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Requirements for submitting GeMS-compliant map databases
to the USGS/AASG National Geologic Map Database (NGMDB)

NOTE: These requirements were developed by staff associated with the National Geologic Map Database (NGMDB), to assist State, Federal, and University authors in: (1) preparation of GeMS-compliant GIS files, and (2) submittal for publication and for repositing in the NGMDB's Trusted Digital Repository. NGMDB staff gratefully acknowledge guidance and suggestions from the NGMDB Technical Advisory Working Group (composed of 26 members of 12 State Geological Surveys) and from the National Cooperative Geologic Mapping Program (NCGMP), the National Geological and Geophysical Preservation Program (NGGDPP), and the Earth Minerals Research Initiative (Earth MRI).

NOTE: This new Requirements document refers to several supporting documents that will soon be provided. Those documents, and any revisions to these Requirements found to be necessary after the community discussion to be held in the GeMS Webinar (Jan. 17), will be posted by late January.

Introduction

Scientists, the private sector, and the general public will download and use the GeMS databases (hereafter referred to as GeMS packages) reposited in the NGMDB. Through these requirements listed below, we strive to provide commonality among those GeMS packages. The science contained in these databases will not be evaluated or revised by the NGMDB. Rather, the purpose of these requirements is to ensure that the GeMS package is as compact and well organized as possible. We specify a directory structure and naming conventions that will serve the community by increasing the predictability of content organization among all GeMS packages available for end-users to download. Predictability aids in ease-of-use, and so your attention to these details should increase a user's confidence in using digital geologic maps.

Your GeMS package should be submitted via the GeMS Upload Form, accessed at NGMDB's Connect web site (https://ngmdb.usgs.gov/connect/). If you don't have a login, please request one via ngmdb@usgs.gov. We will add your login to the registry and notify you. As you prepare the GeMS package:

- If you have technical questions regarding how to represent your science and map data in GeMS, please contact us at gems@usgs.gov.
- If you have questions about the GeMS upload process, please contact us at ngmdb@usgs.gov.

After you submit a GeMS package, it will be evaluated by the GeMS QC Team (gemsqc@usgs.gov) for content and general organization of files, with the goal of providing a simpler and more standardized package to end-users. The QC evaluation process will be detailed in a separate document soon to be available.

Resources

The published GeMS documentation (https://pubs.er.usgs.gov/publication/tm11B10) provides the general information needed to understand and implement the GeMS schema. However, as GeMS implementation has proceeded in our agencies, and our considerations of how to make these packages available for download have evolved, the specific requirements shown in that document's Tables 3, 4, and 5 (p. 11) needed to be amended. The updated requirements will soon be provided to replace the GeMS Checklist that's currently available (https://ngmdb.usgs.gov/Info/standards/GeMS/docs/GeMS_checklist.pdf). Because the process continues to evolve (albeit more slowly now), please check that page for updates prior to your submission.

The GeMS website (https://ngmdb.usgs.gov/Info/standards/GeMS/) provides links to the (ArcMap and ArcGIS Pro) tools for checking your map database for GeMS compliance. These tools check for topology and content adherence to the GeMS standard and provide possible matches between Geolex and the formal geologic names used on your

map. We strongly recommend that you execute the tools iteratively, as you build the map database, rather than waiting until just before submitting the files.

To facilitate a standard directory structure and naming conventions, we will soon provide at the GeMS website a link to the GeMS package template, which we encourage you to use.

The GeMS Upload Form is a two-step process that requires your careful consideration of questions related to your submission, for example: the publication status of the GeMS package; whether the package is considered provisional and will be versioned; the funding Program; the NGMDB Product Description Page from which the GeMS package will be linked; and so forth. We strongly recommend consulting the Help documentation at the Connect site before using the Upload Form; we will soon offer a PDF copy of it on the GeMS website.

Preparing your GeMS package for submission

As you prepare your GeMS package, please monitor the total size when bundled into the zip file. It's been our experience that GeMS zip files for typical geologic maps of 24K and 100K scale are in the range of 20-50 MB. If you've followed the instructions in this document and your zip file still exceeds the NGMDB's current file size upload limit (100 MB), please contact us at ngmdb@usgs.gov to determine how to submit the file. For map compilations or Statewide maps, file size may greatly exceed our current upload limit, and so we'll provide guidance for you when you contact us.

