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/

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A PYTHON-BASED MAP COMPILATION TOOL

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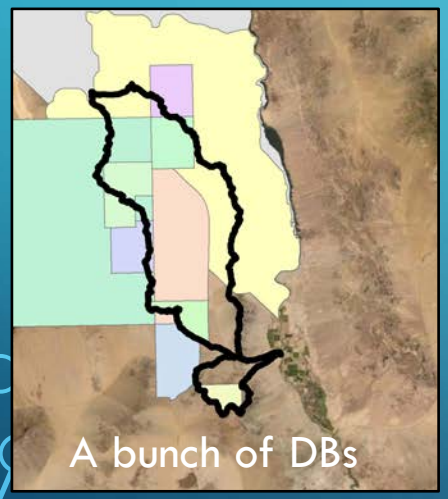
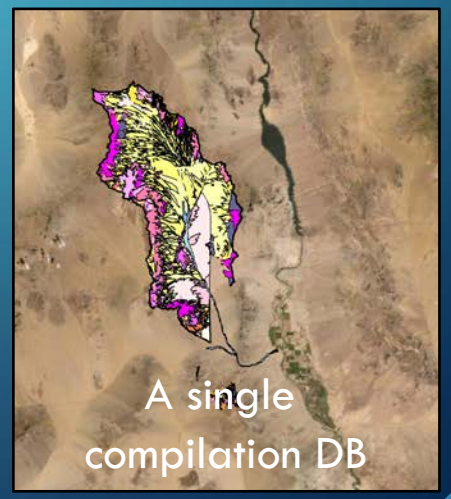
OVERVIEW

- Mention motivations
- Touch on a few tools, but focus on one designed for map compilation



Standardize the databases → **Convert everything to the same map units** → **Merge maps and remove extraneous lines**



- Provide the code

DESIRED FUNCTIONALITY

- Correlate mapunits between adjacent maps
  - Be able to quickly visualize the results in map and table format
- Combine published map databases, parts of map databases, and new mapping as seamlessly as possible
  - Dissolve away “border faults” or map boundaries
  - Preserve original data sources
  - Maintain a GeMS-like structure
  - Maintain clean topologic relationships
- Simplify mapping by combining polygons and removing unneeded line work
- Originally not developing a tool for the community; trying to increase efficiency within our mapping project
  - But I have documented the tool more fully and put it on GitHub in anticipation of this presentation and hope that it is of use to others

