DIGITAL MAPPING TECHNIQUES 2019

The following was presented at DMT’19
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The contents of this document are provisional

See Presentations and Proceedings from the DMT Meetings (1997-2019)

http://ngmdb.usgs.gov/info/dmt/
Implementing GeMS for NCGMP-funded Geologic Maps

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A newly-formed GeMS Working Group met in Spring, 2019, to develop recommendations for the USGS National Cooperative Geologic Mapping Program (NCGMP) about how to implement a program-wide requirement for the use of GeMS for all NCGMP-supported geologic map products. The GeMS Working Group is comprised of fifteen members representing NCGMP, FEDMAP, and the State Geological Surveys, including Directors of both large and small surveys who participate in STATEMAP.

The GeMS Working Group reviewed a recent document developed by the National Geologic Map Database (NGMDB) Technical Advisory Working Group that defined GeMS compliance in terms of three levels. With these definitions of GeMS Compliance in mind, the GeMS Working Group developed a set of consensus recommendations about how to implement a GeMS-requirement for the STATEMAP, FEDMAP, and EDMAP programs. The group also devised recommendations for the NGMDB and other NCGMP mapping activities including 3D geologic mapping and derivative mapping. These draft recommendations, not yet fully endorsed as requirements, are presented here, and will be included in a chapter on GeMS Implementation in the Implementation Plan for the recent NCGMP Decadal Strategic Plan.
Implementing GeMS for NCGMP-funded geologic maps

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NCGMP was established by the National Geologic Mapping Act (NGMA) of 1992 and reauthorized by Congress in March 2019 at $64M. NCGMP is a national Program, in partnership with the State Geological Surveys to map the 3D geology of the Nation. Current appropriated funding level is $25M.

- **Federal Component (FEDMAP)**
  Geologic maps and research, and 3D framework models directed by high priority national issues.

- **State Grants (STATEMAP)**
  Long-standing partnership with States - matching funds double the USGS investment.

- **Education Grants (EDMAP)**
  Training the next generation of geologic mappers - matching funds double the USGS investment.

- **National Geologic Map Database (NGMDB)**
  Public archive of geologic maps for the Nation

- **Great Lakes Geologic Mapping Coalition (GLGMC)**
  Understanding of 3D distribution of deposits overlying the glaciated Midwest

- **Earth Mapping Resources Initiative (Earth MRI)**
  State geologic mapping for critical minerals
2018 – 2030 NCGMP Strategic Plan:

The **renewed vision** of the USGS National Cooperative Geologic Mapping Program is to: *Create an integrated, three-dimensional, digital geologic framework model and derivative map(s) of the United States and its territories to address the changing needs of the Nation by the year 2030.*

**New NCGMP Decadal Goals:**

- Achieve excellence in the performance and relevance of the FEDMAP, STATEMAP and EDMAP Program components, and maximize beneficial partnering between all Program Components.
- Optimize the use of field-based, remote sensing and geophysical technologies, and construct the infrastructure to house a national integrated 2D/3D geologic framework model.
- Populate a geospatial infrastructure to create national integrated 2D/3D geologic framework model that enables the seamless construction of geologic maps within user-defined regions-of-interest across all of U.S. by the Year 2030.
A Geologic Map Database Standard- WHY?

- “Geologic maps contributed to the national archives [the NGMDB] should have standardized format, symbols, and technical attributes so that archival information can be assimilated, manipulated, accessed, exchanged, and compared efficiently and accurately” (NGMA of 1992)

- A National database needs consistent encoding & nomenclature to support computation

- Data should be predictable (Stakeholders want to know that the structure is not going to change); There is need for a common understanding and accessibility of data that is easy to use
A Geologic Map Database Standard - WHY?