A map graphic and GIS database released by an agency might include components such as photographs, ancillary data tables, and print-quality graphics of all Plates. GeMS packages can contain any number of those components, but the principal focus is on elements directly related to the GIS data. Therefore, if the GeMS package's .zip file size exceeds 100 MB, please consider omitting elements not critical to the use of the GIS data. The NGMDB landing pages for GeMS packages will include the URLs that link users to the submitting Agency's website, if available, where the full suite of components for a product may be found.

Requirements and guidance for principal elements of the GeMS package

As noted above, use the GeMS Checklist to ensure that you are including the required files. The Checklist is intended to assist you and will not be the final determiner of whether your submittal is GeMS compliant. The Checklist is in PDF format, but you may submit it in a Word or text document if you so choose.

- ***The GeMS geodatabase:***

This section refers only to the geologic map. Please do not include the base map in this geodatabase, nor significantly large sets of photographs or other information that are tied to point locations but which could be contained outside this geodatabase.
The geologic map geodatabase may include more than one GeologicMap feature dataset. However, only one geologic map geodatabase may be included in the GeMS package. If your deliverable includes more than one (e.g., separate geodatabases for two maps completed under a single STATEMAP proposal award number), you will need to make separate submissions through the GeMS Upload Form.
Duplicate geologic map geodatabases that may be generated by the GeMS validation tool should be deleted.
Regarding the geodatabase's file size, it can be significantly reduced by using the Esri Compact command. Compacting cleans out storage and unused space that results from frequent editing, and it can greatly reduce the file size. Also, please ensure that .lock files are not present in the submitted geodatabase. You can delete these from File Explorer after you have closed all ArcGIS programs.

- ***The GeMS shapefile:***

Only the "open" shapefile version is now required. However, the simple shapefile version may be included as an optional component. Our plans are to eventually remove this requirement entirely – the NGMDB would then generate the open shapefile after your submission and(or) generate a geopackage for the final, publicly-downloadable GeMS package.

- ***Graphic representation of the GeMS data:***

Regarding the requirement in the published GeMS documentation for a high-resolution and a browse graphic, there were two goals: (1) to ensure that the NGMDB obtains a publication-quality PDF copy of the map for display at the website, and (2) to provide the user with a legible depiction of the geology as visualized by the author.

- To meet goal #1, you may include the print-quality PDF as an optional component in the GeMS package, if the package is less than 100 MB in size. If not, please contact USGS as ngmdb@usgs.gov to arrange for the NGMDB to receive the print-quality PDFs of all parts of the deliverable (e.g., all plates, and the report if any). Longer-term plans are to enable the print-quality map, related sheets, and report to be uploaded to the NGMDB via another mechanism in the NGMDB Connect website.
- To meet goal #2, include in the GeMS zip file a "legible" JPG that shows either the cartographically finished map sheet or a GIS-rendered depiction of the geologic map (inside the neatline) along with a List of Map Units or a Description of Map Units. To create a legible JPG, we recommend that you consider reducing the map sheet dimensions somewhat, specifying a resolution of 200 dpi, and saving the JPG at a moderate compression level (e.g., Level 7 in Photoshop). Feel free to deviate from that recommendation – it's offered simply to indicate how you might create a JPG that is of appropriate size (i.e., a few MB) and resolution.

- ***Visualizing the GeMS geodatabase in GIS software:***

The published GeMS documentation was written before ArcGIS Pro became widely used, and so it specifies that a map document (.mxd) is required. ArcGIS Pro offers many options for similar functionality, namely the project file (.aprx), map file (.mapx), map package (.mpkx), and project package (.ppkx), which necessitates the following suggestions to meet that requirement:

