DIGITAL MAPPING TECHNIQUES 2015

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High-Value Thematic Maps and the Importance of Standardized Geology—Presentation text

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Presentation text:

1. Incorporating all of the pieces of the NCGMP09 geologic database standard (http://ngmdb.usgs.gov/Info/standards/NCGMP09/) into an office's map-making workflow can take a lot of time, especially when geologists and GIS staff are still learning the standard. In particular, the mandatory General Lithology fields and optional Standard Lithology table might seem less important and therefore not get populated, because these data are meant to provide a "least-common-denominator" approach to share geologic information with others and facilitate compilation maps (instead of recording only the original data of the mapping project). To create these useful data-sharing fields, some standardization of the lithologic units must be applied to the geologic dataset.

   The Alaska Division of Geological & Geophysical Surveys (DGGS) recently had an opportunity to observe how General Lithology and Standard Lithology fields could be used for geologic research. In 2014 DGGS was contracted by the Alaska Department of Transportation & Public Facilities (DOT&PF) to create a statewide map of naturally occurring asbestos from bedrock geologic units. This project necessitated the compilation of many geologic maps across the state, most of which had been standardized to some extent by the U.S. Geological Survey (USGS) using a database standard other than NCGMP09. During the process of producing these maps, we observed situations where standardized lithologic data would facilitate compilation, and situations where the original data made compilation problematic despite any standardization that might be applied to it. This presentation shares our discoveries and thoughts.

2. This presentation, however, is not a discussion about how to standardize geology or about limiting original mapping with standardization, but instead illustrates one case-in-point for using standardized geologic data. Many geologists are wary of "standardized geology" because they may be expected to use a defined term list. In our experience, geologists generally feel that defined term lists curtail their ability to adequately describe their observations to their audience, which might promote misunderstanding and misuse of the data. (Note that NCGMP09 General Lithology and Standard Lithology fields are in addition to the tables describing the original geologic map data.) Beyond the text descriptions, some artistic ability is required to depict all of these data on a geologic map in a

way that can be implicitly understood and is pleasing to the eye. One could argue that both the science itself and portrayal of the science are a form of art, because "art" can be described as a unique way of seeing and interpreting the world. It's a dilemma. While there is always potential for misuse of data, geologic data are used by many other science disciplines and laypersons, from habitat studies to insurance companies. Because many users do not have the science background to synthesize detailed data or local knowledge to integrate area-specific geologic data for their own purposes, who could be better than the geologist-authors themselves to extract the critical bits of data and make them accessible to a wider audience?

When a geologic mapping project is initiated, there are usually one or more specific reasons why the data need to be collected. Maps that stand the test of time, however, can be used for multiple purposes. For instance, this Wiseman, Alaska, area mapping was originally conducted to further the baseline geologic knowledge of the state, but it has subsequently been used to identify material sources for road construction and find potential bedrock sources of placer gold.

3. What should we as geologists record for posterity on our map publications and in our databases? How can we predict what data people will want ahead of time? Many maps seem to have unit descriptions that go on forever, as if the authors are trying to cover all the possible bases. However, in this age of information overload, many people just can't take the time to read that much text. Like 120-character Tweets, less is more?

> *"Generally speaking, geologists seem to have been much more intent on making little worlds of their own, than in examining the crust of that which they inhabit. It would be much more desirable that facts should be placed in the foreground and theories in the distance, than that theories should be brought forward at the expense of facts. So that, in after times, when the speculations of the present day shall have passed away, from a greater accumulation of information, the facts may be readily seized and converted to account."*
>
> *— Sections and Views Illustrative of Geological Phenomena (1830), iv — Henry Thomas De la Beche*

These are largely unanswerable questions, since every map and area are different. Henry Thomas De la Beche might say, "Just the facts, Ma'am," in the hopes that future researchers can solve the next puzzle with well documented, present-day data. The NCGMP09 database standard is an attempt to find some middle ground, providing guidance on how to present the data so it is eminently shareable, but also the flexibility to record unusual data types and rich supporting information.

4. As geologists in the business of producing and distributing data, we usually use the NCGMP09 standard. During the creation of the naturally occurring asbestos maps, we had an opportunity to think about the database standard from the perspective of a data consumer, which was eye opening, both in terms of what data we wanted and how it was presented.

The General Lithology and Standard Lithology fields are designed to facilitate the creation of compilation maps. Both parts of the standard use defined term lists to describe a geologic unit. General Lithology, which consists of two fields in the Description of Map Units table, is mandatory to populate, and makes use of an abbreviated term list to reduce complex geologic units down to one term that is consumable by the general public. General Lithology includes a field that describes how well that one term actually fits the original geologic map unit.

The Standard Lithology table utilizes the CGI term list (https://www.seegrid.csiro.au/twiki/bin/view/CGIModel/ConceptDefinitionsTG), which is also a GeoSciML vocabulary (http://www.geosciml.org/). The Standard Lithology table allows quite a bit of detail and flexibility in how a geologic unit is defined; multiple lithologies may be selected, including fields that describe where in the unit the lithology is found and its proportion as a text descriptor or percentage. This table also takes longer to populate than the General Lithology fields because it is more complicated.

5. The naturally occurring asbestos (NOA) compilation project afforded us a great example of how standardization is useful and dovetails with map compilation. In the Ambler area of northern Alaska, it is very difficult to find road construction materials that do not contain naturally occurring asbestos. As a result, legislation was passed and resulting regulations adopted that allow the use of NOA-bearing materials in Alaska under certain conditions and restrictions (http://www.dot.state.ak.us/stwddes/desmaterials/assets/pdf/asbestos/noa_regulations.pdf). Alaska's Department of Transportation & Public Facilities (DOT&PF) is the agency responsible for approving Site Specific Plans to provide immunity to landowners and contractors using gravel or aggregate material containing NOA.

