

DIGITAL MAPPING TECHNIQUES 2020

The following was presented at DMT'20
(June 8 - 10, 2020 - A Virtual Event)

The contents of this document are provisional

See Presentations and Proceedings
from the DMT Meetings (1997-2020)

<http://ngmdb.usgs.gov/info/dmt/>

Lessons From Converting Alaska Digital Geologic Maps to the USGS Geologic Map Schema (GeMS)



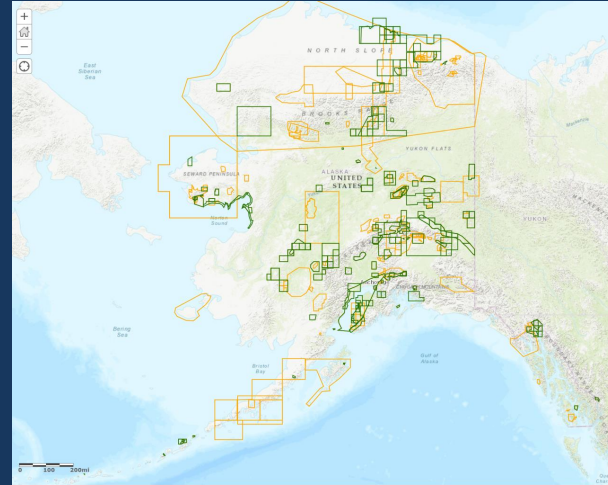
Chris Wyatt, Mike Hendricks, Jennifer Athey, and Patricia Ekberg
Alaska Division of Geological & Geophysical Surveys
June 9, 2020

chris.wyatt@alaska.gov

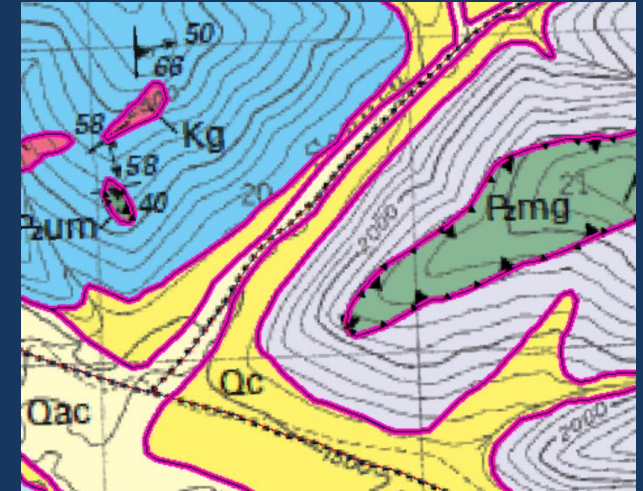
Lessons From Converting Alaska Maps to GeMS

This presentation:

- The maps DGGs is prioritizing for converting to GeMS
- Getting started with a map conversion
- Challenges encountered with legacy map GIS data



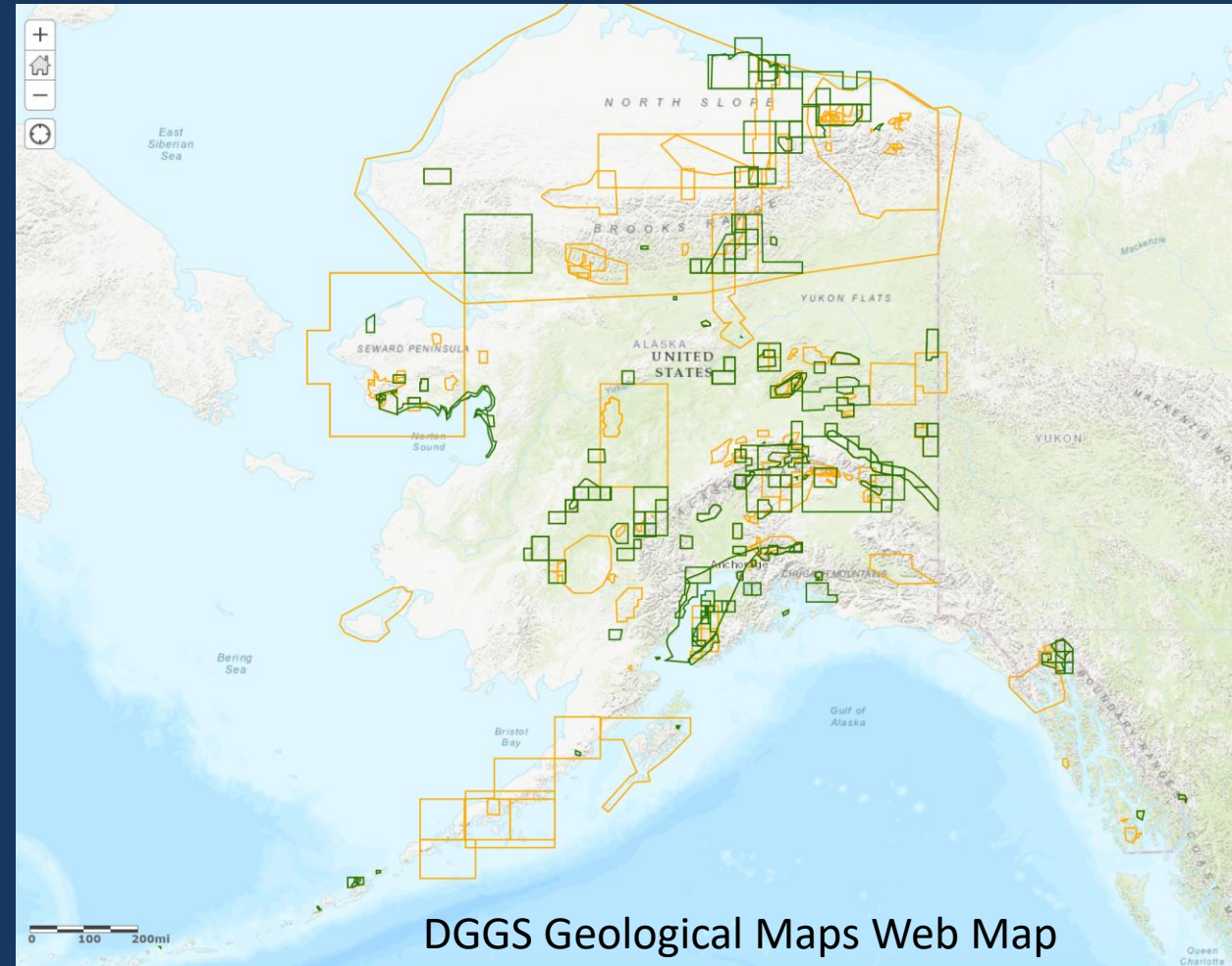
dgg.alaska.gov



www.newsiner.com

Converting Alaska Maps: Where to begin?

- **Map: Bedrock and surficial maps published by DGGS**
- **Includes:**
 - Scanned paper maps, 1970s (and older?)
 - Maps with legacy digital geospatial data
 - Recently published maps with NCGMP09 and GeMS standard data

