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# Shepherding Geologic Data from the Outcrop to Publication (and Beyond?)

By Jennifer E. Athey and DGGS Staff

Alaska Division of Geological & Geophysical Surveys
3354 College Road
Fairbanks, AK 99709
Telephone: (907) 451-5028
Fax: (907) 451-5050
email: *jennifer.athey@alaska.gov*

## Abstract

In 2008 it was recognized that the Alaska Division of Geological & Geophysical Surveys (DGGS) was not meeting some self-prescribed performance targets for publication of geologic data. Consequently, the State Geologist established a committee to review the process by which DGGS collects and publishes geologic data and to make recommendations to the State Geologist for means to streamline the process. An analysis of time spent completing common tasks shows that DGGS staff who are involved in developing publications are overcommitted with other projects that are key to the mission of the agency. These obligations generally cannot be set aside to complete publications; therefore, time needed to facilitate publication must come from streamlining the outcrop-to-publications process and possibly from additional staffing (presented at the DMT'09 meeting as a poster; see *http://ngmdb.usgs.gov/Info/dmt/docs/DMT09_Athey.pdf*).

## Five-Year Publication Rate

Over the past 5 years DGGS has published only one-third of the total maps intended for publication (table 1). Geologic maps that were published during that time period generally took 2 years to process from fieldwork to public release. Maps that have not been completed have been in the queue for up to 10 years. DGGS tends to release preliminary geologic information at technical meetings, as PowerPoint presentations and posters, to get the data out to the public as quickly as possible. However, the data still require publication in one of DGGS's peer-reviewed report or map series before they are formally released to the public. Ideally, DGGS would like to publish all geologic maps in 1.5 to 2 years following completion of field projects.

DGGS does not have a similar delay publishing raw geologic data files or interpretive text reports. Data releases do not require a technical review and are typically published soon

**Table 1.** Portion of DGGS geologic maps initiated in 2003–2007 that have been published.
Note: Geologic maps initiated by the Volcanology section generally require more time to publish because event response duties take precedence over all other functions of that section.

| Geologic Section within DGGS | Maps Initiated | Maps Published | Success Rate |
|---|---|---|---|
| Energy Resources | 3 | 1 | 33% |
| Mineral Resources | 6 | 3 | 50% |
| Engineering Geology | 15 | 6 | 40% |
| Volcanology | 5 | 0 | 0% |

after the analyses are completed. Text reports that contain data and interpretation are usually published within 3 years of the fieldwork. Geologic maps, however, tend to take 2–10+ years.

## Current and Historic Workflow

Prior to 1994, DGGS's turnaround time on one geologic map from field data collection to final printed product averaged 6–7 years. The manual cartography alone took six months to a year to complete. DGGS implemented GIS (Unix-based ArcInfo 4.2) in lieu of manual cartography in 1989 and published the first GIS-based map in 1994. At approximately the same time, DGGS started accepting funding from the federal STATEMAP program, for which DGGS was required to produce a near-publication-quality map in 1 year. The new GIS system and the STATEMAP 1-year deadline provided DGGS with the momentum to decrease geologic map processing time to 2–3 years, and eventually to 2 years. In all cases where the geologic mapping was funded by the STATEMAP program, the 1-year draft map deliverable was completed. Staffing and communication issues kept some geologic maps from progressing to completion.

In the days of manual cartography, DGGS had 2–3 cartographers and one editor on staff. The cartographers only drafted the highest level of reports—Professional Report series—and geologists completed pen and ink cartography on all other maps. An editor and only one cartographer remained shortly after DGGS transitioned to GIS-based cartography (Davidson, 1998). The cartographer became a GIS data manager and eventually the ESRI-product license manager, and currently does not draft geologic maps. Interns and journey-level geologists learned GIS and took over the cartographic duties. Now more than half of the geologists at DGGS usher their own geologic maps through the entire publication process, including fieldwork (arranging extensive logistics, contracting, budgeting, data collection), spatial analysis and digital drafting (using ArcGIS 9.3 [*http://www.esri.com/*] and MapInfo Professional 9.5 [*http://www.pbinsight.com/*]), metadata writing, and archiving. Almost all routine spatial analysis and cartographic tasks completed at the survey are performed by mid- or senior-level geologists, although many DGGS geologists are GIS-capable, with moderate to extensive experience using GIS software (fig. 1).