   (D) reports of tests documenting the presence of NOA in gravel or other aggregate material in the proposed "designated area" that, when tested using the bulk test 4 method prescribed in 17 AAC 97.020, is determined to have a content equal to or greater than 0.25 percent of naturally occurring asbestos (http://www.dot.state.ak.us/stwddes/desmaterials/assets/pdf/asbestos/noa_regulations.pdf, pg. 4)

   (10) after approval of a "designated area", the department shall notify potentially affected persons that the area has been designated as an area where immunity may be granted under AS 09.65.245(a) for landowners and contractors causing asbestos-related injuries. (http://www.dot.state.ak.us/stwddes/desmaterials/assets/pdf/asbestos/noa_regulations.pdf, pg. 5)

   DOT&PF subsequently contracted DGGS to identify where in Alaska NOA might be found. We needed a quick and easy but cogent way to address the question.

6. Given the paucity of asbestos-specific publications in Alaska, we decided to address NOA potential obliquely by classifying bedrock lithologies that are or aren't likely to host asbestos, and then identifying the spatial footprint of those lithologies throughout the state. (Surficial geologic units were not examined as part of this project.) At the time this project was conducted, however, no statewide geologic compilation map existed; we had to build our own. We primarily used digital U.S. Geological Survey (USGS) maps to create the compilation, but we also digitized maps to fill in a few areas. Although the Alaska maps we used were not created using the NCGMP09 standard, many of the maps were based on a USGS–Alaska Science Center database template that has remained fairly stable for about 20 years.

7. The project compilation was conducted relatively quickly because most of the maps were already somewhat standardized, digital, and well documented. In some cases, we joined unit descriptions from separate tables to the spatial objects in the geodatabase to provide for more robust attribution. Attributes in the geodatabase and the original publication texts were used to review and classify each bedrock unit. Classification was subjective, as units often contained multiple NOA-potential lithologies and their relative proportions were not always described.

   Many of the maps were 1:250,000 scale; however, we worked with maps of seven different scales ranging from 1:63,360 to 1:2,800,000. The project was also hastened by the fact that we reported the map data "as is" and didn't attempt to make a cohesive statewide map by concatenating units across adjacent map boundaries.

8. Once all of the map units were classified we created standardized, NOA-specific attributes for each map polygon, including its NOA-potential rating, the NOA-potential lithology and its proportion in

the unit, a brief description of the unit as a whole, and other fields linking users back to the data in the original publication.

In this example, note the scales of the three map sources shown on the table: both Mayfield and others maps are 1:63,360 scale (1 inch = 1 mile), and the Mull and others map is 1:2,851,200 scale (1 inch = 45 miles). In cases such as this, we digitized and used multiple, overlapping maps to make a best-case decision on the NOA rating of the geologic unit. Field "Amount_NOA" was defined as trace (less than 1%), minor (1–10%), moderate (11–50%), and major (greater than 50%). Field "NOA_Potential" is based on NOA rating criteria described in DGGS publication MP157.

9. The "NSA class" field is populated by a term list defined by USGS–Alaska Science Center, and it is present in many USGS Alaska maps. NSA class is used by their map standard to organize map units across multiple maps into cohesive, documented geologic map units for the statewide compilation. In the polygon attributes, we included a URL to the NSA class description, as this a great online resource for users.

   NSA class, which was very useful in our compilation efforts, is analogous to the General Lithology fields in the NCGMP09 national standardization schema. Some of the USGS maps also contained additional fields with information about multiple lithologies and their proportions similar to the Standard Lithology table in NCGMP09. We also used this information in the compilation, but relied more heavily on the text descriptions of the geologic units.

10. Given that we had all of this information at our disposal, creation of the NOA potential maps went fairly smoothly. We noted that standardization and defined terms were extremely helpful for breaking down geologic units into their component lithologies, but because geologic units can be combined and defined in many different ways, joining maps together is very problematic.

11. Unfortunately, standardization might not help with all of the issues you have to deal with when compiling maps. Here are some examples:

    Map A: Till and others (2006) vs. Till and others (2008). The 2006 bedrock geology in orange and surficial geology in yellow are very generalized (top-left corner of large orange area is the northwest corner of Till and others [2006].) These adjacent maps have same authors and same scale, but because they were created for different purposes, the units are defined differently. Also in example A, are mafics from Imm (1993) the same as metamafics from Till (2006)? Are they the same rocks but described differently, or is there a real difference of metamorphic grade between them? Because we were unable to further differentiate the area mapped in orange, the final compilation map reflects the differences in the original mapping.

    Map B: Foster (1976) at a scale of 1:250,000 vs. Till and others (2006) at a scale of 1:500,000. High NOA-potential serpentinized ultramafics and altered basalt probably continue into the map to the north, but the northern map's units and descriptions are too generalized and cover too broad an area to rate a higher NOA category. Elsewhere the unit probably does have low NOA potential. In this case, discrepancies in scale and detail of the two maps are reflected in the compilation map.

12. The colored blocks on the map of Alaska represent the different digital maps we used to create the compilation map. Where black lines cross a polygon, there are also overlapping maps. In most cases, we selected one map to use that contained the most data relevant to the project. Between maps there are sometimes small gaps or "holes" in the GIS data. We classified areas within gaps as "unknown," and did not edit the original shapes of the digital features.

13. Although not related to database standards *per se*, we wanted to take a moment to acknowledge the time factor of working with big files and having to customize our own base map. Because each map sheet takes 1.5 hours to export to PDF from ArcGIS 10.2, it took two staff about a week and a half to

get all 21 of the maps ready for the map's reviewers. Although there are plenty of fast-drawing, pre-made base maps for web applications out there, we had to develop a printable 1:500,000-scale Alaska base map especially for this project.

14. The information is available to the public as PDF versions of text and maps as well as GIS data in the form of shapefiles and a geodatabase. We also hope to make the data available in a web mapping application in the future. One of the added benefits of this project has been the aggregation and attribution of the USGS Alaska maps.

    Solie, D.N., and Athey, J.E., 2015, Preliminary Evaluation of Bedrock Potential for Naturally Occurring Asbestos in Alaska: Alaska Division of Geological & Geophysical Surveys Miscellaneous Publication 157, 15 p., 21 sheets, scale 1:500,000, http://dx.doi.org/10.14509/29447.

15. Now that we have created a compilation map for the state, other users with unrelated regional geology questions and needs are asking us for our project files. Here are some examples:
    - DGGS Minerals section used the compiled USGS maps for project planning.
    - An Alaska museum asked us to create a generalized, printable map of the state's geology for a dinosaur display. (The USGS ultimately answered this request, but we could have done it.)
    - DGGS contributed road corridor materials information to an emergency DOT&PF meeting regarding the Dalton Highway.

