DIGITAL MAPPING TECHNIQUES 2015

The following was presented at DMT'15
(May 17-20, 2015 - Utah Geological Survey,
Salt Lake City, UT)

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NCGMP09 Workflows at the Alaska Geological & Geophysical Survey

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ABSTRACT

There is no perfect or standard workflow for creating new data in the NCGMP09 format. Workflows vary greatly depending on the type and scope of project, information and time available for analysis, and the GIS capabilities of the project geologists. Typically the process of creating and publishing a geologic map has four basic phases: Pre-field Work; Field Work and Data Collection; Office GIS Work and Interpretation/Analysis; and Revisions and Review. This article briefly describes these phases, each of which presents its own workflow and challenges.

NCGMP09 WORKFLOWS

Phase One – Pre-field Work

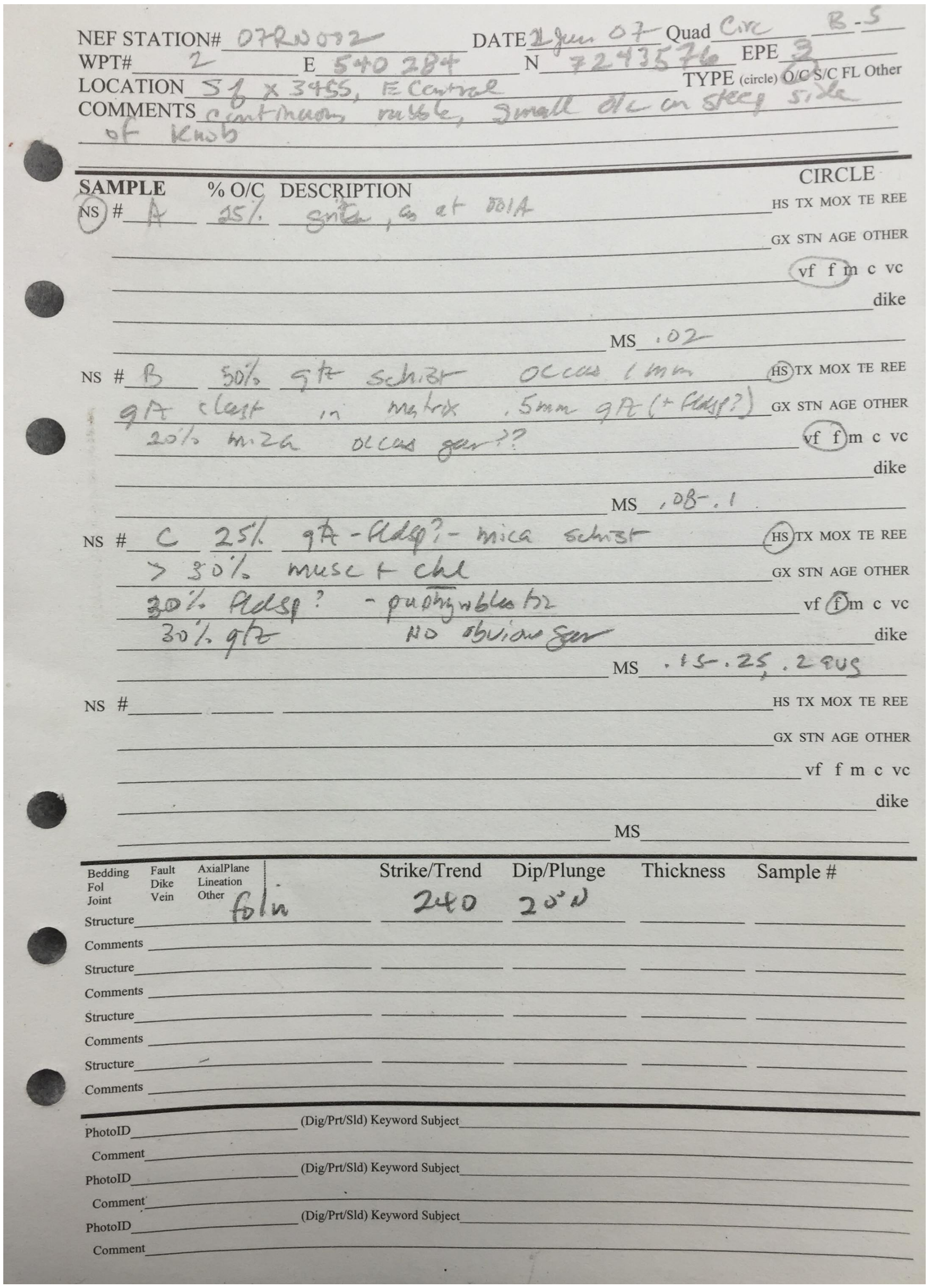
In this phase, geologists at the Division of Geological & Geophysical Surveys (DGGS) compile literature and previous map products for the study area. Air photos, satellite imagery, and appropriate base maps are gathered. Preliminary interpretation of air photos and imagery may be completed if time permits. Field logistics are determined, arrangements are made, and contracts are formalized.