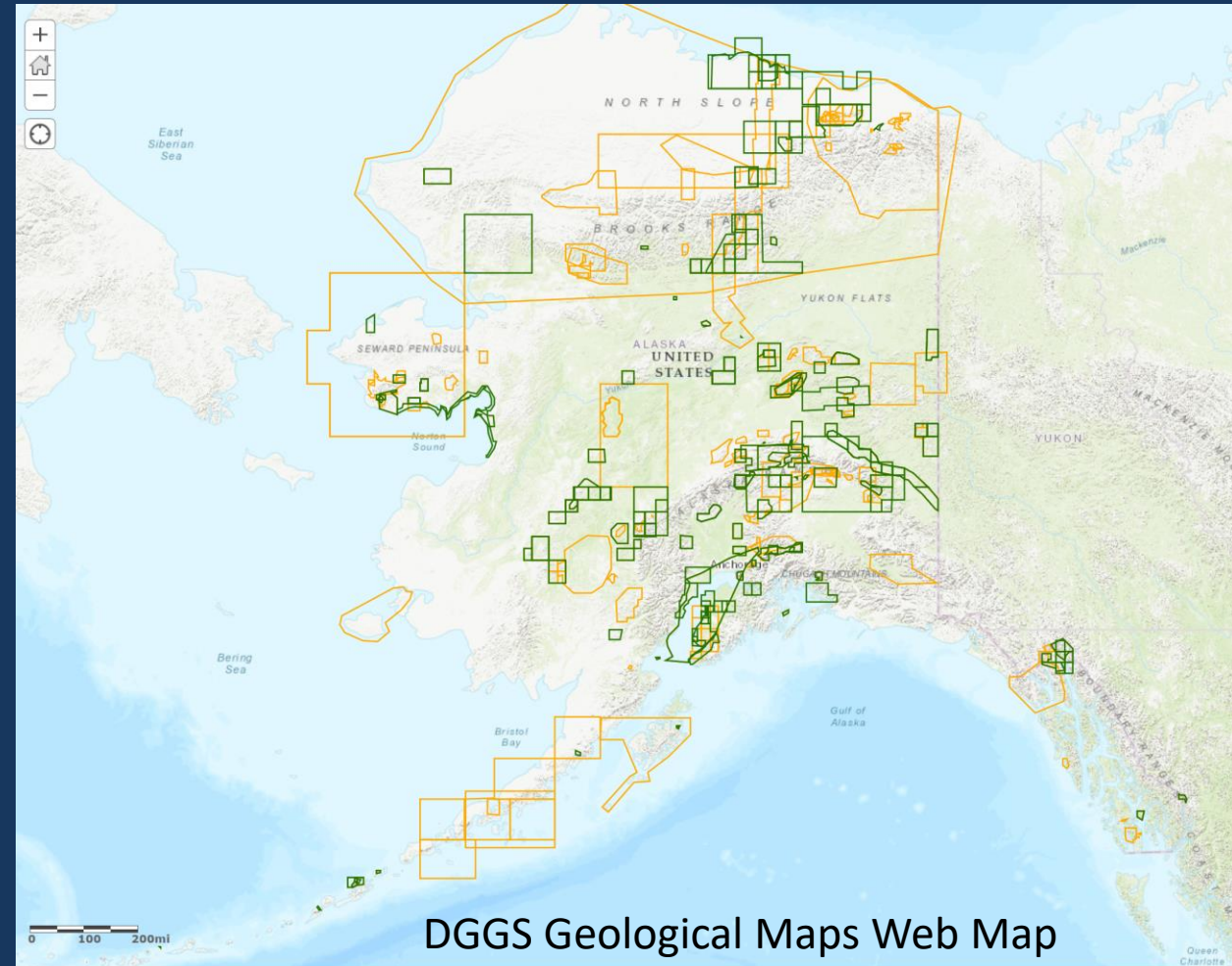


DGGS Geological Maps Web Map

<https://geoportal.dggs.dnr.alaska.gov/portal/home/>

Converting Alaska Maps: Where to begin?

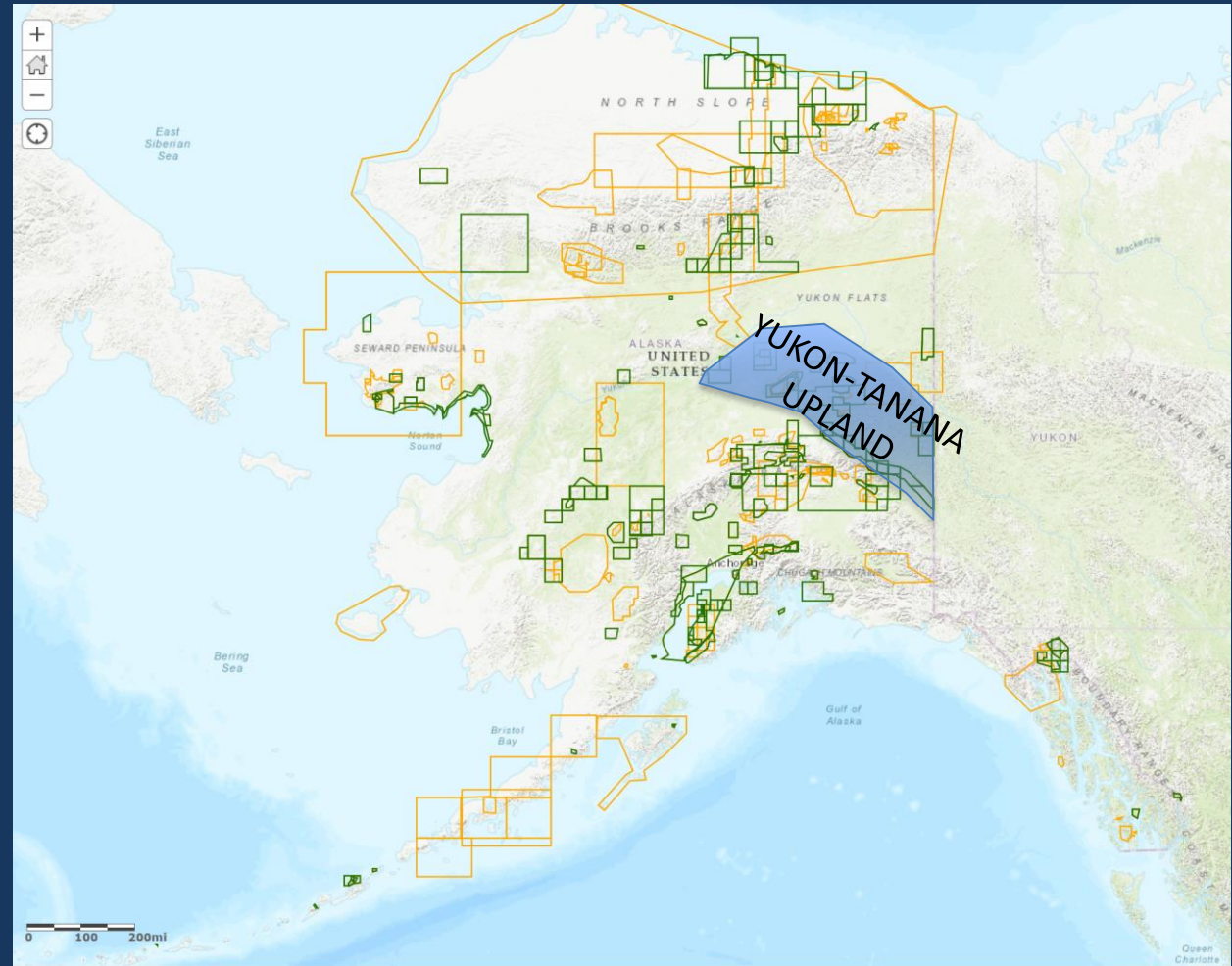
- **Bedrock and surficial maps published by DGGS**
- **Includes:**
 - Scanned paper maps, 1970s (and older?)
 - **Maps with legacy digital geospatial data**
 - Recently published maps with NCGMP09 and GeMS standard data
- **GeMS versions/conversions across the state**
 - Aleutian Islands
 - North Slope



<https://geoportal.dggs.dnr.alaska.gov/portal/home/>

Map Conversion Target Area: YTU

- Yukon-Tanana Uplands
- “mountainous region of about 30,000 sq. mi. between the Yukon and Tanana Rivers” (Foster et al., 1970)
- **Gold** and other mineral resources identified and produced for >130 years
- Our Mission at DGGs:
“Determine the **potential of Alaskan land for production of metals, minerals, fuels, and geothermal resources, the locations and supplies of groundwater and construction material, and the potential geologic hazards to buildings, roads, bridges, and other installations and structures (AS 41.08.020).**”



Mineral Potential of the YTU

- **Hundreds of mineral prospects recognized**
 - Alaska Resource Data File sites
- **Includes two of Alaska's largest producing hard-rock gold mines**
 - Fort Knox
 - Pogo