16. Now that we have experienced this issue from the consumer side, we will be more proactive in making products useable to a wider audience. After all, as authors we know our data best. The NGCMP09 General Lithology and Standard Lithology fields will provide ready tools for sharing data. Standardization will also facilitate web-ready products at DGGS.

17. The rocks are waiting in anticipation to find out what happens next in geologic standardization.

High-value thematic maps and the importance of standardized geology

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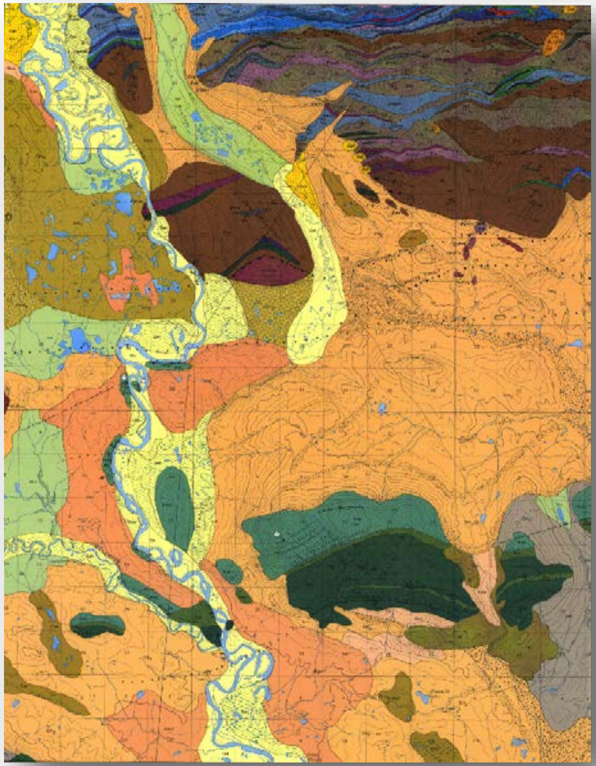
Geologic mapping is an art *with purpose*

This is not…

- a presentation on how to standardize geology
- a plan to limit content and creativity in mapping



Dillon and others, 1987

> “…when the speculations of the present day shall have passed away, from a greater accumulation of information, the facts may be readily seized and converted to account.”

HENRY THOMAS DE LA BECHE (1830)

How can we predict what geologic data people will want to see?

NCGMP09 term classifications
to describe map units

General Lithology

Traditional map units can be classified by this hierarchical, defined list of “earth materials”, i.e., one term per map unit

- Reduce jargon
- Provide for consistency among maps

Standard Lithology

Describe a map unit using multiple defined terms and their relative proportions

- Allows more flexibility in descriptions
- Requires more work

“StandardLithology was received with little enthusiasm by many of the reviewers of version 1.0.” –v1.1 documentation

Per Alaska DOT&PF:

Where is naturally occurring asbestos (NOA) in Alaska?

Need a cheap, quick but cogent answer!

Ambler,
Alaska

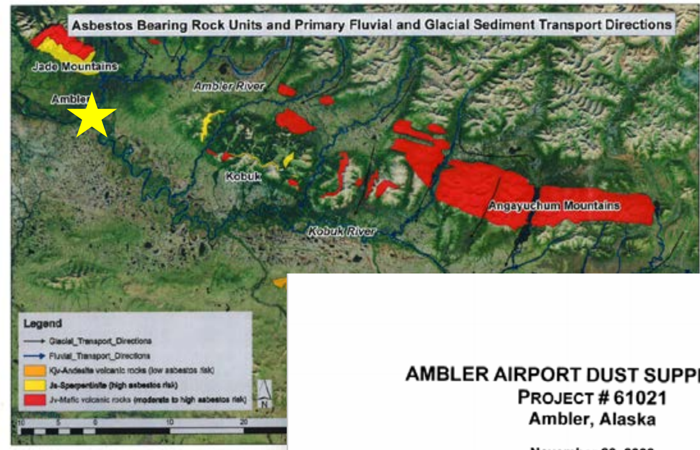
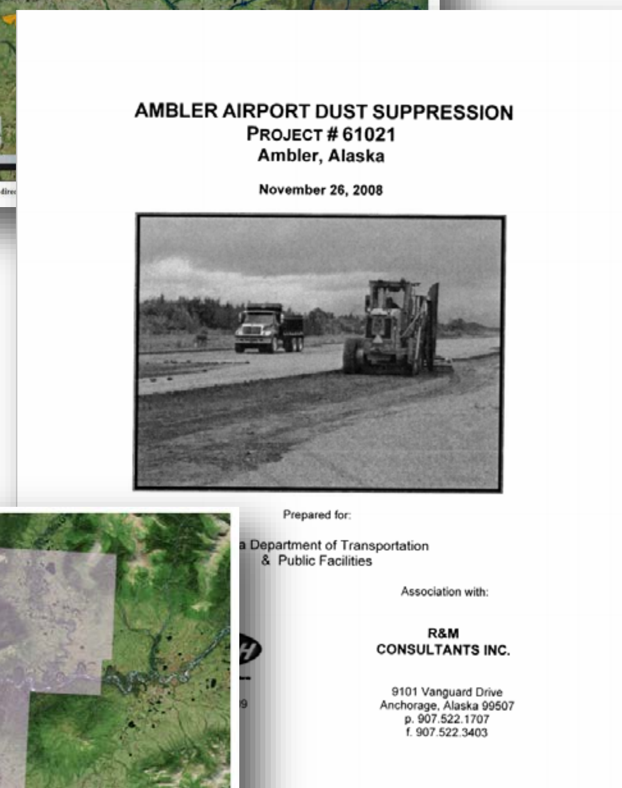


Figure 1. Generalized map of known asbestos sources and fluvial/glacial sediment transport dire



AMBLER AIRPORT DUST SUPPRESSION
PROJECT # 61021
Ambler, Alaska

November 26, 2008

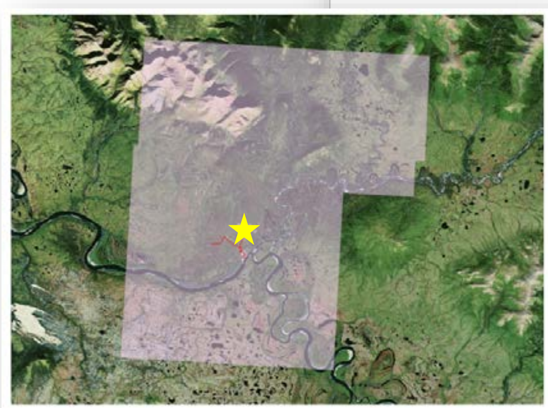
Prepared for:

a Department of Transportation
& Public Facilities

Association with:

R&M
CONSULTANTS INC.