Before people go out to the field, geologists are encouraged to create a blank NCGMP09 geodatabase. We currently use the 10.1 script tool available from the NCGMP09 website, but in the future, we will have a DGGS-specific “master template” of an empty NCGMP09 geodatabase with coded domains and pick lists. It will be much simpler for geologists to copy and paste this master template rather than running the script tools each time. This empty geodatabase gives geologists an opportunity to look at the standard geodatabase and think about what information they need to collect in the field, such as location confidence in meters. They are also encouraged to think about how to integrate NCGMP09 required fields into what they already collect.

Phase Two – Field Work and Data Collection

The methods geologists use to collect data in the field have undergone many changes in the last few years. In the not-too-distant past, bound notebooks and printed sample cards were used

(Figure 1). In 2014, geologists from the minerals section used Trimble Juno T41/5 handheld computers to aid in data collection. The T41/5 runs ArcGIS for Mobile with a custom geodatabase designed to collect field data. This field geodatabase is set up to gather information analogous to the old DGGS field cards. It is important to note that the field geodatabase does not include any NCGMP09 fields. DGGS geologists generally agree that the NCGMP09 standard format is better used for the final interpretation of the map rather than for collecting the raw data itself.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WPT# 2 E 540284 N 7243576 EPE 3
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COMMENTS continuous rubble, small o/c on steep side of knob

SAMPLE % O/C DESCRIPTION CIRCLE
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GX STN AGE OTHER
vf f m c vc
dike
MS .02

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dike
MS .08-.1

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> 30% musc + chl GX STN AGE OTHER
30% fldsp? - porphyroblasts vf f m c vc
30% qtz NO obvious gar dike
MS .15-.25, .2 avg

NS # HS TX MOX TE REE
GX STN AGE OTHER
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Bedding Fol Joint | Fault Dike Vein | AxialPlane Lineation Other | Strike/Trend | Dip/Plunge | Thickness | Sample #
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Figure 1. This example of an old DGGS field card shows the level of detail geologists collect at each station.

The field collection geodatabase is unique to each project and contains five feature classes (Figure 2). Rock_Station and Structure_Station are the most frequently used. Each night, data from individual Juno units are downloaded and synced to all of the other devices. Although some lines can be drawn using the handheld devices, use of this feature was found to be problematic during the nightly syncing.

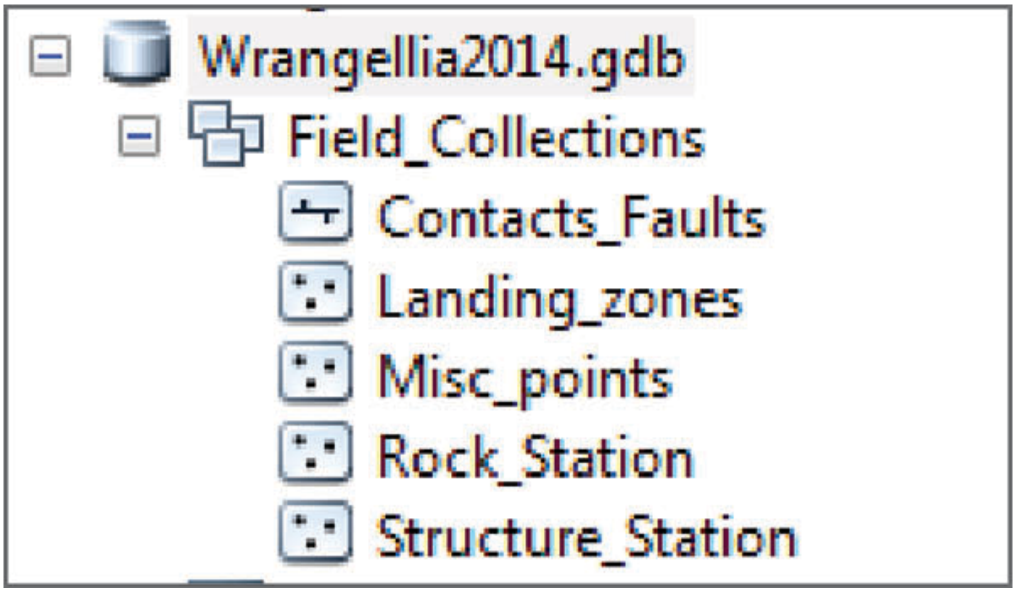

Figure 2. Example of a field collection geodatabase.

Every evening, geologists use colored pencils on a mylar sheet (shared by all the geologists) that overlays the USGS topo map of the area to record their traverses and preliminary geologic interpretations. The shared map is not allowed to be taken out of the main camp.