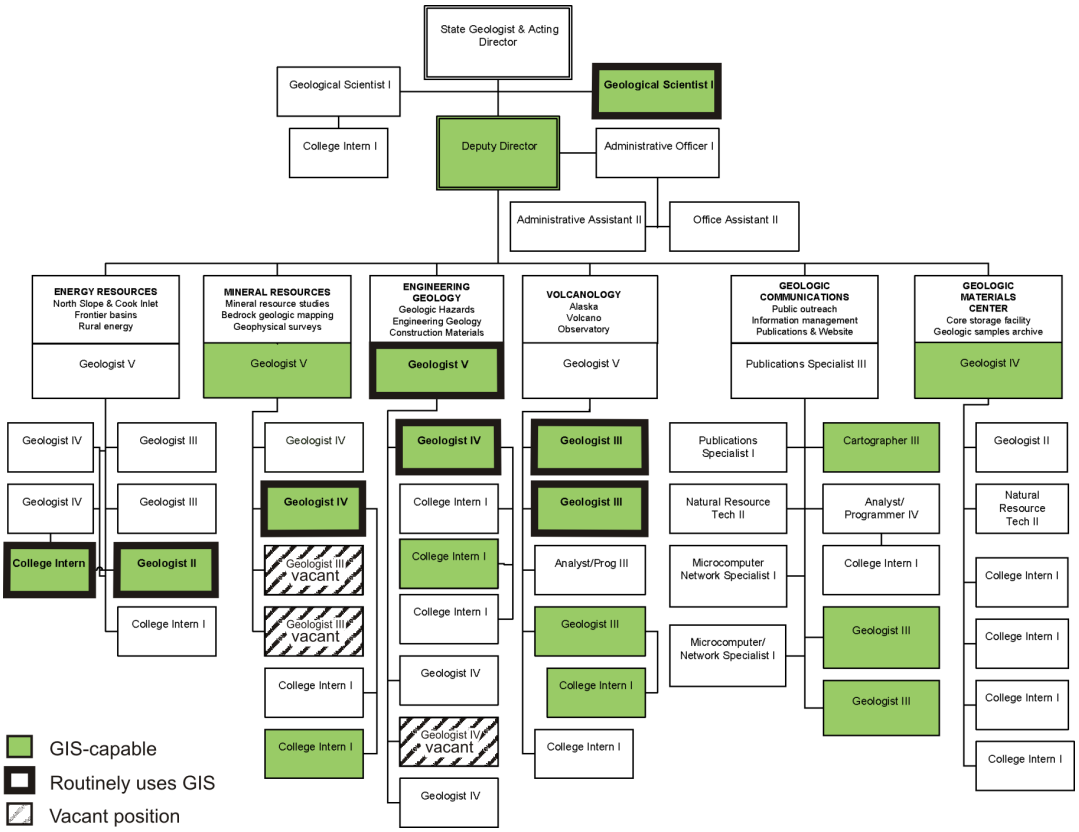


**Figure 1.** DGGS's organizational chart (August 2009). The survey contains five sections, each with a different focus: Engineering Geology, Energy Resources, Mineral Resources, Volcanology, and Geologic Communications. The Geologic Materials Center is a separate facility located in Eagle River, Alaska. Geologist positions are ranked 1 through 5. Geologist V's are typically section supervisors.

## Review Process

DGGS established a committee to find out why geologic maps are stalling in the publication process and to recommend improvements to the process. The review committee was formed in November 2008 and met several times per month until May 21, 2009. The committee was composed of several members of each of the five DGGS sections. Committee members agreed on specific questions to answer, compiled the data, and then discussed each topic. Below are the major questions discussed by the committee.

*Question:* On what tasks are employees spending their time? Can some tasks be sacrificed in order to spend more time on publishing geologic maps?

*Finding:* The committee created a list of 11 common, broadly defined tasks, and asked each employee except upper management, administrative support, and interns to classify how much time they spend on each task. The data show that less than 10 percent of time resources can be redistributed in most sections to spend more time on map-based and non-map-based geologic data. Most tasks performed by each section are mandatory to the DGGS's mission and cannot be deferred or suspended (fig. 2).

*Question:* How can the outcrop-to-publication process be made more efficient?

*Finding:* Each section created a flow chart that identified problem areas and bottlenecks. When similar problems were found in at least two sections, solutions were discussed. Problems are wide ranging; however, most solutions fall into two categories—various means to free up geologists' time to work on key tasks, and the implementation of new technology. Some specific ideas discussed to streamline the process include revamping the procurement process, initiating digital geologic field mapping (Athey and others, 2008), and buying or creating software applications to automate tasks where possible (Papp, 2005; Papp and others, 2007). Training staff on applications and the use of new technologies ultimately would save time overall.

*Question:* Are publication-related tasks being completed by the most appropriate staff members?