9101 Vanguard Drive
Anchorage, Alaska 99507
p. 907.522.1707
f. 907.522.3403



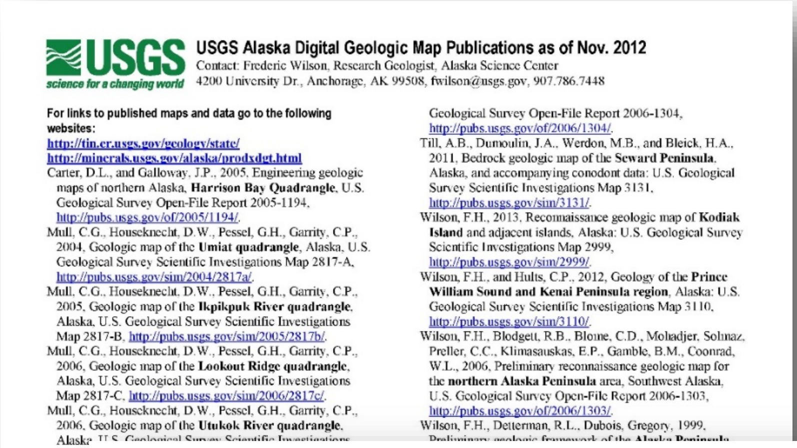
Ambler, Alaska – Designated Area

http://www.dot.state.ak.us/stwddes/desmaterials/noa.shtml

USGS maps are the best available source

In the literature:

- No previous asbestos statewide studies
- Few asbestos occurrences are documented
- No modern statewide map of Alaska



USGS Alaska Digital Geologic Map Publications as of Nov. 2012

Contact: Frederic Wilson, Research Geologist, Alaska Science Center
4200 University Dr., Anchorage, AK 99508, fwilson@usgs.gov, 907.786.7448

For links to published maps and data go to the following websites:
http://tin.er.usgs.gov/geology/state/
http://minerals.usgs.gov/alaska/prodxdgt.html

Carter, D.L., and Galloway, J.P., 2005, Engineering geologic maps of northern Alaska, **Harrison Bay Quadrangle**, U.S. Geological Survey Open-File Report 2005-1194, http://pubs.usgs.gov/of/2005/1194/.

Mull, C.G., Houseknecht, D.W., Pessel, G.H., Garrity, C.P., 2004, Geologic map of the **Umiat quadrangle**, Alaska, U.S. Geological Survey Scientific Investigations Map 2817-A, http://pubs.usgs.gov/sim/2004/2817a/.

Mull, C.G., Houseknecht, D.W., Pessel, G.H., Garrity, C.P., 2005, Geologic map of the **Ikpikpuk River quadrangle**, Alaska, U.S. Geological Survey Scientific Investigations Map 2817-B, http://pubs.usgs.gov/sim/2005/2817b/.

Mull, C.G., Houseknecht, D.W., Pessel, G.H., Garrity, C.P., 2006, Geologic map of the **Lookout Ridge quadrangle**, Alaska, U.S. Geological Survey Scientific Investigations Map 2817-C, http://pubs.usgs.gov/sim/2006/2817c/.

Mull, C.G., Houseknecht, D.W., Pessel, G.H., Garrity, C.P., 2006, Geologic map of the **Utukok River quadrangle**, Alaska, U.S. Geological Survey Scientific Investigations

Geological Survey Open-File Report 2006-1304, http://pubs.usgs.gov/of/2006/1304/.

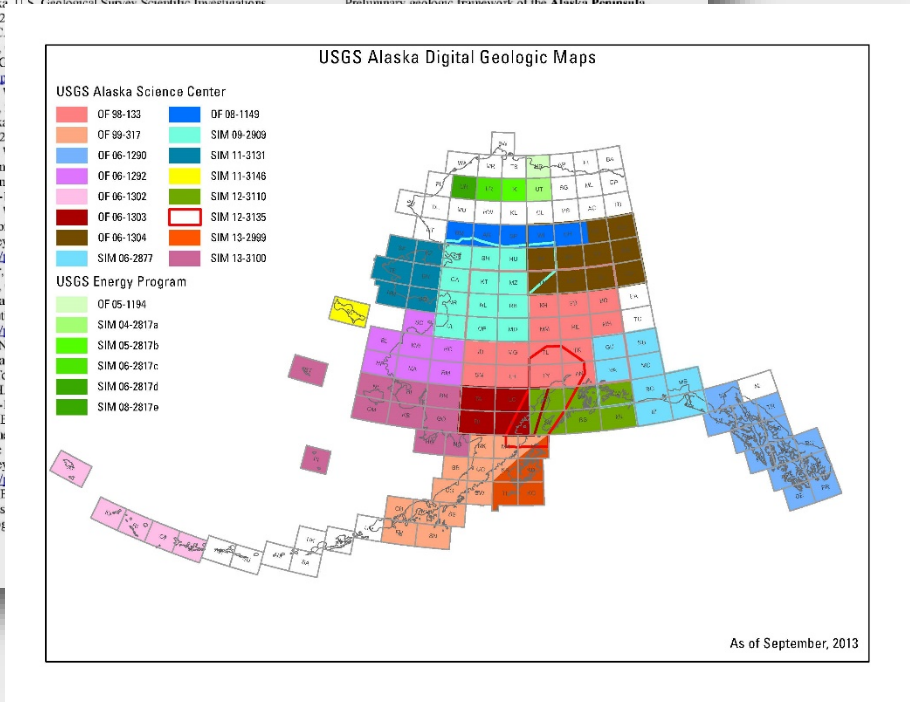
Till, A.B., Dumoulin, J.A., Werdon, M.B., and Bleick, H.A., 2011, Bedrock geologic map of the **Seward Peninsula**, Alaska, and accompanying conodont data: U.S. Geological Survey Scientific Investigations Map 3131, http://pubs.usgs.gov/sim/3131/.