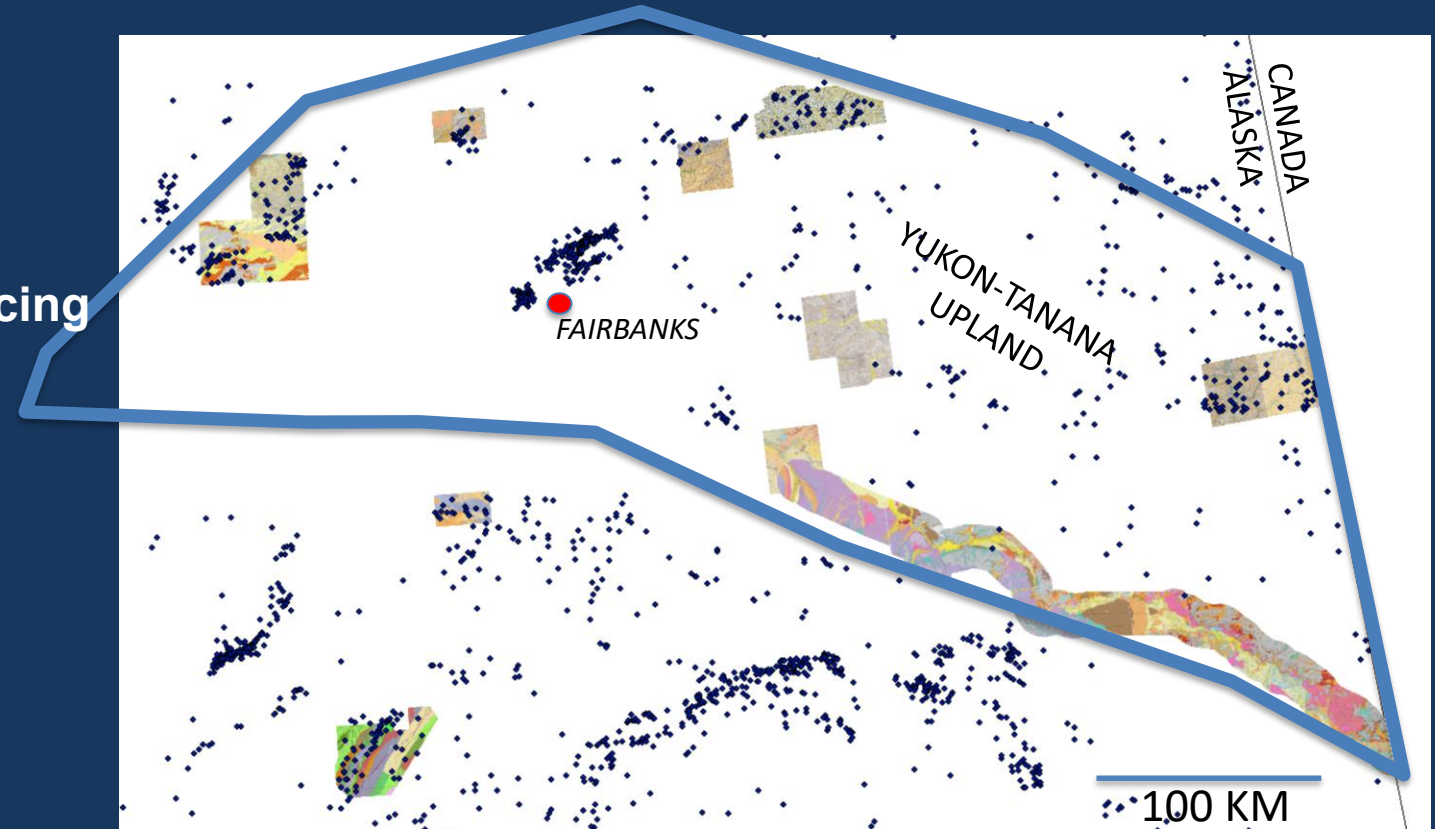


Image Service of Alaska Key Geologic Map Images
<https://geoportal.dggs.dnr.alaska.gov/portal/home/>

Mineral Potential of the Y-T Uplands



www.newsiner.com

Fort Knox Gold Mine
near Fairbanks



www.newsiner.com

Pogo Gold Mine
Southeast of Fairbanks









fortymilegold.ca

Fortymile District area placer mine
near the US-Canada border

- Paleozoic metamorphic rocks
- Cretaceous intrusions
- Tertiary volcanics

Map Conversion: Legacy Map Input Data

- **Variety of ESRI data structures**
- **Distribution in these different formats continues at AKDGGS and USGS**

Software:	ArcInfo	ArcView	ArcGIS
Developed:	1980s	1990s	2000s
Same data:			
Data format:	 Coverage	 Shapefile	 Geodatabase
	Topology required	Topology absent	Topology optional
	Complicated	Simple	Sophisticated
	Hard to use	Easy to use	Easy to use
	Efficient data	Inefficient data	↑ Functionality

(Figure from: University of Toronto and Coursera, <https://www.coursera.org>)

Map Conversion: Legacy Map Input Data

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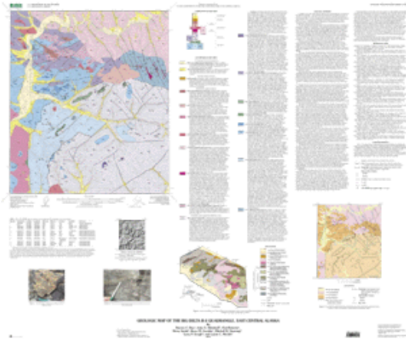


Map Conversion: Download legacy data

Geologic Map of the Big Delta B-2 Quadrangle, East-Central Alaska

By Warren C. Day¹, John N. Aleinikoff¹, Paul Roberts², Moira Smith², Bruce M. Gamble¹, Mitchell W. Henning³, Larry P. Gough¹, and Laurie C. Morath¹

Version 1.0



Input data source:
<https://pubs.usgs.gov/imap/i-2788/>

¹U.S. Geological Survey
²Teck Cominco Limited, #600-200 Burrard Street, Vancouver, B.C., Canada V6C3L9
³Alaska Department of Natural Resources, Division of Mining and Water Management, Anchorage, AK 99501

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[I-2788 PDF file \(2.85 MB\)](#)

[I-2788 text only PDF file \(57 KB\)](#) (This version of the report is accessible as defined in Section 508.)

[I-2788 MET file \(21 KB\)](#) Metadata File

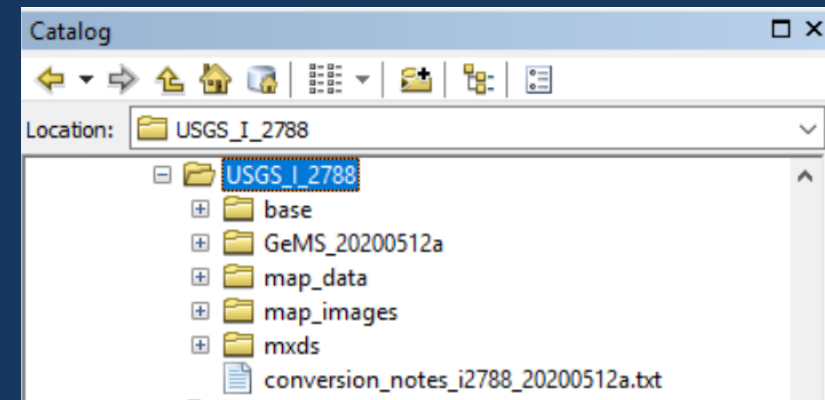
[Bases ZIP file \(1.14 MB\)](#) Contains georegistered raster images of the topographic base maps.

ArcInfo export files of each geospatial data set are included in the archived files (below).

[I-2788 ZIP file \(807 KB\)](#)

[I-2788 TAR.GZ file \(813 KB\)](#)

ArcCatalog view of working folders on server or PC:



.zip → .e00 → coverage → feature class → feature class
(in .gdb) (in feature dataset, in desired projection)

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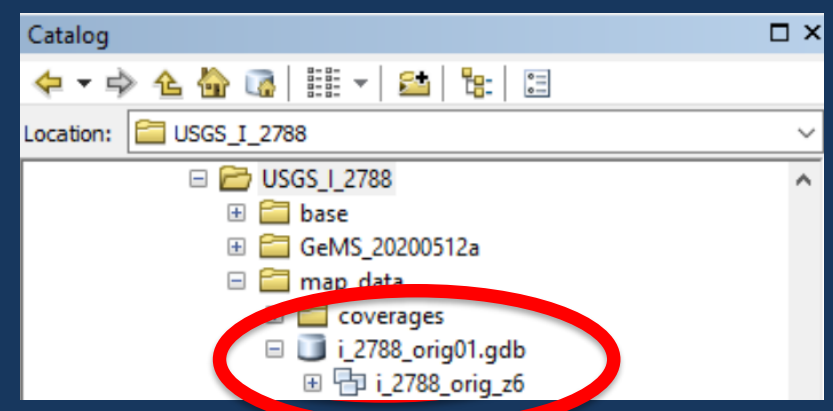
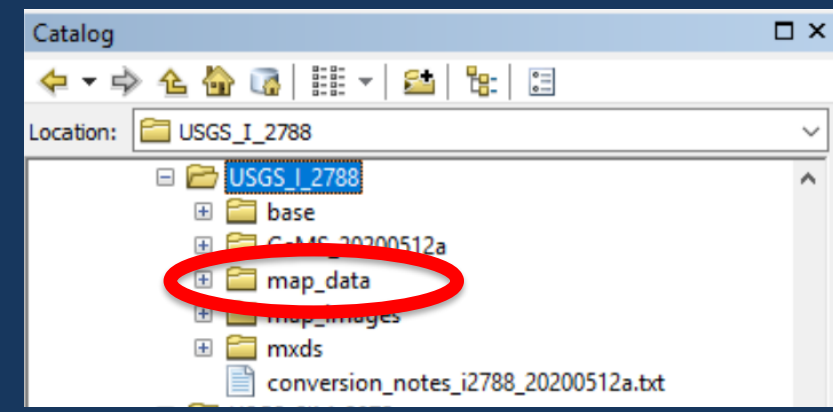
[I-2788 MET file \(21 KB\)](#) Metadata File

[Bases ZIP file \(1.14 MB\)](#) Contains georegistered raster images of the topographic base maps.

A [7.5 MB zip file](#) of each geospatial data set are included in the archived files (below).