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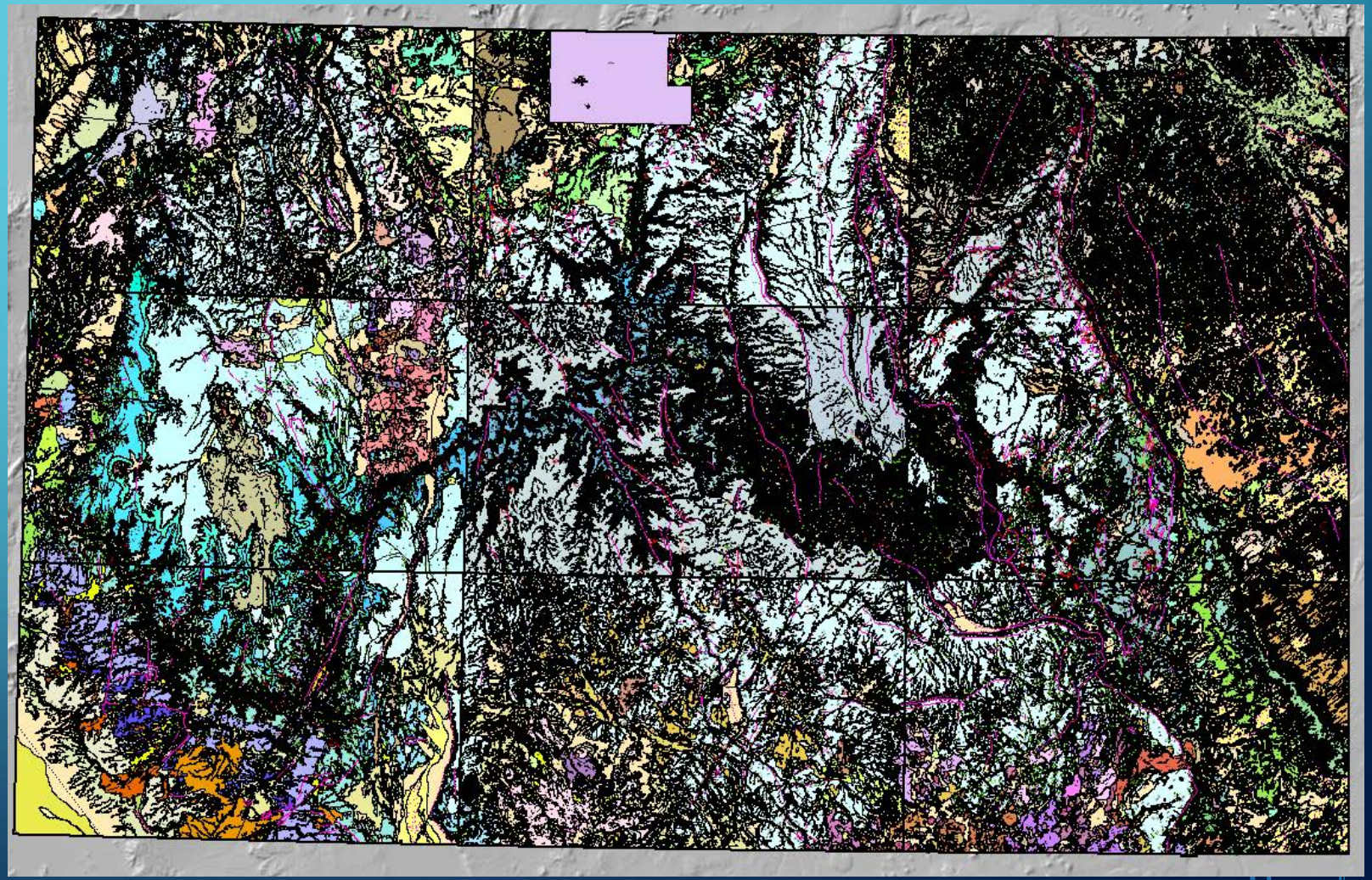
A GRAND CANYON TEST CASE

- George Billingsley et. al mapping
- Nine 30'x60' quads mapped @ 24k to 100k
- 18,000 square miles
  - 288 24k quads
  - About the size of West Virginia (a little smaller)



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PRECONDITION THE DATABASES

- Convert everything to “barebones” GeMS (no non-spatial tables)

1. Create an empty GeMS database
2. Import the legacy map into an empty GeMS container, mapping attribute fields from the source data to the corresponding GeMS fields
3. “Crosswalk” the line and polygon attributes from the legacy format to GeMS