Wilson, F.H., 2013, Reconnaissance geologic map of **Kodiak Island** and adjacent islands, Alaska: U.S. Geological Survey Scientific Investigations Map 2999, http://pubs.usgs.gov/sim/2999/.

Wilson, F.H., and Hults, C.P., 2012, Geology of the **Prince William Sound and Kenai Peninsula region**, Alaska: U.S. Geological Survey Scientific Investigations Map 3110, http://pubs.usgs.gov/sim/3110/.

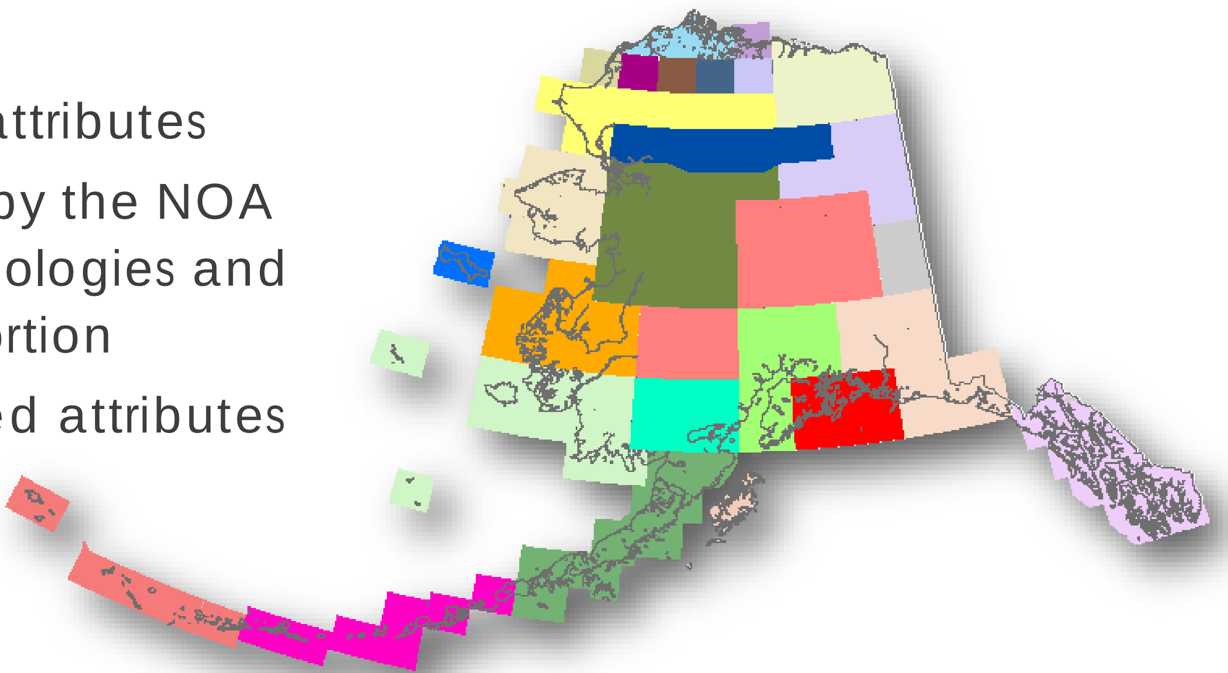
Wilson, F.H., Blodgett, R.B., Blome, C.D., Mohadjer, Solmaz, Preller, C.C., Klimasauskas, E.P., Gamble, B.M., Coonrad, W.L., 2006, Preliminary reconnaissance geologic map for the **northern Alaska Peninsula** area, Southwest Alaska, U.S. Geological Survey Open-File Report 2006-1303, http://pubs.usgs.gov/of/2006/1303/.

Wilson, F.H., Detterman, R.L., Dubois, Gregory, 1999,



Methodology

- Compiled 27 maps in ArcGIS
- Added human-readable, feature-level data into the attributes
- Standardized the attributes
- Categorized units by the NOA potential of the lithologies and their relative proportion
- Added NOA-related attributes



NOA-potential categorization

Table

BrooksRangeTier_NOA_potential

NOA_POTENTIAL	NOA_FAV_LITHOLOGY	AMOUNT_NOA	UNIT_ABBREV	NSA_CLASS_URL	REFERENCE	LITHOLOGY
Zero to low	basalt	moderate	MzPzv	<Null>	Mull and Adams (1989)	Pillow basalt, chert, carbonate rocks
High to known	ultramafic rocks	major	Mzim	<Null>	Mull and Adams (1989)	Ultramafic rocks
Medium	greenstone	minor	PzpCm	<Null>	Mull and Adams (1989)	Calc-schist, marble, quartzite, phyllite, greenstone
Surficial deposit	surficial deposit	unknown	Qu	<Null>	Mull and Adams (1989)	Undifferentiated surficial deposits
Zero to low	basalt	moderate	MzPzv	<Null>	Mull and Adams (1989)	Pillow basalt, chert, carbonate rocks
High to known	ultramafic rocks	major	Mzim	<Null>	Mull and Adams (1989)	Ultramafic rocks
Zero to low	mafic rocks	major	mi	<Null>	Mayfield and others (1987)	Mafic igneous rocks
Zero to low	basalt	major	JTrb6	<Null>	Mayfield and others (1987)	Pillow basalt, diabase
Zero to low	basalt	major	JTrb6	<Null>	Mayfield and others (1987)	Pillow basalt, diabase
Zero to low	basalt	major	JTrb6	<Null>	Mayfield and others (1987)	Pillow basalt, diabase
Zero to low	basalt	major	JTrb6	<Null>	Mayfield and others (1987)	Pillow basalt, diabase
Zero to low	mafic rocks	major	JPm4	<Null>	Mayfield and others (1987)	Mafic sills and dikes
Zero to low	mafic rocks	major	mi	<Null>	Mayfield and others (1987)	Mafic igneous rocks
High to known	ultramafic rocks	major	Ju7	<Null>	Mayfield and others (1987),	Serpentinite and partly serpentinized peridotite
Surficial deposit	surficial deposit	unknown	Qu	<Null>	Mayfield and others (1987)	Undifferentiated surficial deposits
Zero to low	<Null>	<Null>	mixed	<Null>	Mayfield and others (1987)	Mixed lithologies with low noa potential
Zero to low	<Null>	<Null>	Dbl	<Null>	Mayfield and others (1987)	Upper baird group, limestone
Surficial deposit	surficial deposit	unknown	Qu	<Null>	Mull and Adams (1989)	Undifferentiated surficial deposits
Surficial deposit	surficial deposit	unknown	Qu	<Null>	Mull and Adams (1989)	Undifferentiated surficial deposits
Medium	peridotite/pyroxenite dikes	minor	Jg7	<Null>	Mayfield and others (1990)	Unmetamorphosed gabbro
Zero to low	basalt	major	JTrb6	<Null>	Mayfield and others (1990)	Pillow basalt
Zero to low	diabase	major	JPm4	<Null>	Mayfield and others (1990)	Diabase sills and dikes
Medium	dolomite	moderate	PMcd4	<Null>	Mayfield and others (1990)	Black chert and dolomite