- Standardization and coordination are key challenges for supporting effective emergency management practices, land-use planning, natural resource assessments, water management, infrastructure development, and other practical uses of geologic maps.
- Data management costs are reduced where the data are standardized, well organized and therefore readily migrated when the standard evolves.
- Data are less likely to be lost if it is well-organized and standardized.
- Map production and publication may be streamlined with standardization.
NCGMP Strategy Implementation Plan

- Plan based on the Strategic Plan that will guide FEDMAP Project Prospectus through 2030 (Chapters organized by Geologic Province)

- Chapter outlining Nationwide 3D Mapping efforts

- Chapter outlining GEMS Implementation

- Summer 2019: Publish Strategy; Implementation Plan into Review
GeMS Working Group Meeting Objectives

• Outline the process by which NCGMP will require GeMS-compliant map data for all NCGMP-funded products
• Provide recommendations on the above to be included in the NCGMP Implementation Plan of the 2018-2030 NCGMP Strategic Plan
• Meeting at USGS in Denver, April 30-May 1
GeMS Working Group Members

Darcy McPhee, *USGS*
Dave Soller, *USGS*
Ralph Haugerud, *USGS*
Tracey Felger, *USGS*
Joe Colgan, *USGS*
Dave Norman, *Washington GS*
David Wunsch, *Delaware GS*
Margaret Thomas, *Connecticut GS*

Dick Berg, *Illinois State GS*
Jim Faulds, *Nevada Bureau of Mines & Geology*
Jessica Czajkowski, *Washington GS*
Lillian Wang, *Delaware GS*
Jen Athey, *Alaska DGGS*
Mark Yacucci, *Illinois State GS*
John Dunham, *Kansas GS*
GeMS Compliance- What does this mean?

Implementation plan for State and Federal compliance with NCGMP’s standard “Geologic Map Schema” (GeMS) for geologic map databases (prepared by Dave Soller and Ralph Haugerud in collaboration with the NGMDB Working Group)

- GeMS was designed as a publication format, not a ‘working-level’ research database- Agencies are encouraged to manage their geologic map data however they conclude is most practical
- GeMS is stable and will not change in the foreseeable future, however supporting documentation and software tools will evolve as needed
- NGMDB will build and maintain the nationwide GeMS repository
- 3 levels of compliance
GeMS Compliance - What does this mean?

3 Levels of GeMS Compliance:

- **Level One** -- GIS format/adheres to GeMS topology requirements; stratigraphic nomenclature differences with Geolex are documented

- **Level Two** -- Level One requirements, plus the GeMS schema is implemented for the map (but only specified fields must have appropriate content, and GeMS validation script must be run)

- **Level Three** -- Level 2 requirements, plus legitimate content for all required fields not noted for Level 2, and population of optional fields is strongly encouraged
GeMS Working Group Recommendations

- STATEMAP (GLGMC)
- FEDMAP
- EDMAP
- NGMDB
- Other NCGMP mapping activities (for example, 3D Geologic Mapping, Derivative Mapping, etc.)
- Earth MRI (new effort, no recommendations- *All geologic map deliverables will be required to comply with GeMS*)
GeMS Working Group Recommendations: **GENERAL**

- A balance between mapping and cartography needs to be maintained
- Needed resources:
  - Funding/staff at both state surveys and USGS
  - Funding for technical support
    - Maintain NGMDB repository
    - Maintain and grow toolboxes
    - Create training materials and conduct training
    - Conduct digital reviews
    - Answer technical questions
    - Services to States (these may be State provided)
- Without more funding, states will achieve compliance within a much slower timeframe.
- GeMS conversion for legacy maps (older than 5 years) should be handled through the National Geological and Geophysical Data Preservation Program
GeMS Working Group Recommendations: STATEMAP

- **FY20 Products (due Summer 2021, *NOT dependent on additional resources*)**
  - PDF map(s) of FY20 deliverables; publication-quality cartography IS NOT REQUIRED
  - Program Officer will choose a **published map** from the NGMDB for evaluation by review panel; must be a recent (within 5 years) STATEMAP product
  - One database with Level 1 GeMS compliance; can be for any recent published STATEMAP map

- **FY21 Products (due Summer 2022, *dependent on additional resources*)**
  - PDF map(s) of FY21 deliverables; publication-quality cartography IS NOT REQUIRED
  - Program Officer will choose a **published map** from the NGMDB for evaluation by review panel; must be a recent (within 5 years) STATEMAP product
  - One database with Level 2 or 3 GeMS compliance on any recent published STATEMAP map; will also include a reconciliation document describing aspects that don’t conform to GeMS