*Finding:* Staff created an inclusive list of tasks necessary to prepare and publish geologic data, and each section recorded both the staff member(s) currently responsible for the task and the staff member(s) who would be most appropriate for the task. The spreadsheets clearly show that DGGS suffers from a lack of support staff (fig. 3). Each section noted that some tasks being performed by mid- to senior-level geologists would more appropriately be performed by interns, journey-level geologists (for example, geologist levels 1 and 2), GIS technicians (a job class not currently employed by DGGS), and non-specialized natural resource technicians. Increasing DGGS's support staffing is the highest priority to improve the effectiveness of our outcrop-to-publications mapping process.

As part of the review process, the committee contacted five other State geological surveys directly and canvassed several others at the DMT'09 conference. Our brief survey indicated that other State geological surveys have significant cartographic/GIS support staff as part of their map publication process. The ratio is approximately 1 GIS technician to 5 geologists. Even though some of these organizations are still

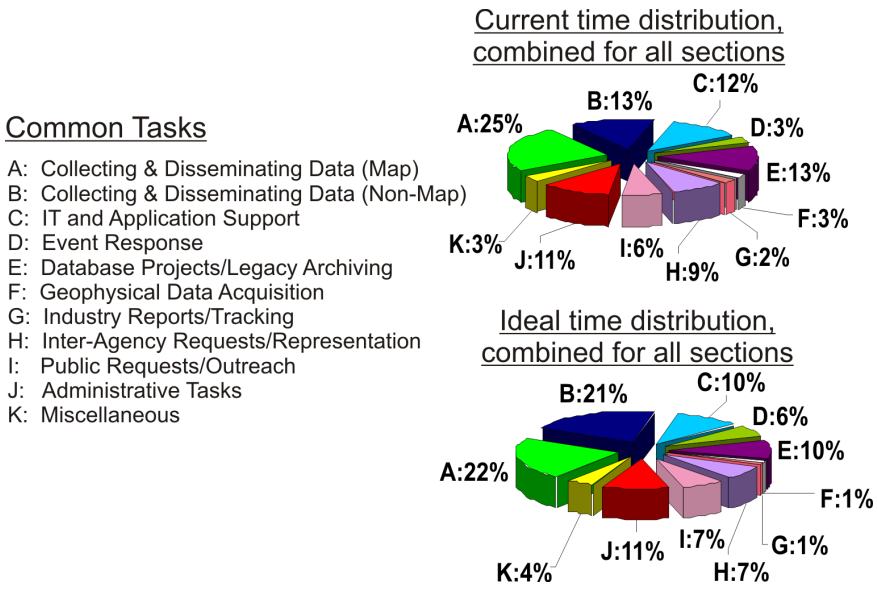


**Figure 2.** Current and ideal employee time distribution on common tasks. Ideally, DGGS would like to produce an equal number of geologic maps and non-map geologic publications.

| TASK | NRT | INTERN | GEO I | GEO II | GEO III | GEO IV | GEO V |
|---|---|---|---|---|---|---|---|
| **Field work tasks** | | | | | | | |
| Assemble and deploy field gear | | M | | | M | M | m |
| Supervise field personnel | | | | | M | M | |
| Maintain field office and communications equipment | | M | | | M | m | m |
| Collect field data and samples | | | | | M | M | M |
| Preliminary interpretation and mapping | | | | | M | M | M |
| Organize samples for transport/shipping | | M | | | m | m | m |
| Enter field data into database | | M | | | m | m | |
| Complete draft field map | | | | | M | M | m |
| Disassemble and demob field gear | | M | | | M | M | M |
| Return field gear to warehouse | | M | | | M | M | M |

**Figure 3.** Excerpt from task-staffing spreadsheet filled out by the Mineral Resources section. Because of the high turnover rate of student interns, constant training is a necessity. Mineral Resources section would prefer a permanent Geologist I series staff member to complete recurring tasks. Column headings indicate job class: NRT = Natural Resource Technician; Intern = undergraduate or graduate level student intern; Geo I–V = Geologist series. Cells marked with a 'M' or 'm' indicate the current (August 2009) scenario of task completion in the Mineral Resources section. 'M' indicates that an employee of the specified job class currently performs a major role in the completion of the task; 'm' indicates that an employee of the specified job class currently performs a minor role in the completion of the task. Shaded cells indicate the hypothetical, best-case scenario of task completion in the Mineral Resources section. Dark shaded boxes indicate the most appropriate job class to perform a major role in the completion of the task; light shaded boxes indicate the most appropriate job class to perform a minor role in the completion of the task.

having difficulties meeting their mapping obligations, the extent of their shortfalls appear to be less significant than DGGS's.