- The GeMS Toolbox contains the functionality to do most of this

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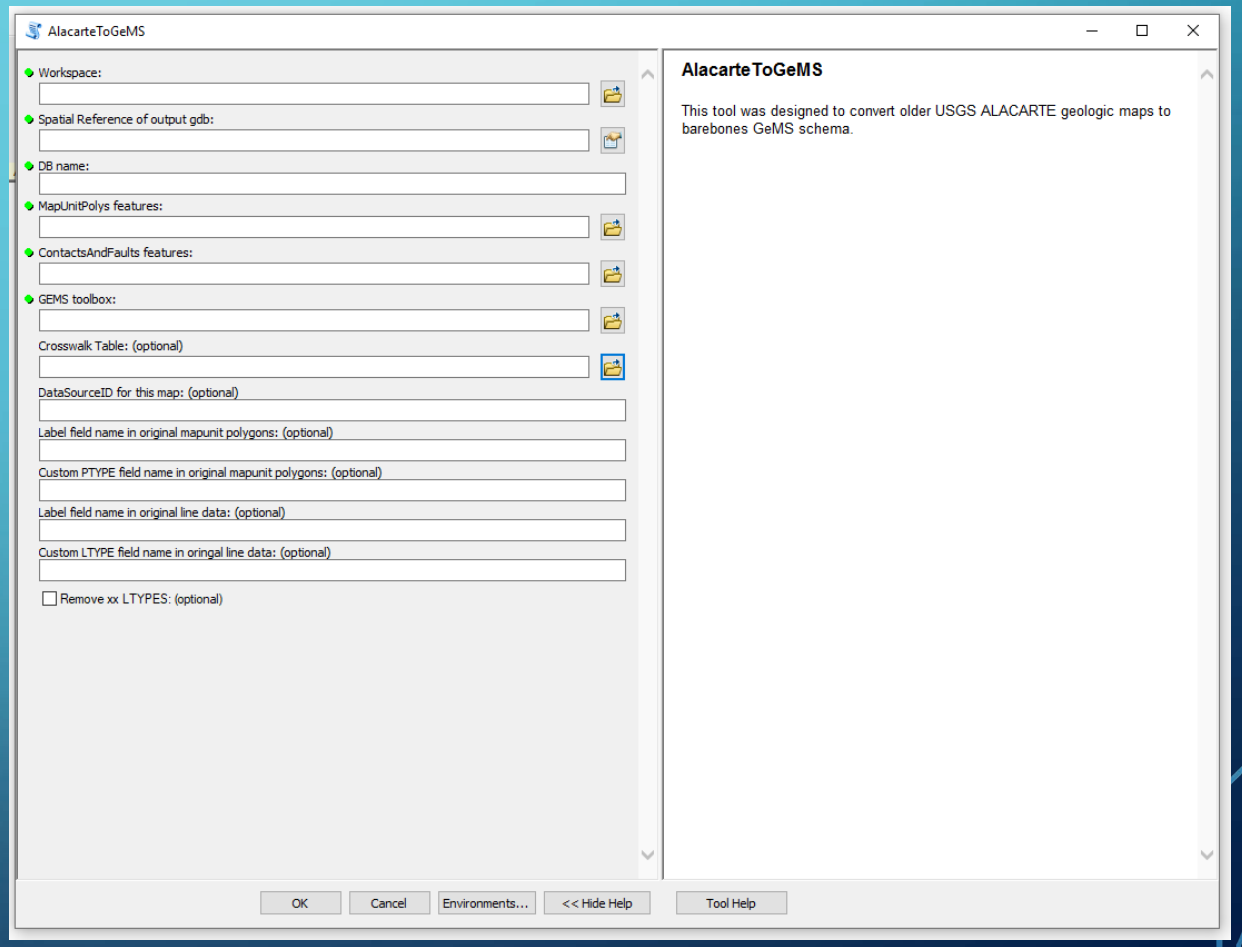
PRECONDITION THE DATABASES

- I have wrapped all these steps into a single ArcMap tool designed around the USGS's ALACARTE data model (and some state survey schemas too)
- The result is a GeMS database with only ContactsAndFaults and MapUnitPolys (no non-spatial tables)



https://github.com/rcrow/MapExtractor_SchemaConverter

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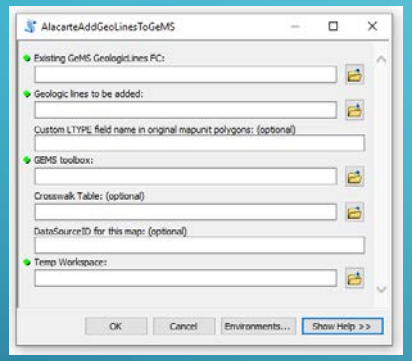
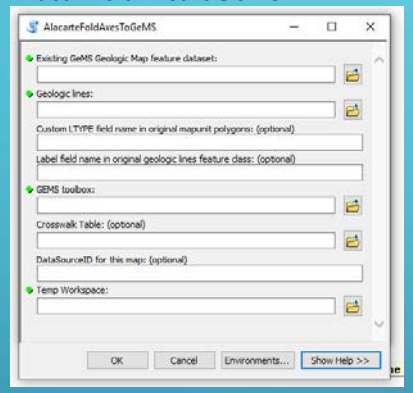
PRECONDITION THE DATABASES