[I-2788 ZIP file \(807 KB\)](#)

[I-2788 metadata file \(613 KB\)](#)



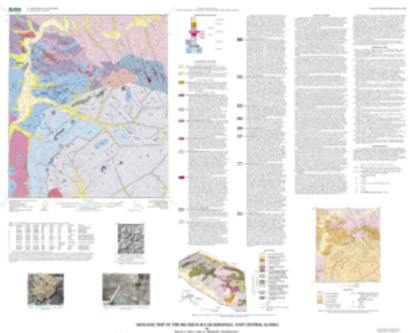


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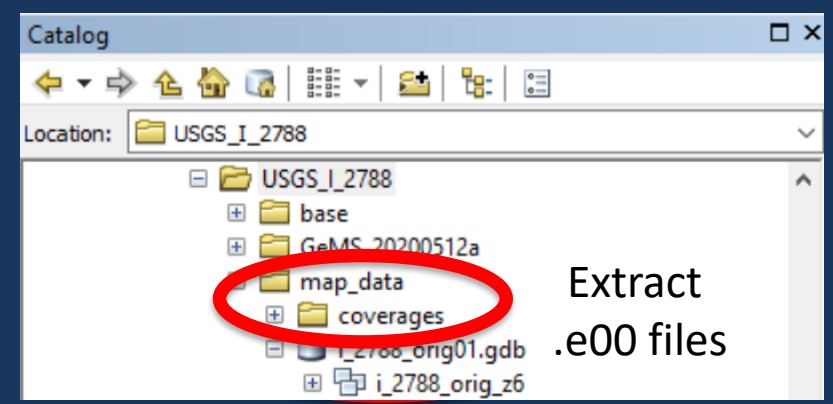
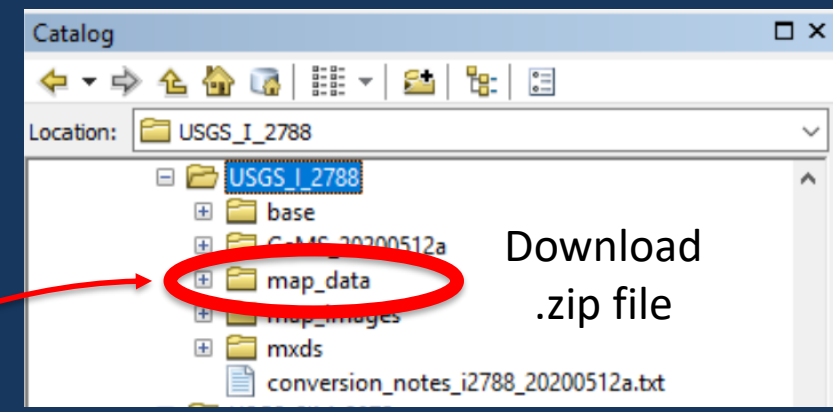


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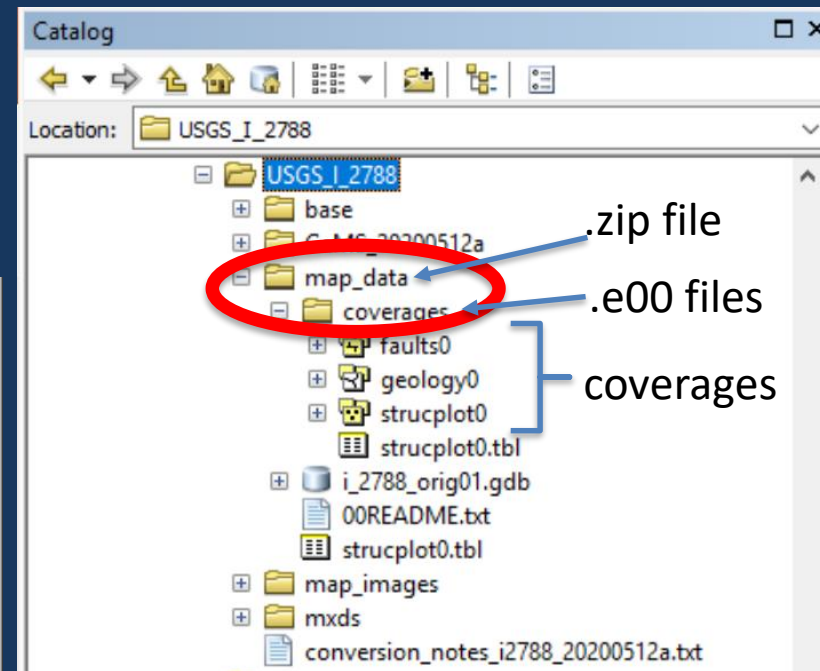
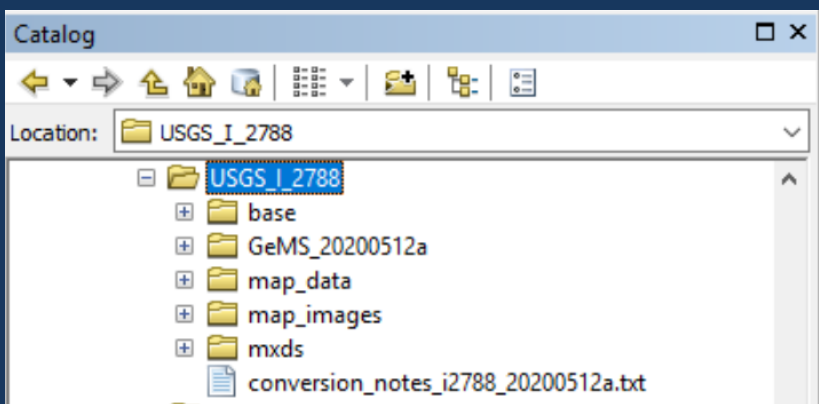
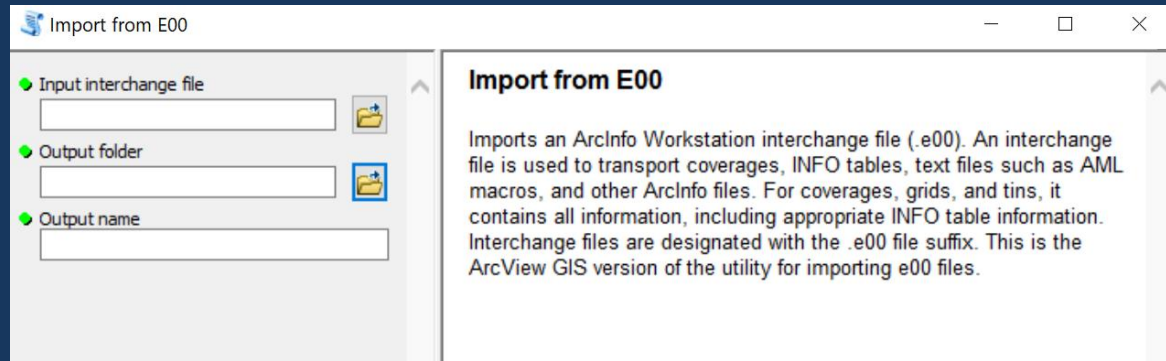
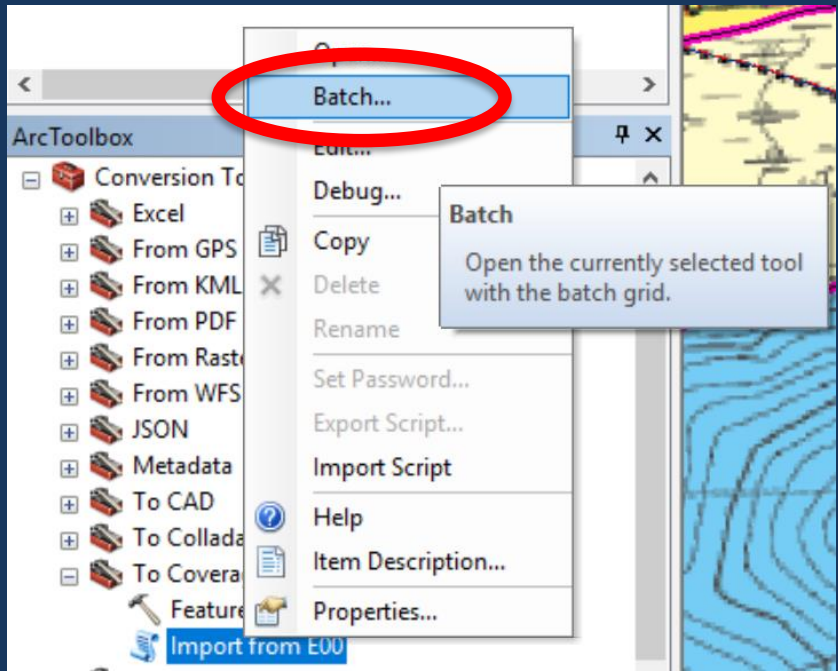
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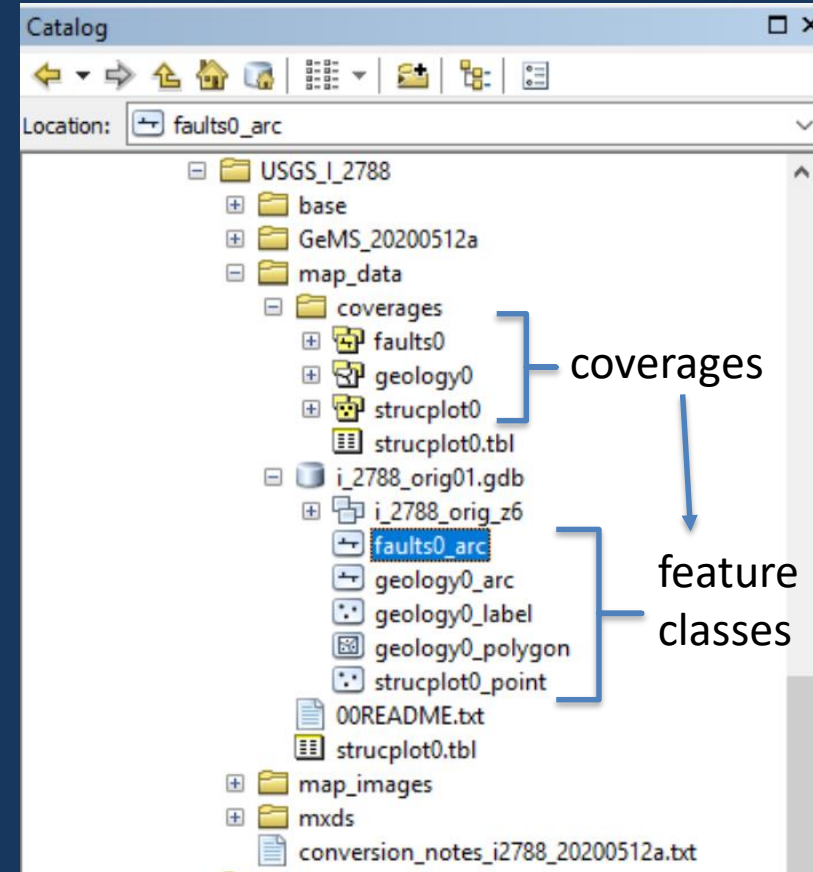
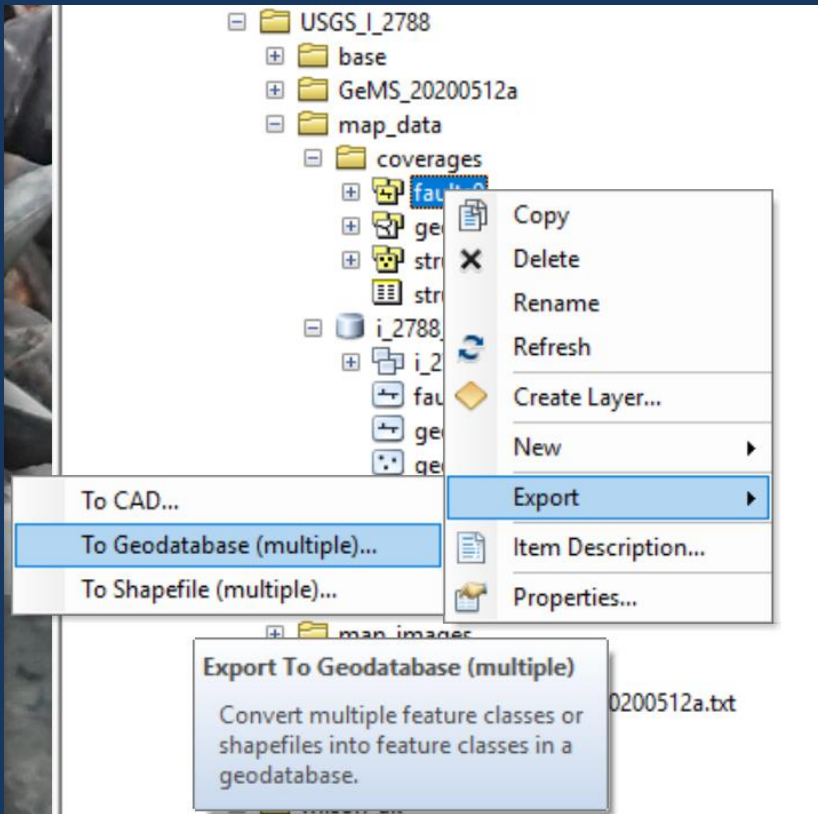
A [7.5-minute geospatial data set](#) are included in the archived files (below).
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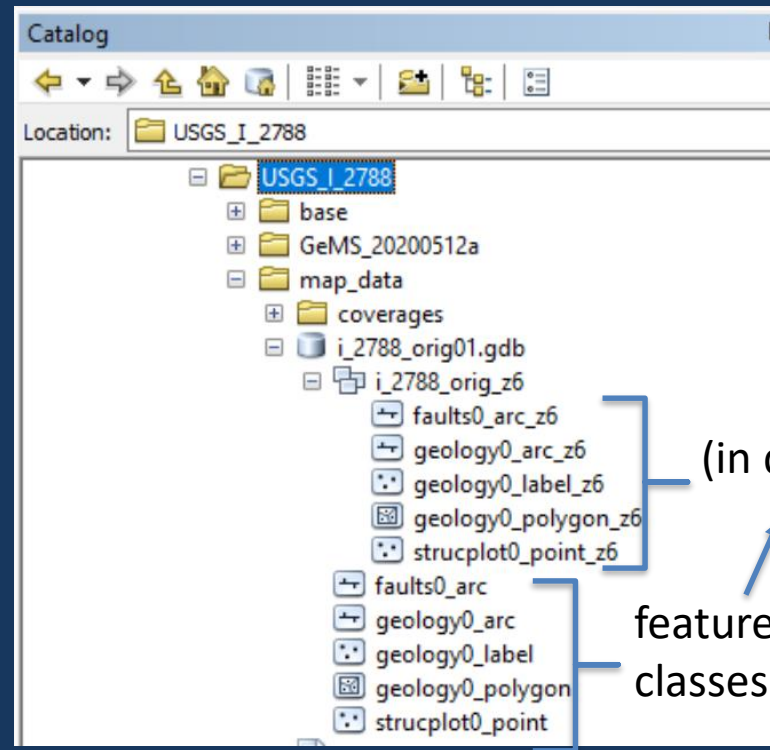
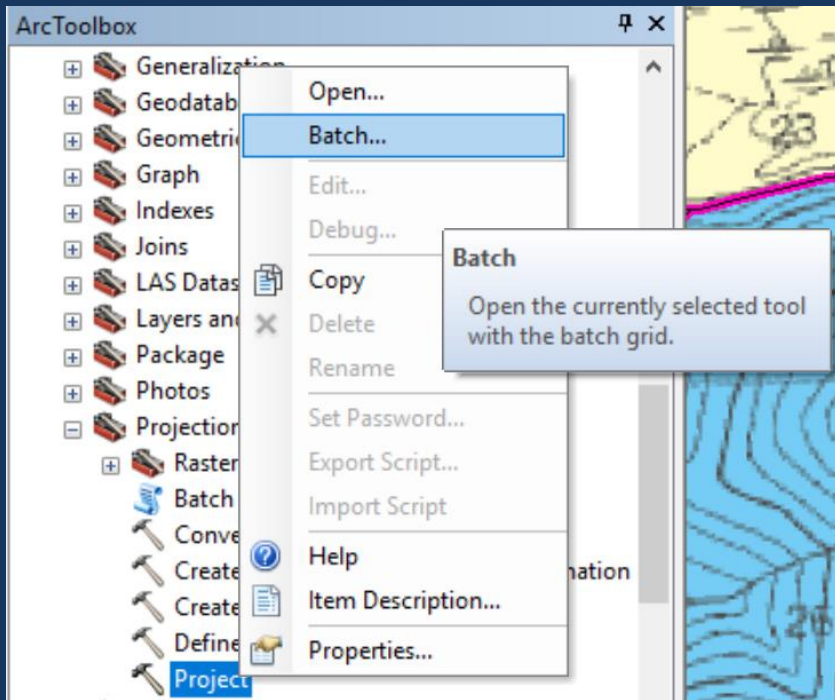
Map Conversion: .e00 to coverage