9 (0 out of 605 Selected)

BrooksRangeTier_NOA_potential

NOA-potential categorization

Table

BrooksRangeTier_NOA_potential

NOA_POTENTIAL	NOA_FAV_LITHOLOGY	AMOUNT_NOA	UNIT_
Zero to low	basalt	moderate	MzPzv
High to known	ultramafic rocks	major	Mzim
Medium	greenstone	minor	PzpCm
Surficial deposit	surficial deposit	unknown	Qu
Zero to low	basalt	moderate	MzPzv
High to known	ultramafic rocks	major	Mzim
Zero to low	mafic rocks	major	mi
Zero to low	basalt	major	JTrb6
Zero to low	basalt	major	JTrb6
Zero to low	basalt	major	JTrb6
Zero to low	basalt	major	JTrb6
Zero to low	mafic rocks	major	JPm4
Zero to low	mafic rocks	major	mi
High to known	ultramafic rocks	major	Ju7
Surficial deposit	surficial deposit	unknown	Qu
Zero to low	<Null>	<Null>	mixed
Zero to low	<Null>	<Null>	Dbl
Surficial deposit	surficial deposit	unknown	Qu
Surficial deposit	surficial deposit	unknown	Qu
Medium	peridotite/pyroxenite dikes	minor	Jg7
Zero to low	basalt	major	JTrb6
Zero to low	diabase	major	JPm4
Medium	dolomite	moderate	PMcd4

9 (0 out of 605 Selected)

BrooksRangeTier_NOA_potential

mrdata.usgs.gov/geology/state/ak/akgeo-unit.php?unit=2470

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Mineral Resources > Online Spatial Data > Geology > by state > Alaska

Alaska geologic unit Kgk

Quartz monzonite, monzonite, and syenite [< 85 Ma]

NSAclass	2470
Label	Kgk
Geologic setting	Intrusive
Lithology	Quartz-monzonite *Pluton* (Indeterminate, major) < Syenitic < Plutonic < Igneous
	Monzonite *Pluton* (Indeterminate, major) < Syenitic < Plutonic < Igneous
	Syenite *Pluton* (Indeterminate, major) < Syenitic < Plutonic < Igneous
Absolute age	65.5 Ma to 99.6 Ma
Age type	Relative
Minimum age	Phanerozoic > Mesozoic > Cretaceous > Late-Cretaceous
Maximum age	Phanerozoic > Mesozoic > Cretaceous > Late-Cretaceous
Geographic extent	McGrath, Dillingham, Bendeleben, Lime Hills, Tyonek, Tanana, Talkeetna Mountains, Iliamna, Lake Clark, Livengood
References	Till, A.B., Dumoulin, J.A., Werdon, M.B., and Bleick, H.A., 2010, Preliminary bedrock geologic map of the Seward Peninsula, Alaska, and accompanying conodont data: U.S. Geological Survey Open-File Report 2009-1254, 2 plates, scale 1:500,000, 1 pamphlet, 57 p., and database. [http://pubs.er.usgs.gov/publication/ofr20091254]

Issues that NCGMP09 standardization might help

Map unit name vs. actual lithologies

=?

General Lithology

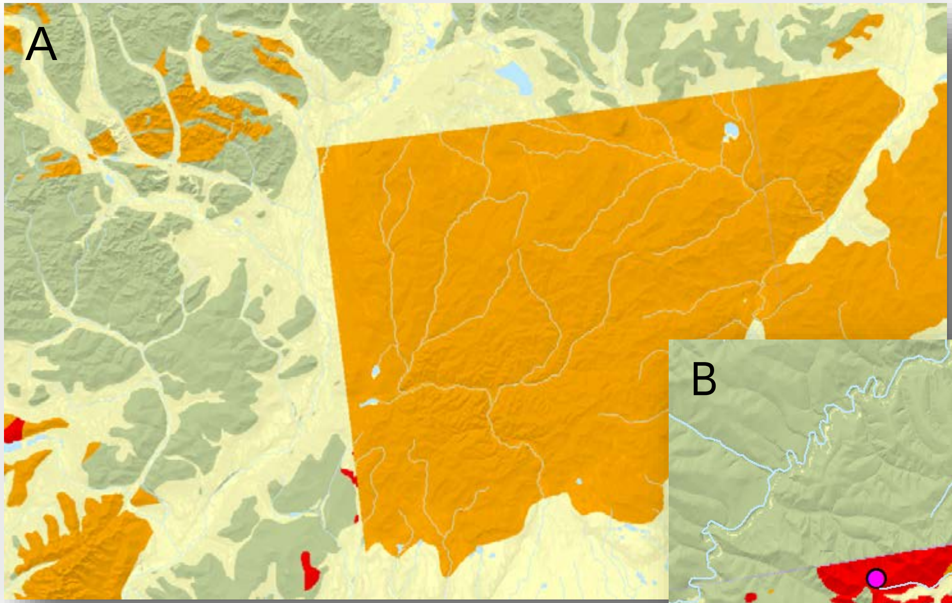
- Map units don't match even though their names do
- Map units are the same even though names don't match
- Lithology of units not in formal name (e.g., formation name)
- Lithologies are not combined into traditional map units, but by some other categorization
- Lack of detailed information about rock type
- Level of descriptive detail is different on adjacent maps