Phase Three – Office GIS Work and Interpretation/Analysis

The major GIS work begins when everyone is back in the office and the dust has settled. This phase has the most variation in workflow, and the process depends on what data were collected or are available. Workflows can also vary based on personal preference or to suit the needs of individual projects. Following are the basic steps in the workflow.

1. Assemble data
   a. Export data from Juno devices to a geodatabase. DGGS created a custom script to pull data from the Juno devices and save it into a file geodatabase.
   b. Convert the geodatabase to an Excel spreadsheet. This spreadsheet is then sorted by the “geologist” field and distributed to the geologist who recorded the data point. The geologist corrects any spelling or grammar mistakes and writes out any abbreviations they used in the field. Geologists are asked to NOT change any of their interpretations at this time.

c. Combine corrected Excel data. The data is merged back into one Excel sheet once individual geologists have finished their corrections. From this data, various fields are concatenated to form a short station description, which is used later to help identify potential map units. Original fields stay intact to facilitate future queries, despite some fields being concatenated into a station description. This becomes the final corrected composite spreadsheet for the project.
d. Convert the final corrected Excel spreadsheet to a geodatabase. This geodatabase is shared as a read-only copy for multiple geologists to view and query while compiling their interpretations. It is also updated for specific stations as more accurate information is gathered, such as results from geochemistry analysis, thin section petrography, age dating, or fossil analysis.
e. Scan and georeference the mylar field map.

2. Start digitizing and interpreting. Populate the blank NCGMP09 geodatabase (that was created during the pre-field work phase) with the interpretation that will later be turned into the final map.
    a. Position the read-only geodatabase containing rock stations and structure stations on top of the scanned mylar field map in ArcMap. Topographic base maps, air photos, satellite imagery, or geophysical images may also be used.
    b. Digitize major faults and folds using the mylar field map as a general guide. Minor faults and folds can be added later in the process
    c. Digitize polygons using the mylar field map and rock stations for reference. Use a "working" color scheme until standard FGDC colors are chosen in a later phase. Create Feature templates are used during this step, but only the field for MapUnit is filled in during this time because the designated map unit is often a "moving target" and may change one or more times during the interpretation process.
    d. Create a Geodatabase Topology to make sure there are no gaps or overlaps in the polygon featureclass; use the topology tools to edit.
    e. Create Contact Lines. Use the Polygon to Line (Data Management) tool to convert the polygons to lines. The tool creates an intermediate featureclass that is loaded into the NCGMP09 ContactsAndFaults feature class. Once created, contact lines are split and attributed into confidence classes. LocationConfidenceMeters is often derived from the line's proximity to a rock station or by using the mylar map. Some users prefer to choose the FGDC symbol number and then populate the attributes associated with that symbol, while others choose to populate the attributes, then look up the required symbol.
    f. Load Orientation Points into the NCGMP09 from the read-only field geodatabase. Assign points the proper FGDC symbol and rotate them properly. Pay special attention to measurements that were taken using dip direction! When multiple structure measurements are taken at one station, the project manager (with input from field geologists) must determine which measurements will be shown on the final map. Populate the PlotAtScale field at this time.
    g. Provide information for any other NCGMP09 feature classes that are appropriate for the project.
    h. Modify the Geodatabase Topology to include:
        - No overlaps or gaps in polygons
        - Edges of polygons must have a line overlapping them

    - Lines must not have dangles except where made an exception
    - Lines must not overlap
3. Create cross sections and correlation of map units; both can be made using ArcMap.
4. Verify that all required NCGMP09 fields are filled in properly. Delete feature classes that are not being used.
5. Complete Map Sheet Checklist and Color and Pattern Plan.
6. Hand everything over to the Cartographer for the initial layout

<u>The Eternal Question: Digitize Polygons or Lines first?</u>

Polygons are the primary feature and are digitized first in the basic workflow outlined above. This works well in situations where there is a fairly reasonable knowledge of where units will be drawn. The Engineering Geology Section at DGGS, which uses a lot of imagery during the map making process, almost always digitizes polygons first. This works particularly well in situations where a senior geologist has drawn specific geologic units onto an air photo overlay, which is georeferenced for digitizing (Figure 3a). In this type of situation, where units are predefined and known, an intern or junior geologist can use feature templates with default values to quickly digitize into the NCGMP09 format. Additionally, the overall workflow is simplified when polygons are converted to lines. In the case of air-photo-interpreted contacts, all lines will share the same attributes and symbol and the values can be quickly populated using the Field Calculator.

In other cases, significant gaps exist in the interpretation of the scanned field map, and many types of line symbols will need to be generated (Figure 3b). In this example, digitizing lines first (perhaps with only the FGDC symbol populated) would be the best option. Digitizing lines first, while using Snapping, can also simplify future modifications, reducing any concerns about gaps and overlaps. Polygons can be generated with the Feature to Polygon tool once the contacts are in place.