Map Conversion: coverage to .gdb



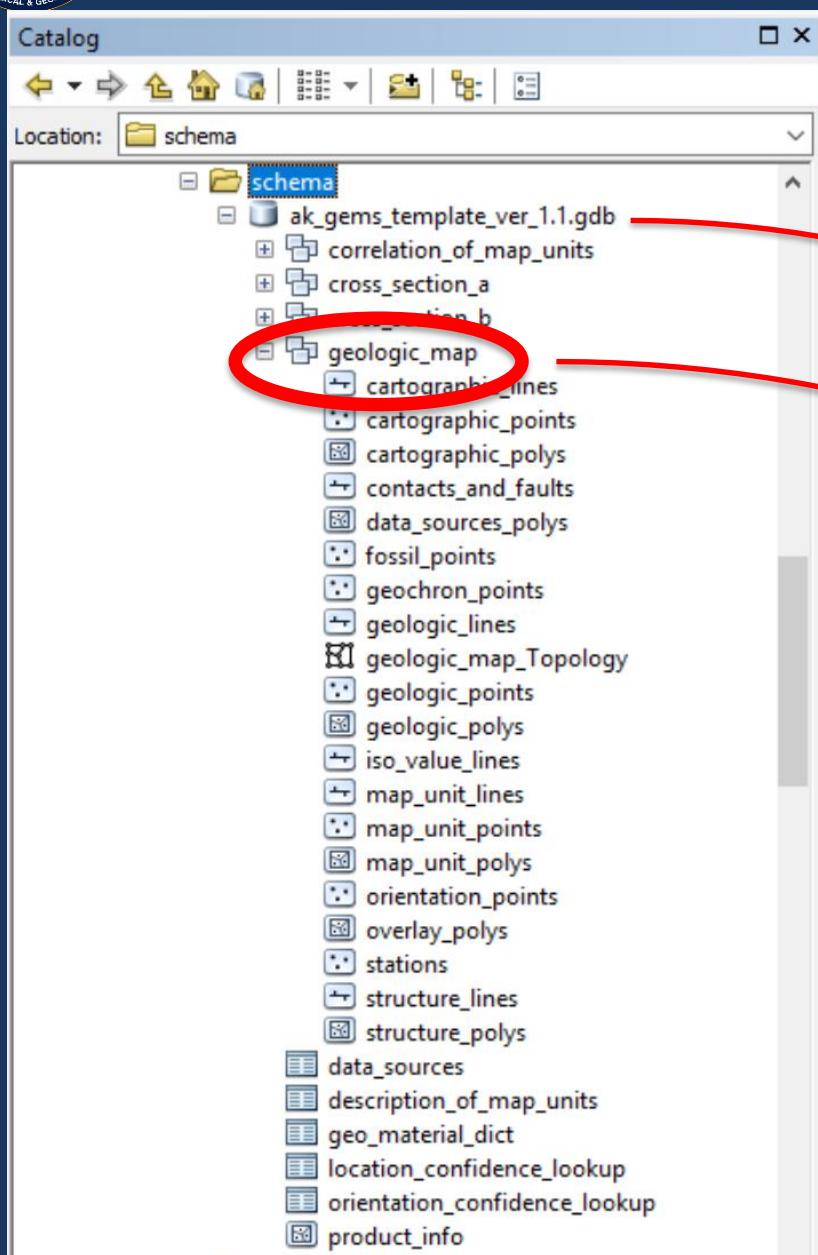
Map Conversion: Feature Class into Feature Dataset