The committee recommended hiring four new positions to be shared among the geologic projects—two logistics/equipment technicians (Natural Resource Technicians) and two GIS technicians—to significantly improve timely output of map and non-map publications. Logistics/equipment technicians would primarily organize and maintain field equipment and arrange field logistics, tasks that take several months for each project. GIS technicians would complete the digital cartography of a geologic map after the geologist finalizes the map's vector and attribute data. In the future, when the publication of geologic maps in GIS database form becomes routine, database preparation and publication will likely be completed through a collaborative effort by the geologist and the GIS technician. Whether in paper or digital form, project geologists would remain ultimately responsible for the map's production. The new shared positions are expected to allow more time for geologists to focus on the geologic science necessary to complete their publications, resulting in the most effective changes to the outcrop-to-publication process.

## Conclusion

In general, the review committee believes that DGGS is collecting the correct amount of geologic data and covering an acceptable amount of area. However, geologic map publication is lagging behind data collection because DGGS geologists are overcommitted. Currently, if a geologist must set his/her project aside to work on something else, there are no other geologists available to step in and move the project forward. Because there are always new projects cycling through, older unfinished projects rarely get completed. DGGS's solution is to hire appropriate new support staff and increase efficiency within the outcrop-to-publication process to create flexibility in project schedules and help expedite publication output. It is critical that staffing levels be reasonably balanced with existing and future workloads.

# Discussion

During the review process, DGGS identified, but did not resolve, several questions related to data collection and distribution. As these issues are probably commonplace among State geological surveys and will only become more relevant, discussion and planning now will help with future decisions and ease whatever transitions are needed.

### *Should DGGS Eventually become a Paperless Organization?*

DGGS strives to make our geologic data widely available online. All DGGS and U.S. Geological Survey (USGS) Alaskan publications are available for free download on our Web site as PDF or Lizardtech MrSID format (*http://www.dggs.dnr.state.ak.us/index.php?menu_link=publications&link=publications_search*). In addition, DGGS developed an enterprise Oracle database that houses and will serve analytical and spatial data (Freeman, 2001a, b; Freeman and others, 2002; Freeman and Sturmann, 2004). DGGS is currently developing a Web Feature Service (WFS) via GeoServer (*http://geoserver.org/*) to make these data available to the public. Some DGGS digital and analytical data are already available for download on our Web site (*http://www.dggs.dnr.state.ak.us/pubs/pubs?reqtype=digitaldata*; *http://www.dggs.dnr.state.ak.us/webgeochem/*).

Since all of this information is available online, does the public need paper maps to be available as well? At the moment, the answer is yes. Many users do not have high-speed internet capable of downloading large files, or easy access to plotters. Also, most users lack the software and GIS skills necessary to create maps from digital data. DGGS will undoubtedly revisit this question as user expectations change with technological advances.

### *Should DGGS have a Software Development Group?*

Regular maintenance of the enterprise Oracle database, creation of Web-database interfaces, Web site maintenance, and delivery of online interactive spatial data require time-consuming and expensive programming time. In addition, each new in-house application that goes online requires maintenance, which leaves less time for project development. DGGS currently employs only one analyst/programmer dedicated to these tasks. To date, most of the Web-database and online interactive spatial data interface development has been contracted out. However, this strategy has met with limited success as the deliverables often do not meet specifications. Another option is to train other staff members to assist; however, minimal staff time is available, the training itself is time consuming, and programming by a novice takes much longer to complete. Ideally, additional analyst/programmers would be hired to round out the group, but new staff positions are difficult to secure in the State's current fiscal climate.

### *How Much Time Should DGGS Allot to Compiling and Inputting Legacy and Other Agencies' Data?*

DGGS functions as the State's lead source and repository of Alaska geologic information and the primary source of information concerning Alaska's energy resources, mineral resources, and geologic hazards. Currently, DGGS is concentrating on archiving its own historical and current project data. Various other agencies, institutions, and students have also produced data for Alaska that eventually should be compiled in DGGS's enterprise Oracle database. In recent years, DGGS has accepted funding to compile and make accessible certain "at risk" datasets such as geochronologic and geochemical analytical data (*http://www.dggs.dnr.state.ak.us/webgeochem/*). DGGS will continue to prioritize which datasets should be compiled, archived, and disseminated to the public and to work on them as time allows.

### *How will DGGS Keep Data Current in the Enterprise Oracle Database?*

The integration of data loading and database maintenance into DGGS's business process will help ensure that DGGS's data are kept up to date. The creation of user-friendly data loading forms, clear documentation, and staff training will also facilitate data loading. How other agency, institutional, and student data will be kept current is less clear. To maintain the most reliable and up-to-date non-DGGS records, a staff member will probably need to be dedicated to harvest data on specific topics and enter the data into DGGS's database. This is currently how we ensure that all Alaska USGS publications are included in our online publications database, but it is a time-consuming process. Another method would be to lobby laboratories and authors to voluntarily send us their data or to enter it into the database themselves via a Web interface. This latter scenario would require persuading an entity that the effort would be worthwhile.

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