- A series of separate tools can be used to add geologic lines and points to the database

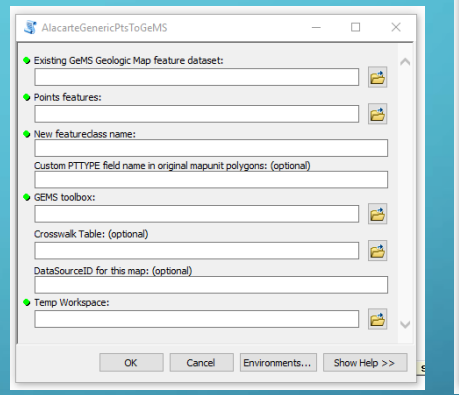
AlacartAddGeoLinesToGeMS



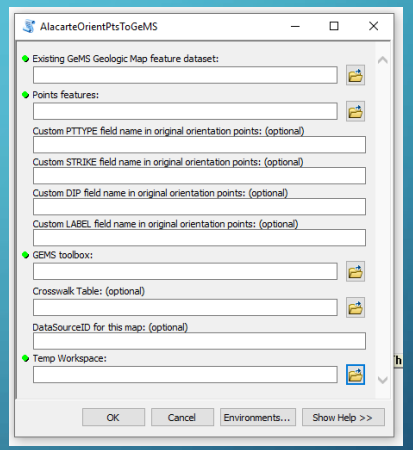
AlacartFoldAxesToGeMS



AlacartGenericPtsToGeMS



AlacartOrientPtsToGeMS

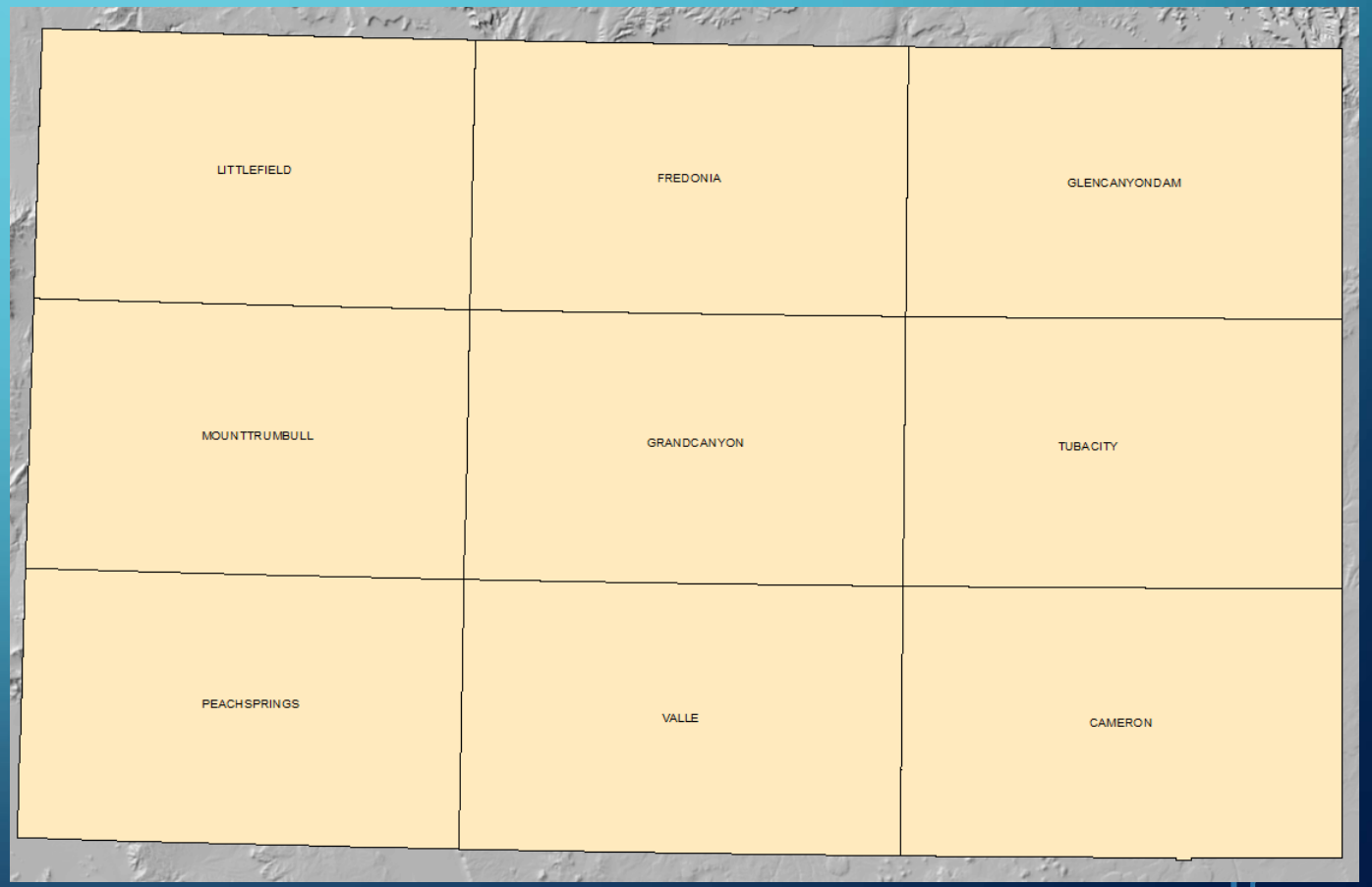


- These have been used along with other tools (both from the GeMS toolbox and other custom tools) to convert a legacy unpublished version of the Grand Canyon 30'x60' from ALACARTE to an entirely GeMS-compliant database (including non-spatial tables) in less than a day.

https://github.com/rcrow/MapExtractor_SchemaConverter

ESTABLISH WHAT MAPPING IS TO BE USED WHERE

- A Polygon Feature Class indicates:
  - Where the GeMS databases are and where they will be used
    - Can use parts of maps
  - What feature classes to include



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CREATE MAPUNIT CONVERSION TABLES FOR EACH MAP

- Lists original units and the new mapunits for the compilation

Original mapunit as published

Mapunit in the new compilation

Optional Notes Fields

	A	B	C	D	E	F
1	previous map unit	new map unit	mapunit description	notes		
44	Qsp	Qp	Pyroclastic deposits of Shadow Mountain (Pleistocene; Brunhes age)			
45	QTa	QTa	Older alluvial fan deposits (Pleistocene and Pliocene)			
46	QTab	QTab	Basalt and andesite flows (Pleistocene(?) or Pliocene; Matuyama)			
47	QTae	QTae	Old mixed alluvium and eolian deposits (Pleistocene and Pliocene(?))			
48	QTap	QTap	Basalt and andesite pyroclastic deposits (Pleistocene(?) or Pliocene; Matuyama)			
49	QTb	QTb	Basalt flows (Pleistocene(?) or Pliocene; Matuyama)			
50	QTd	Qd	Old dune deposits, undivided (Pleistocene and Pliocene(?))	Qd in Tuba City - QT or Q?		
51	QTes	Qes	Old eolian sand sheet and dune deposits (Pleistocene and Pliocene(?))	Qes in Tuba City - QT or Q?		
52	QTg4	QTg	Older terrace-gravel deposits (Pleistocene and Pliocene(?))			