- We encourage delivery of a Map File (.mapx) which simply records (in plain-text JSON) the properties of a single map within an ArcGIS Pro project and references to data sources without bundling everything into one file, as map and project packages do. If critically necessary to the submission, please save multiple maps or layouts in their respective file formats. Because there is no explicit setting for saving relative paths with map files, save the file in the same folder as the geodatabase being submitted. Although project and package (.aprx, .mpkx, .ppkx) files will be accepted, the main reasons they are not preferred are: (1) projects require an Index folder and a Default.gdb geodatabase which will be created if they do not already exist, potentially cluttering the archive folder; (2) the compressed data in a package file and the required standalone geodatabase are redundant; and (3) package files are not inspectable outside of ArcGIS Pro and are therefore not appropriate archival formats.
- To create a Map File, make sure there is ONE map that contains layers pointing to all of the geologic data in the geodatabase that is being delivered, and include as few other layers as possible (e.g., don't include the basemap data unless it is a unique, custom dataset). Click on the Share tab, and click 'Map File' in the 'Save As' section. Save that file in the same folder that holds the geodatabase to be delivered and ensure the style file(s) is(are) included as suggested. If you wish to save a layout file for the geodatabase, the method is similar -- select the layout tab > Share > Save As > Layout File.

- ***Metadata:***

FGDC-compliant metadata for the geologic map geodatabase as a whole is required. Metadata for constituent Feature Classes may be included but are not required.

The metadata file is read by the GeMS Upload Form's script and used to populate the metadata fields shown in the Form's "Step 2. In that Step, please review and edit as needed so that the information pertaining to the GeMS package is accurate (e.g., especially the bounding coordinates). Content for the following fields is required by the script: <title>, <origin> (i.e., submitters or authors), <pubdate>, <abstract>, <purpose>, and <bounding> (the four bounding coordinates). If there is content for the following fields, they also will be read: <sername> (series name), <issue> (series number), and <publish> (publisher).

- ***The Resources subdirectory:***

The focus of these GeMS packages is the GeMS database itself, supported by certain ancillary files so that the end user can properly use it. If your GeMS package's zip file size approaches the 100 MB limit, we suggest, for example, that you consider whether or not to include in the Resources subdirectory any or all photographs or figures associated with the map. This is especially the case where the photographs are included on the map

sheet that is available through your agency's website or are legible in the provided JPG. If you choose to include the photographs, we suggest they be of moderate resolution (e.g., 150-200 dpi) so that file size can be kept to a minimum without sacrificing readability.

- ***Base map:***

Do not include a geodatabase or graphic version of the base map unless it is a custom product that was used to compile the geologic map. An exception to this would be if the commonly available and authoritative base map for the geologic map's area is deemed unsuitable for use. If you must include a base map, please be sure to note this in the Transmittal Letter. If the zip file exceeds our 100 MB limit, please contact us at ngmdb@usgs.gov and we will arrange to upload it using a method other than the NGMDB Connect site.

File structure and naming conventions

The submitted GeMS package must be contained in a single .zip file (i.e., no zip files within that zip file). Please note that, in rare cases, a zip file may not successfully upload even though you've just successfully submitted other GeMS packages – in this case, we suggest trying a different compression software (e.g., 7zip). Also, there have been instances of failure upload when attempting to submit via your agency's Remote Desktop connection.

Regarding how the zip file should be named, to the extent possible, follow this terse and informative convention: **<State postal code>_<Federal Fiscal Year of award>_<a name for the map>_<version number>.zip**. Syntax for the version number is to be <Major>-<Minor>. For example, the filename should be "VA_2020_Fairfax_2-1.zip". The Major-Minor code for your initial submission should be "1-1".
[Regarding what is "Major" and "Minor" – at an Oct., 2022, meeting attended by State GS staff and USGS Program managers, these two concepts were devised as part of the new workflow for GeMS Quality Control evaluation. Each submission will be reviewed by the GeMS QC Team, which will document any required revisions to a GeMS submission that must be made before final acceptance and repositing in the NGMDB. Those revisions can be "Major" issues that involve the science content (e.g., in the geodatabase), or "Minor" issues that are organizational or editorial in nature (e.g., simplifying the directory structure or renaming files).]

Regarding the organization of files within the submitted zip file, to the extent possible use the simple structure provided in the GeMS package template (to be provided soon). Doing so will minimize the number of "Minor" revisions identified by the GeMS QC Team.

Thank you for working with us to reposit and make available these valuable GeMS files! Please let us know (at ngmdb@usgs.gov) if you have any suggestions for improving the process.