Standard Lithology

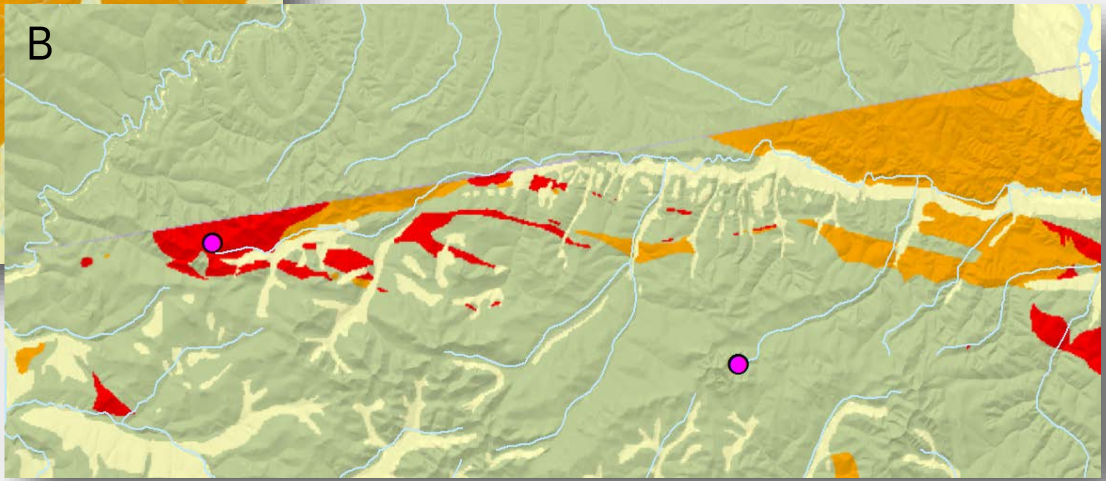
- Multiple lithologies and their relative proportions