- **FY22 Products (due Summer 2023, *dependent on additional resources*)**
  - PDF map(s) of FY22 deliverables; publication-quality cartography IS NOT REQUIRED
  - One database with Level 3 GeMS compliance for one recently (within 5 years) published map database (to be submitted to the NGMDB repository); can be for any recent STATEMAP map
  - Program Officer will use PDF generated from delivered GeMS database of a published map from NGMDB for evaluation by review panel
GeMS Working Group Recommendations: FEDMAP

- FY2019 FEDMAP Prospectus requires all projects to use GeMS for all maps deliverables
- Mapping that began in FY19 should publish GeMS compliant databases
- Applying the GeMS requirement to products for projects that began prior to FY19 could result in a significant delay in publication
- For mapping that began prior to FY19, the project will submit compliance plans for in-progress maps as part of the FY20 workplan (maps that are far enough along that conversion would significantly delay publication should not be required to convert)
- There is a shortage of staff who are qualified and available to do digital reviews, and even fewer who are currently ‘GeMS capable’
- Additional resources are needed to avoid further delays in the publication process, particularly ‘GeMS capable’ staff to conduct digital reviews (to fulfill USGS review requirements)
**GeMS Working Group Recommendations: EDMAP**

- Continue to recommend use of GeMS in the Program Announcement; encourage use and inform participants of GeMS resources, but don’t make a requirement until FEDMAP and STATEMAP are fully on board and USGS resources are developed.

- Encourage EDMAP maps to be published through the State Surveys - This is an opportunity to get EDMAP PI’s and States working together; publication through a State Survey is a way to give EDMAP PI’s exposure to GeMS. Provide encouragement in the EDMAP Program Announcement to work with States for publication in GeMS format.
GeMS Working Group Recommendations: NGMDB

• NGMDB will develop a system and repository to track and store GEMS compliant databases, and an associated maintenance plan.
• NGMDB will develop a template reconciliation report that FEDMAP and STATEMAP projects will use to document GeMS compliance.
• NGMDB needs additional FTE to adequately support the implementation of GeMS by FEDMAP and STATEMAP; NGMDB is currently lacking the staff needed to maintain and upgrade the GeMS toolbox, provide technical support and training to users/projects who are attempting to implement GeMS, establish and maintain the GeMS repository, etc.
National Geologic Map Database
Standards and guidelines

Background
To create, manage, and disseminate digital earth-science information, it is increasingly clear to data producers and users that certain widely-accepted standards are essential in the past, many organizational units (e.g., projects or programs) have of necessity developed their own standard practices for creating and managing digital map data. Because the resources needed to develop widely-accepted standards are difficult for a single organizational unit to justify, many of these standard practices developed in an ad hoc fashion, with scant input from other groups.

Two notable mechanisms now exist in the United States to promote the coordination of widely-accepted standards: 1) the National Geologic Mapping Act of 1992 stipulates that necessary standards be developed by USGS and the Association of American State Geologists (AASG) to support the National Geologic Map Database (NGMDB); and 2) the Federal Geographic Data Committee (FGDC), through its Geologic Data Subcommittee, is responsible for development of standards to support geologic data management at the Federal level.

The links below contain information pertinent to the development of standards and guidelines for geologic mapping. Many of these works stemmed from discussions held at the annual Digital Mapping Techniques workshop, sponsored by the NGMDB and the Association of American State Geologists. The beginning stages of this work (ca. 1996-1997) are documented and preserved in an archival site and in the earliest NGMDB reports of progress.

"GeMS" — standard Geologic Map Schema
"GeMS" (formerly named NCGMP09) is the standard schema for geologic maps funded by the USGS National Cooperative Geologic Mapping Program (NCGMP). Its design specifies encoding the content analogous to that contained in a single, traditional geologic map. GeMS is intended to provide a stepping stone toward development of multimap databases, in particular the National Geologic Map Database (NGMDB). Please visit our GeMS site.

Related, Older Database Designs
This list focuses on the work by USGS and AASG staff, ca. 1998-2010, to define conceptual data models and physical implementations, mostly preceding development of NCGMP09.

- NADM Design, esp. see Variants and Implementations [North American Data Model Steering Committee, 2004]
- NGMDB-Lite – Database design for the National Geologic Map Database’s Data Portal [NGMDB, 2010]

Additional Resources
- Geologic Content Specification for a Single-Main Database (NGMDB, 2010)
Thank you. Questions?