Figure 3a. In cases where geologic units are well defined, using feature templates and digitizing polygons first is the better work flow.

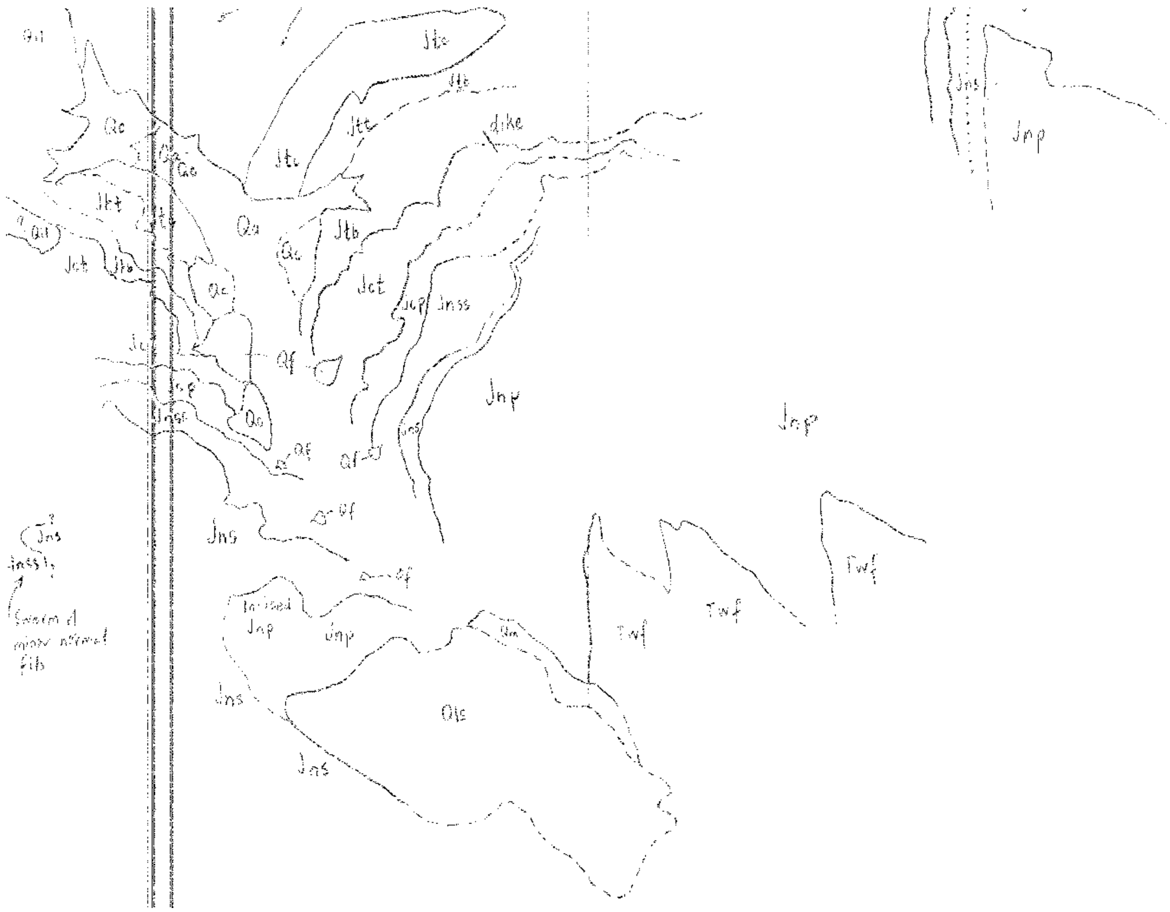

Figure 3b. Significant gaps in the geologic interpretation of this scanned field map make the more flexible workflow of digitizing lines first a better option.

Phase Four – Revisions and Review

DGGS publications undergo a thorough review process. Project co-authors evaluate and revise the interpretation before the polished NCGMP09 geodatabase is handed off to the cartographer, who produces a map layout that conforms to FGDC standards before the map is seen by external peer reviewers. Making a preliminary layout ensures reviewers see a clean and well-thought-out product. After scientific review is completed and corrections are made, the map and text get another review from the Publications Specialist, Section Chief, and Division Director. The final step is compiling metadata, which is greatly streamlined through the use of the NCGMP09 format.

CONCLUSION

Workflows at DGGS are constantly changing and evolving. As new technology is integrated into projects and geologists become more comfortable with the NCGMP09 standard, workflows will become more efficient. The four basic phases (Pre-field Work; Field Work and Data

Collection; Office GIS Work and Interpretation/Analysis; and Revisions and Review) are unlikely to change, but they may be modified to allow for greater flexibility and control. Documenting these new workflows is an important part of the process to better enable modification and standardization as projects progress.