- Similar table for lines

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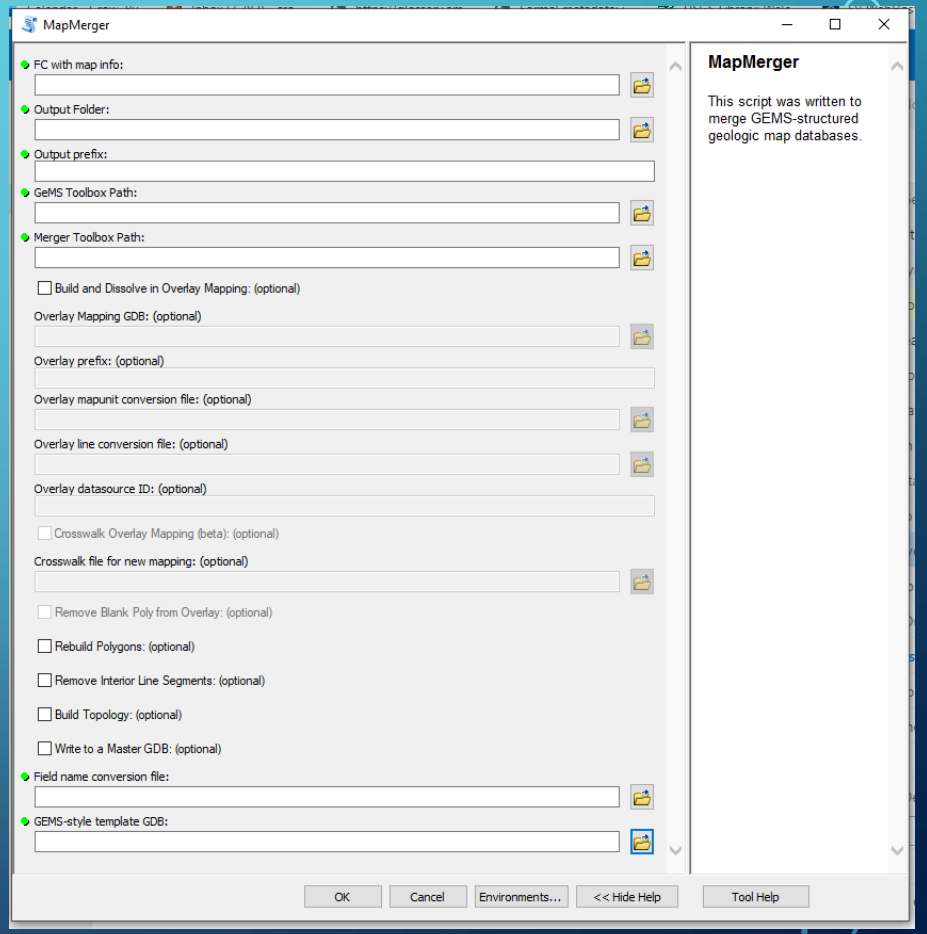
THE MAPMERGER SCRIPT

- Clips out each area of interest from each map database
- Updates the mapunit of the clipped map polygons using the conversion tables
  - Can do the same thing for lines (e.g. if different line types were used for the same feature)
- Different databases are combined, splitting all lines at intersections and removing pseudo nodes (if IsConcealed, LocationConfidenceMeters, ExistenceConfidence, IdentityConfidence, Symbol, Label, DataSourceID, and Notes are identical)

