 2013

OMB Circular A–16
A–16, Coordination of Data Activities
Geological mapping, like all of the mapping we do, is an essential service.
Geological mapping, like all of the mapping we do, saves money.

- lives saved
- resources discovered
- costs avoided
- increased efficiency
- fundamental understanding
Future geological mapping needs to be

Regularly updated
Zoomable
Queryable
Complete
Seamless
3D
Onshore to offshore
3D starts with stacking, then thickness
Users desire compatible geological mapping at multiple zoom levels.
Geological mapping of the world is coordinated by the Commission for the Geological Map of the World (CGMW).
The National Cooperative Geologic Mapping Program (NCGMP) is the primary source of funds for the production of geologic maps in the United States and provides accurate geologic maps and three-dimensional framework models that help to sustain and improve the quality of life and economic vitality of the Nation and to mitigate natural hazards.

The NCGMP represents over 2 decades of successful cooperation among Federal (FEDMAP), State (STATEMAP), and university (EDMAP) partners to deliver digital geologic maps to customers. Each of these three components has a unique role, yet all work cooperatively to select and map high-priority areas for new geologic maps.

Geologic mapping data from all of North America are presented via the National Geologic Map Database, and a common set of geologic map standards is being developed by the NCGMP in cooperation with the North American Geologic Map Data Model Steering Committee.

From August 9th to 11th, 2016, the NCGMP Decadal Strategic Planning Workshop was chaired by John Brock.
Accessibility
Standards

- Users expect standardization (Kresse et al., 2012)
- A standard launched too early will be overtaken; if too late, the cost to reconcile competing solutions is great, so industry consortia define abstract standards before development
  - Key principles are: do it once, do it right, and do it internationally
- Any national approach is at best preparation for an international solution
- Abstract standards are independent of operating systems, applications, hardware, and encodings
  - Implementation standards determine encoding
  - Interface standards determine hardware or firmware
- Most ISO standards are abstract; industry standards are at the implementation or interface level
Data model

- A conceptual model is fundamental to geographic system design (Roswell, 2012; ISO/TS 19103:2015)
- data models define concepts, their relationships, and how they are represented as data
  - semantic elements define terminology, while syntactic elements define structure, of discrete and continuous features, and their attributes, relationships, and functions, categorized as feature types
- the model is summarized as a diagram or schema
Encoding

- **Encoding** of geographic information according to an application schema allows storage and transfer (Portele, 2012)
- An encoding rule is used to create a data structure that is system independent and suitable for a transfer protocol such as ftp or http
- Encoding rules are specified implicitly by formats such as ESRI shapefiles, and geography markup language (GML)
Registration

- Registers are dictionaries and common code lists that hold definitions applicable to datasets of geospatial information elements that include features, attributes, relations, and metadata (O’Brien and Lott, 2012; ISO 19135-1:2015)
As part of NCGMP, the NGMDB Project has coordinated development of standards and databases under the leadership of Dave Soller.
Our principal forum for the development of geologic map standards in the US is the annual DMT workshop, which will be held in Minneapolis next year.
Metadata standard

How will I find data, and will I know how to use it?

- data about other data that assists in their discovery and use
- what the data describes
- by whom, why, and how the data were created
- how reliable the data are
- problems remaining
- how the data can be obtained
- who wrote the metadata

Digital map standard

- guidelines for publication of digital maps as a common set of digital files, which undergo both peer review and release in a consistent manner (Soller et al., 1999b)
  - guidelines for authorship credit and citation format for geologic maps, digital geologic maps, and associated digital databases (Berquist, 1999; Richard, 2000; Berquist and Soller, 2001)
- NCGMP ‘Guidelines for Digital Review of a Geological Map Database’
- NCGMP ‘Guidelines for Peer Review of a Geologic Map Product’
- guidelines for citation of unpublished GIS Files (Soller, 2012)
Cartographic standard

- defines geologic map symbols, colors, and patterns
- needs to be regularly updated
- prevailing USGS standard of the early 1990s was Hansen (1991)
- updated by a committee led by Mitch Reynolds (USGS, 1995a; 1995b)
  - reviewed initiated by Soller (1996)
  - review process was described by Soller and Lindquist (2000)
- published in 2006 (FGDC, 2006)
- standard undergoes ongoing maintenance
**Database standard**

- The US-Canada NGMDB Data Model working group produced a relational and object-oriented database structure for geologic map information (Raines et al., 1997; Johnson and others, 1998)
- The North American Geologic Map Data Model (NADM) Steering Committee developed a prototype to more effectively manage map information (Soller et al., 2002)
  - In 2004, the NADM C1 conceptual data model was published (NADM, 2004a), and a draft standard terminology for earth materials was produced (NADM, 2004b)
- The ESRI Geologic Mapping template was later produced by Frye and Day (2011)
- NCGMP09 is now the standard format for geologic maps funded by NCGMP
  - GeoSciML standard is being developed on the international level
  - Work also has focused on the Terminology Standard
NCGMP09 is now the standard format for geologic maps in the US funded by NCGMP.
The Commission for the Management and Application of Geoscience Information works with OGC to develop international geologic map standards.
GeoSciML is now a data transfer standard for all geological data from map data to complex geological databases.
An outcome of the June OGC meetings in Dublin is a group examining 3D geologic map standards.
Next steps

- Ongoing efforts to require NCGMP09 compliance under NCGMP
- Consideration regarding whether USGS should engage with international activity
  - Launch of GeoSciML 4.1 as an OGC standard
  - Consideration whether GeoSciML 4.1 will be able to accommodate 3D geological maps
  - OGC examination of competing 3D geology standards