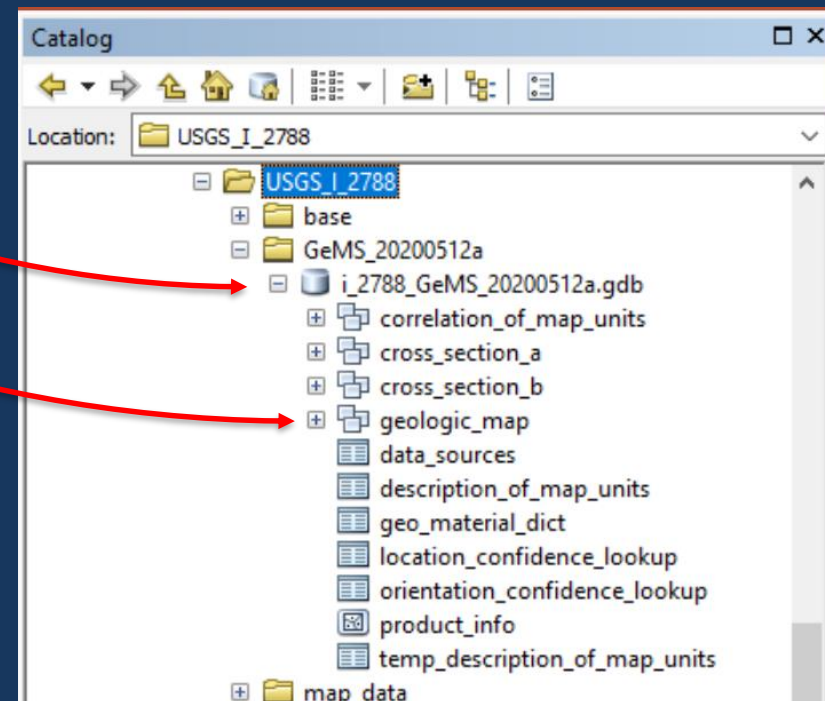
feature classes within a feature dataset (in desired coordinate system)

feature classes

GeMS: empty schema template



Copy/rename the empty template geodatabase to the working folder

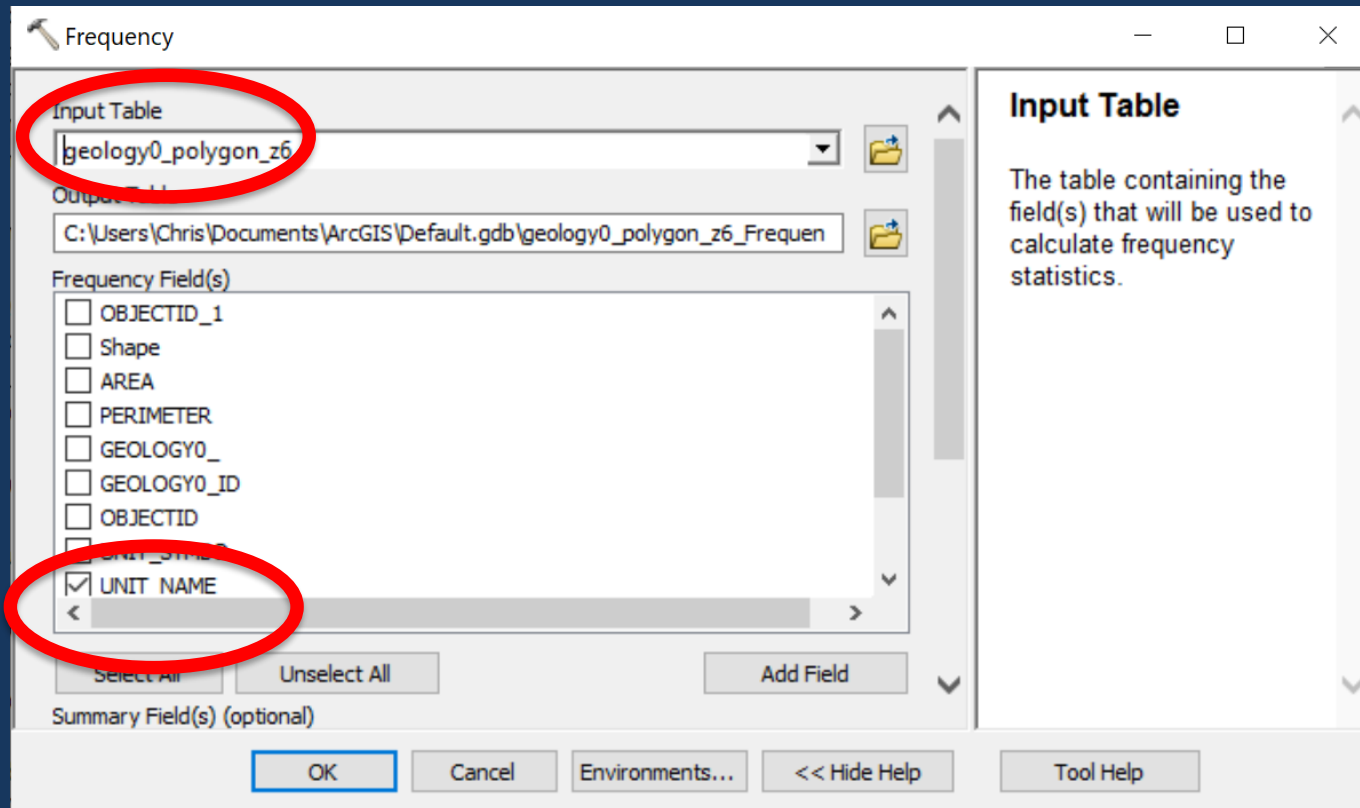


Redefine the coordinate system of the empty "geologic_map" feature dataset



GeMS Description of Map Units Table (DMU)

Run “Frequency” on the input polygon feature class to generate a table with a row for each map unit:



FID *	FREQUENCY	UNIT_NAME
1	7	Alluvium and colluvium
2	6	Augen gneiss
3	1	Basalt
4	1	Biotite-sillimanite gneiss
5	2	Biotite gneiss
6	17	Biotite orthogneiss
7	95	Colluvium
8	5	Diorite and tonalite
9	2	Dioritic orthogneiss
10	15	Goodpaster batholith
11	2	Granite of Slide Peak
12	18	Granite stock
13	1	Granite Stock
14	14	Granite-like
15	1	Granodiorite to granite, undivided
16	9	Mafic gneiss
17	21	Paragneiss
18	5	Quartzite and metapelite
19	1	Shawnee Peak intrusion
20	4	Ultramafic schist



GeMS Description of Map Units Table (DMU)

Run "Merge" on the "Frequency" output table and the empty GeMS description_of_map_units table to generate a table with a row for each map unit:

Table

geology0_polygon_z6_Frequenc

FID *	FREQUENCY	UNIT_NAME
1	7	Alluvium and colluvium
2	6	Augen gneiss
3	1	Basalt
4	1	Biotite-sillimanite gneiss
5	2	Biotite gneiss
6	17	Biotite orthogneiss
7	95	Colluvium
8	5	Diorite and tonalite
9	2	Dioritic orthogneiss
10	15	Goodpaster batholith
11	2	Granite of Swede Peak
12	18	Granite stock
13	1	Granite Stock
14	14	Granitoid dike
15	1	Granodiorite to granite, undivided
16	9	Mafic gneiss
17	21	Paragneiss
18	5	Quartzite and metapelite
19	1	Shawnee Peak intrusion
20	4	Ultramafic schist