Troublesome compilation issues
that are tough to standardize

Border "faults," or adjoining maps with different…



- Detail in map units
- Lithologic groupings
- Lithologic definitions

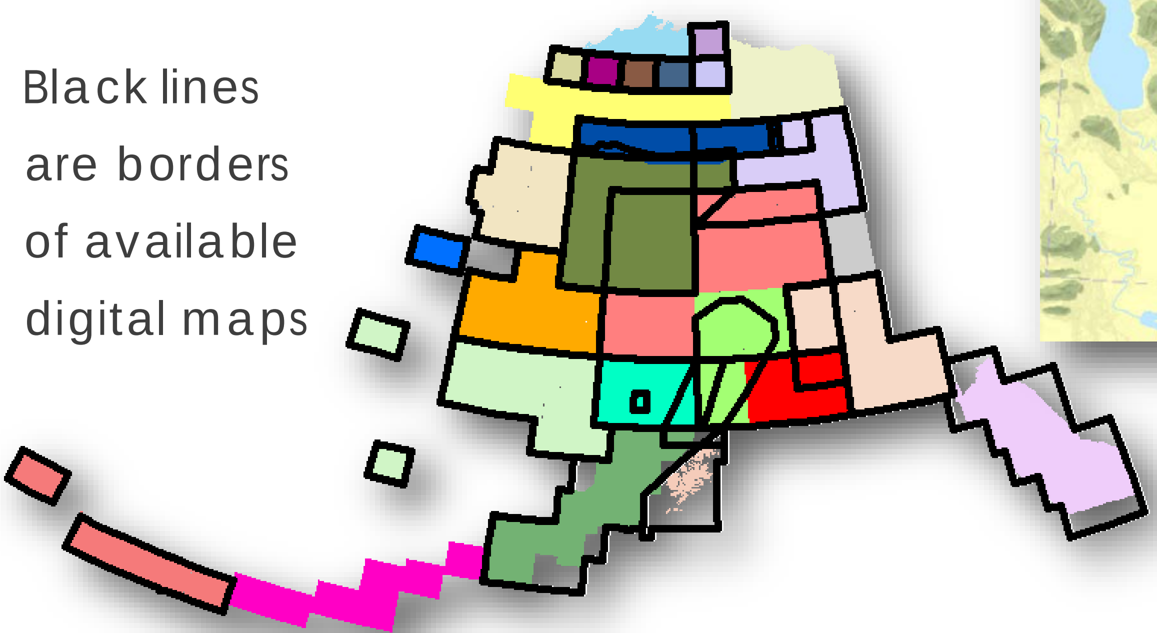


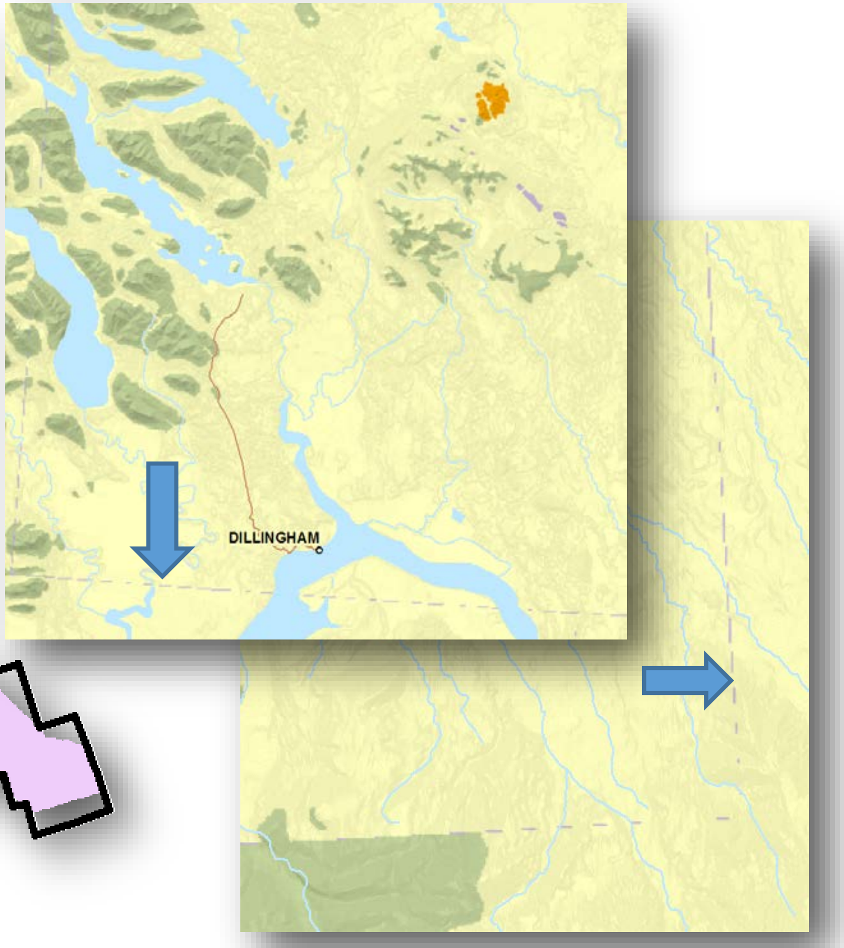
- Map scales
- Vintages

Troublesome compilation issues
that are tough to standardize

Overlaps and gaps between maps

Black lines are borders of available digital maps

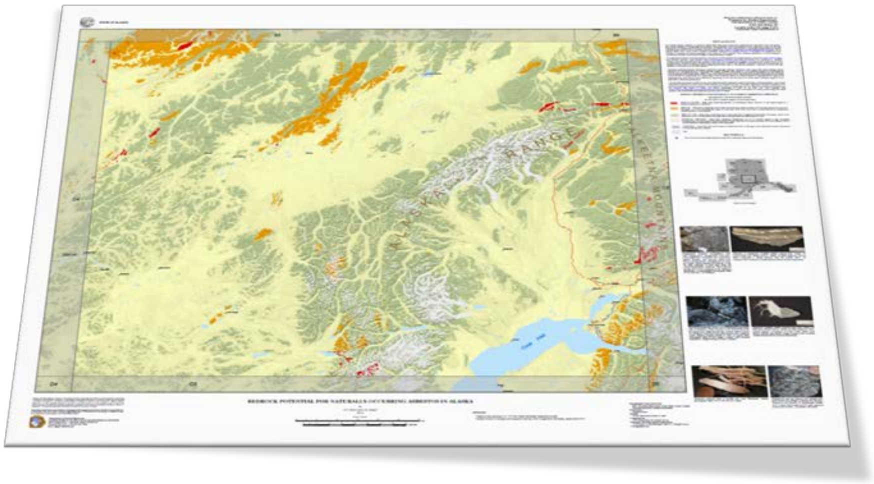




Troublesome compilation issues
from working with big data

Slow and time-consuming process

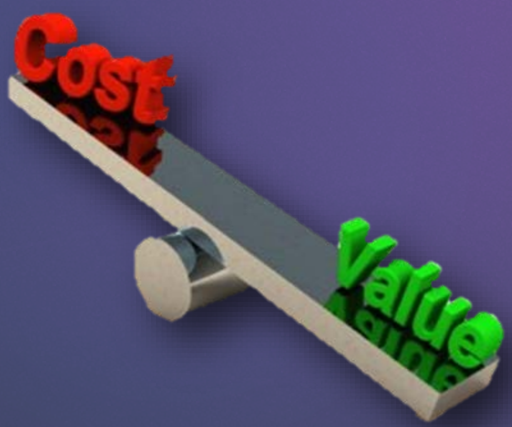
- Big GIS files (contains 143,893 polygons)
- Developed a print-ready base map at 1:500,000 scale with locatable features
- Raster-blended hillshade for background (600 x 600 m cell size, 9.53 GB)



One map takes 1.5 hours to export to PDF from ArcGIS 10.2

Final product specifications

Multiple agencies are interested in the data!



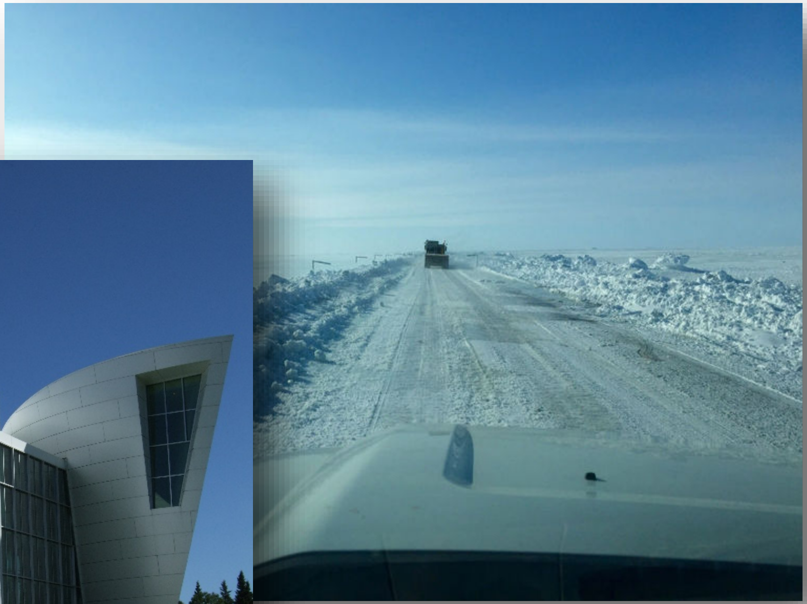
Product includes:

- Statewide digital NOA-potential units
- References to the original maps at the feature level
- URLs to online USGS geospatial data at http://mrdata.usgs.gov/general/alaska.html
- Digital data are web-ready

Build it and they will come...

Mineral extraction in Alaska;
photo courtesy of
Fort Knox Gold Mine

UAF Museum of the North; photo courtesy of
Andrei from New York City/Juneau, USA



Dalton Highway overflow ice;
photo courtesy of
Alaska DOT&PF

Consider facilitating the use of your work for derivative products

You're gonna call me **what?**

If you don't standardize your terms ahead of time, future users will have to guess. *(Which is worse?)*

Tad Lauritzen Wright, Pet Rock; David Lusk Gallery
Accessed at *http://www.memphisflyer.com/ExhibitM/archives/2010/08/03/the-price-is-right* on 5/15/2015