Fields from empty GeMS DMU

Fields from "Frequency" output table

Table

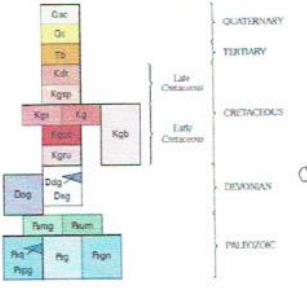
temp_description_of_map_unitsB

OBJECTID *	symbol	map_unit	name	full_name	label	description	hierarchy_key	area_fill_rgb	geo_material	FREQUENCY	UNIT_NAME
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2	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	6	Augen gneiss
3	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	1	Basalt
4	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	1	Biotite-sillimanite gneiss
5	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	2	Biotite gneiss
6	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	17	Biotite orthogneiss
7	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	95	Colluvium
8	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	5	Diorite and tonalite
9	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	2	Dioritic orthogneiss
10	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	15	Goodpaster batholith
11	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	2	Granite of Swede Peak
12	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	18	Granite stock
13	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	1	Granite Stock
14	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	14	Granitoid dike
15	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	1	Granodiorite to granite, undivided
16	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	9	Mafic gneiss
17	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	21	Paragneiss
18	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	5	Quartzite and metapelite
19	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	1	Shawnee Peak intrusion
20	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	4	Ultramafic schist



GeMS DMU: Hierarchy Key

CORRELATION OF MAP UNITS



DESCRIPTION OF MAP UNITS

- 01-01 Qac Alluvial and colluvial deposits (Quaternary)—Block to silt-size, unconsolidated alluvial and colluvial deposits. Unit includes material deposited in stream channels, flood plains, abandoned river and stream channels, swamps, and wetlands.
- 01-02 Qc Colluvial deposits (Quaternary)—Block to silt-size, unconsolidated talus, depositional deposits, colluvium, and minor alluvial deposits. Unit includes alluvial deposits within small, narrow active stream channels.
- 02-01 Tb Basalt (Tertiary)—Dark-gray to black, nonfoliated basalt (dike contains) small, randomly oriented plagioclase phenocrysts set in devitrified aegirine groundmass. Age uncertain, but may be correlated with a 50 Ma basaltic dike near the Yukon-Tanana Unconformity. Crisp out poorly in sec. 15, R. 15 E., T. 6 S. in upper part of Susitna Creek drainage.
- 03-01 Kgt Diorite and tonalite (Late Cretaceous)—Medium-grained, dark-gray, nonfoliated, equigranular, hornblende-biotite diorite to tonalite. In Lase Creek, outcrops of unit exhibit weak to moderate quartz-chlorite-sillimanite alteration and include the Pogo gold deposit. Smith and others (1999) reported a $^{40}\text{Ar}/^{39}\text{Ar}$ U-Pb zircon age for the diorite of Lase Creek. Sericite alteration of the diorite of Lase Creek ranges in age from 91.2 to 91.7 Ma using $^{40}\text{Ar}/^{39}\text{Ar}$ technique (Smith and others, 1999) and postdates the main gold mineralization event at the Pogo gold deposit at 104.3-0.3 Ma (Sally and others, 2002).
- 03-02 Kgp Shawnee Peak intrusion (Late Cretaceous)—Coarse-grained, nonfoliated, equigranular, light-gray to white diorite to biotite tonalite; from western flank of Swede Peak. Lacks evidence for intergranular recrystallization as seen in the granite of Swede Peak (unit Kgb). Implying intrusion occurred at a higher structural level relative to the granite of Swede Peak and emplacement postdated regional Early Cretaceous deformation.
- 03-03 Kgs Granite of Swede Peak (Early Cretaceous)—Coarse-grained, light-gray to white, biotite-garnet-muscovite leucocratic. In this section, quartz and feldspar crystals exhibit narrow textures, and quartz shows undulatory extinction indicating post-emplacement strain and regional recrystallization possibly due to relatively deeper level of initial emplacement or emplacement during later stages of Early Cretaceous to 110-Ma regional tectonics. Western margin of unit is intrusive into country rock Pzmg. Contact with first fault on northeast margin of intrusion is buried beneath valley fill alluvium; southwest trending first fault does not appear to cut the intrusion. Eastern margin of unit cut by high-angle fault.
- 03-04 Kq Granite stock (Early Cretaceous)—Small, medium- to coarse-grained, nonfoliated to weakly foliated stock and plugs of leucocratic biotite granodiorite to granite composition, locally contains muscovite. Minor texture between quartz and feldspar phenocrysts, combined with weak foliation to microscopic scale, indicates unit was at least partially recrystallized. Age uncertain, but predominantly nonfoliated texture indicates unit emplaced after Early Cretaceous regional tectonics.
- 03-05 Kgb Goodpaster batholith (Early Cretaceous)—Composite batholith made up of nonfoliated to weakly foliated, coarse-grained, equigranular biotite granodiorite, granite, and pegmatite. Southern part of batholith is a border phase of medium-grained, lepidomorphous, equigranular, moderately foliated biotite granodiorite, distinguished from adjacent biotite-sillimanite gneiss (unit Pzgn), which unit Kgb intrudes, by lack of recrystallization and lesser amount of intense sericite alteration. Foliated southern boundary of batholith probably represents an earlier

Dool-Bacon and others (2001) reported a Late Devonian U-Pb zircon SHRIMP age of 362.3 Ma their sample AG-25 from an augen gneiss sample taken north of Central Creek and west of Calliterra Creek. 13 Pb zircon SHRIMP ages of 363.6 Ma Late Devonian obtained for continuous unit approximately 10 km east of map area (sample AG-3; table 1). A sample from the same map unit yielded a 388.3 Ma Middle Devonian age as reported by Dool-Bacon and others (2001) their sample AG-5, lat 64° 15' 34" N, long 144° 26' 30" W. The Late Devonian age reported here (sample AG-3; table 1) supersedes that reported by Alekoff and others (1986), who published a U-Pb concordia age of 341.0 Ma (Early Mississippian) on zircon from several samples of the gneiss. Alekoff and others (1986), their sample AG-1 reported K-Ar dates on muscovite of 113.4 Ma and on biotite of 110.4 Ma, reflecting postmetamorphic cooling during the Early Cretaceous.

Dioritic orthogneiss (Late Devonian)—Dark-green, medium-grained, foliated, hornblende-biotite-quartz orthogneiss. Interpreted to be a coarse mafic phase of the Devonian augen gneiss (unit Dag); contact zone with augen gneiss is apparently not faulted and is a typical igneous contact. Major and trace element geochemical data (W. Dag, unpub. data, 2002) are compatible with interpretation that unit Dag is cognate with plutonic protolith of unit Dag. A SHRIMP U-Pb date of 369.6 Ma from zircon core from a dioritic orthogneiss (sample Q2AD332; table 1) represents a Devonian age of primary crystallization. No Cretaceous metamorphic overprints were noted on the zircon, although unit experienced the same tectonic events recorded at the enclosing augen gneiss (unit Dag). Dool-Bacon and others (2001) reported an age of 361.3 Ma for an "amphibolite" interpreted as a diorite core from the same augen gneiss body that they interpreted as a cognate phase within the augen gneiss body (Dool-Bacon, oral comm., 2002). Wilson and others (1985) reported a K-Ar age of 188.5 Ma for hornblende (asthenospheric) from unit Dag. Dool-Bacon and others (2002) reported $^{40}\text{Ar}/^{39}\text{Ar}$ ages of 151.7 Ma and 130 Ma on hornblende from the unit, which would represent time of post-peak metamorphic cooling from Mesozoic deformation and metamorphic events. Dool-Bacon and coworkers' previous studies also interpreted the unit to be a cognate mafic enclave within protolith intrusion of the augen gneiss.

Granodioritic orthogneiss (Middle to Late Devonian)—Predominantly light to medium gray, medium-grained, layered (stratigraphic to granitic) orthogneiss with lesser amounts of biotite, quartz, and perovskite. Occurs in northern and western parts of map area and is distinguished from unit Pzgn by lack of sillimanite. Xenocryst zircon cores vary in age from 367 Ma to 1,184 Ma (sample Q2AD339; table 1). One zircon core yields a U-Pb SHRIMP age of 367.7 Ma and is assumed to be a 3000-12 Ma moderately zoned leucocratic zircon overgrowth. Both Devonian ages are within error of each other and indicate a Middle to Late Devonian emplacement age of the protolith, which is equivalent to slightly older than that of the protolith for the augen gneiss (unit Dag). U-Pb SHRIMP ages on zircon from these two populations—an older group at 114.2 Ma and a younger group at 109.2 Ma (sample Q2AD339; table 1). U-Pb SHRIMP data on zircon from unit indicate that protolith intrusion affected zircon from a crustal source that was in part Precambrian, was emplaced during the Devonian, and was recrystallized twice during pulses of regional Cretaceous tectonism at ~114 Ma and at ~109 Ma.

Mafic gneiss (Paleozoic)—Dark-gray, fine to medium-grained, strongly foliated, hornblende-biotite amphibolite orthogneiss. Moderately foliated, medium-grained, equigranular orthogneiss. Calc-silicate schist contains hornblende, biotite, and diopside. Basal contact with underlying augen gneiss (unit Dag) is highly sheared biotite-phyllosilicate contact in a mylonitic zone (fig. 1) interpreted to be associated with regional low-angle faulting. Bodies represent structural klippe resting upon the augen gneiss (unit Dag).

Ultramafic schist (Paleozoic)—Dark-green, foliated, sericitized ultramafic schist. Weathers to light-brown color; protolith was peridotite. Equivalent to unit Pzq of Weber and others (1978). Age uncertain, but protolith presumed coeval with unit Pzmg. Basal contact poorly exposed, but structural discordance in foliation direction with underlying zircon suggests unit is low-angle fault regional low-angle faulting. Bodies represent structural klippe resting upon the augen gneiss (unit Dag).

Quartzite and metapelite (Paleozoic)—Light-gray, equigranular, muscovite-bearing quartzite and metapelite. Protolith was an igneous gneiss interbedded with pelite. Age uncertain, but protolith assumed to be part of non-structurally deformed sedimentary sequence that includes the protolith for units Pzpg, Pzq, and Pzgn.

Paragneiss (Paleozoic)—Medium-gray, equigranular, medium- to fine-grained quartz-feldspathic biotite schist with lesser amounts of metapelite and quartzite. Locally, dark-gray, medium-grained biotite schist horizons are interbedded with light gray, fine- to medium-grained, equigranular quartz-feldspathic biotite schist horizons (1-5 cm thick) as well as light-gray, medium-grained pelitic horizons. Metamorphic mineral assemblage includes biotite, muscovite, garnet, and locally sillimanite. Protolith for unit was gneissic to weakly silicified sediment and sandstone. Depositional age of protolith uncertain. Zircon U-Pb age data by Alekoff and others (1986) on a sample from same map area of Weber and others (1978) and Pzq-Dag range from Mississippian to Paleoproterozoic; the older ages are from inherited detrital zircon eroded from a Precambrian crustal source. Dool-Bacon and others (2002) reported $^{40}\text{Ar}/^{39}\text{Ar}$ age of 135 Ma on hornblende from ridge crest east of Susitna Creek. The Early Cretaceous age is thought to represent a metamorphic cooling temperature from regional tectonics.

Table

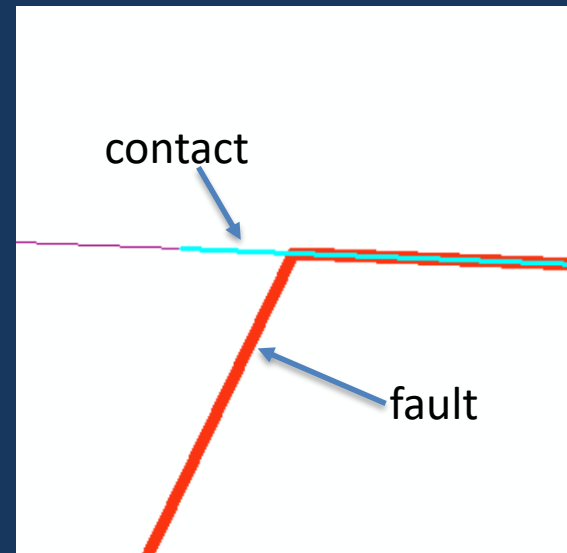
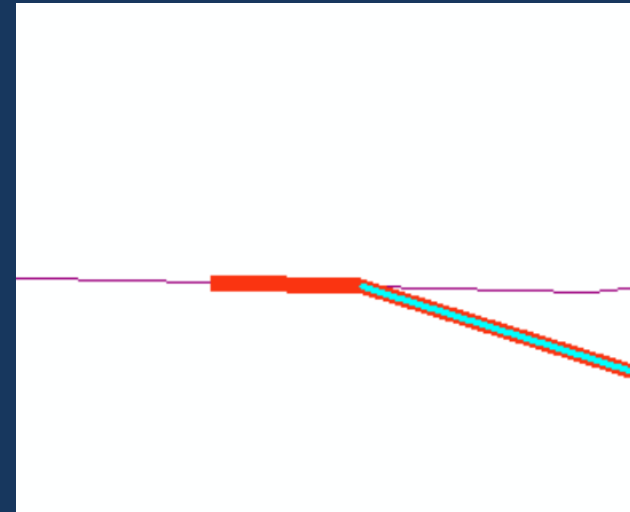


temp_description_of_map_units

OBJECTID *	map_unit	name	hierarchy_key
		QUATERNARY SURFICIAL UNITS	01
21	<Null>	QUATERNARY SURFICIAL UNITS	01
1	Qac	Alluvial and colluvial deposits	01-01
7	Qc	Colluvial deposits	01-02
22	<Null>	TERTIARY IGNEOUS ROCKS	02
3	Tb	Basalt	02-01
23	<Null>	CRETACEOUS IGNEOUS ROCKS	03
8	Kdt	Diorite and tonalite	03-01
19	Kgsp	Shawnee Peak intrusion	03-02
11	Kgs	Granite of Swede Peak	03-03
12	Kg	Granite stock	03-04
10	Kgb	Goodpaster batholith	03-05
14	Kgcd	Granitoid dike	03-06
15	Kgru	Granodiorite to granite, undivided	03-07
24	<Null>	PALEOZOIC AND OLDER METAMORPHIC UNITS	04
2	Dag	Augen gneiss	04-01
9	Ddg	Dioritic orthogneiss	04-02
6	Dog	Granodioritic orthogneiss	04-03
16	Pzmg	Mafic gneiss	04-04
20	Pzum	Ultramafic schist	04-05
18	Pzq	Quartzite and metapelite	04-06
17	Pzpg	Paragneiss	04-07
5	Pzg	Biotite gneiss	04-08
4	Pzgn	Biotite-sillimanite gneiss	04-09

Special cases: GeMS contacts_and_faults

Table		
geology0_arc_z6		
FID *	Shape *	CONT_TYPE
236	Polyline	Contact, Coincident with Fault
247	Polyline	Contact, Coincident with Fault
248	Polyline	Contact, Coincident with Fault
257	Polyline	Contact, Coincident with Fault
264	Polyline	Contact, Coincident with Fault
269	Polyline	Contact, Coincident with Fault
272	Polyline	Contact, Coincident with Fault
282	Polyline	Contact, Coincident with Fault



Contacts and faults are coincident but not congruent

Resolution: identify and manually edit coincident contacts and faults to comply with GeMS topology rules

Special cases: “compound” orientation_points

Table

strucplot0_point_z6

	S1_STRIKE	S1_DIP	L2_TREND	L2_PLUNGE	F2_TREND	F2_PLUNGE	F3_TREND	F3_PLUNGE	POINT_TYPE
	0	0	115	26	0	0	150	12	Lineation and F3 fold
	0	0	85	22	0	0	85	22	Lineation and F3 fold
	0	0	120	33	0	0	75	38	Lineation and F3 fold
	300	56	0	0	0	0	290	26	Strike and dip of foliation and F3 fold
	72	48	135	43	0	0	0	0	Strike and dip of foliation with lineation
	15	54	100	35	0	0	0	0	Strike and dip of foliation with lineation
					0	0	0	0	Strike and dip of foliation with lineation
					0	0	0	0	Strike and dip of foliation with lineation
	62	42	100	40	0	0	0	0	Strike and dip of foliation with lineation
	15	42	125	42	0	0	0	0	Strike and dip of foliation with lineation
	30	30	170	28	0	0	0	0	Strike and dip of foliation with lineation
	5	32	120	28	0	0	0	0	Strike and dip of foliation with lineation
	58	32	85	18	0	0	0	0	Strike and dip of foliation with lineation
	50	50	110	45	0	0	0	0	Strike and dip of foliation with lineation
	30	35	100	30	0	0	0	0	Strike and dip of foliation with lineation
	12	28	68	22	0	0	0	0	Strike and dip of foliation with lineation
	12	35	100	35	0	0	0	0	Strike and dip of foliation with lineation
	7	32	140	22	0	0	0	0	Strike and dip of foliation with lineation
	30	22	110	18	0	0	0	0	Strike and dip of foliation with lineation
	282	44	80	25	0	0	0	0	Strike and dip of foliation with lineation
	345	42	100	35	0	0	0	0	Strike and dip of foliation with lineation

four pairs of azimuth/inclination attributes




Resolution: replicate original compound features to represent single orientation_points, and edit GeMS attributes (type, azimuth, inclination, etc.) for each as needed



Special cases: location_confidence vs map symbol

In GeMS, solid lines will represent “location accurate” according to the FGDC symbol standards

Legend for geological symbols:

-  **Contact**—Approximately located. Dashed where inferred
-  **Fault**—Approximately located. Dashed where inferred; dotted where concealed. Opposed arrows show relative movement where known
-  **Thrust fault**—Approximately located. Dashed where inferred; dotted where concealed. Sawteeth on upper plate

Resolution: code the GeMS version as “approximate” to agree with the legend description and GIS data



Lessons From Converting Alaska Digital Geologic Maps to the USGS Geologic Map Schema (GeMS)

- Useful to have a prioritized list of maps in your GeMS conversion queue
- Helpful to be familiar with different ESRI data structures and how to migrate from them
- Expect to encounter features that require modest editing to be GeMS-compliant