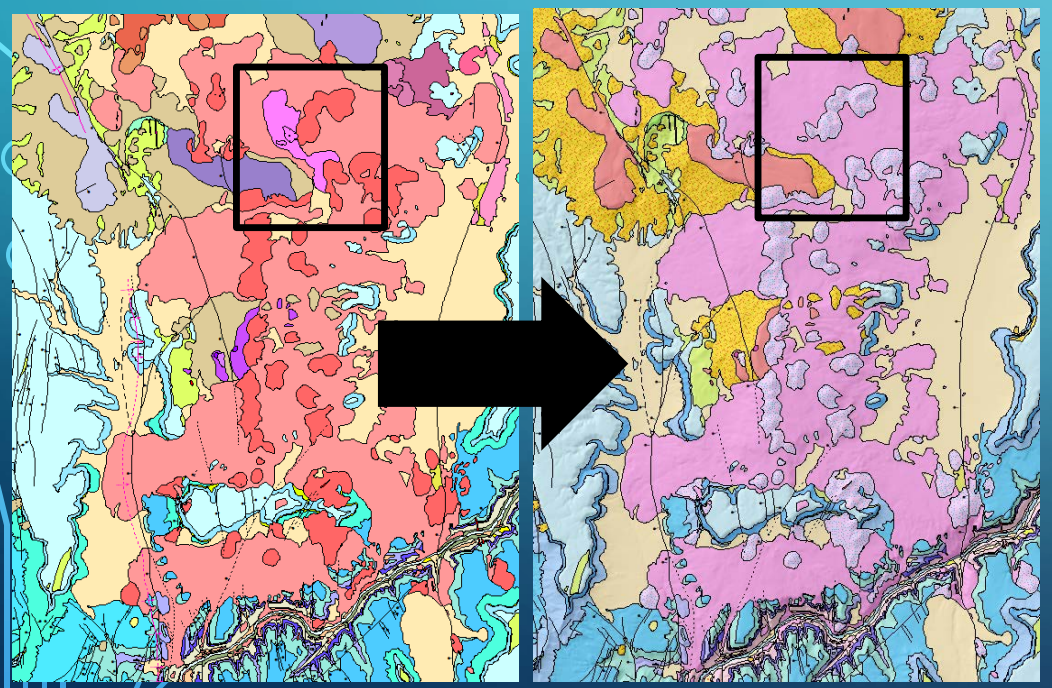


https://github.com/rcrow/MapMerger

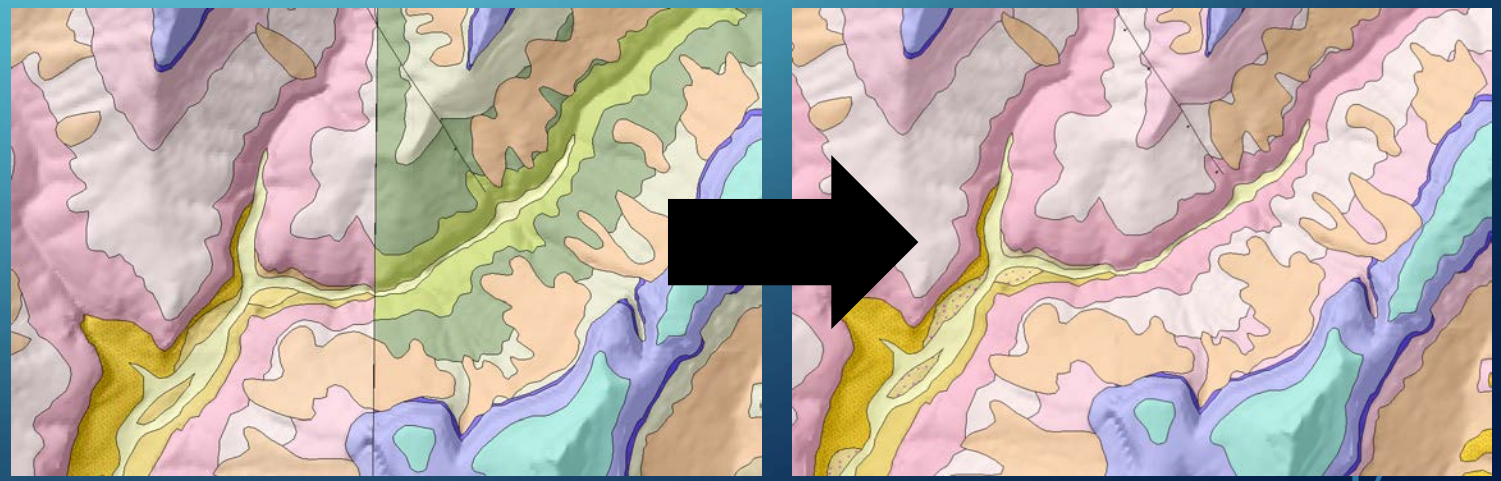
THE MAPMERGER SCRIPT

- Combine adjacent polygons with the same attribution
  - Remove unneeded contacts (but not faults)

Combine units/ Simplify

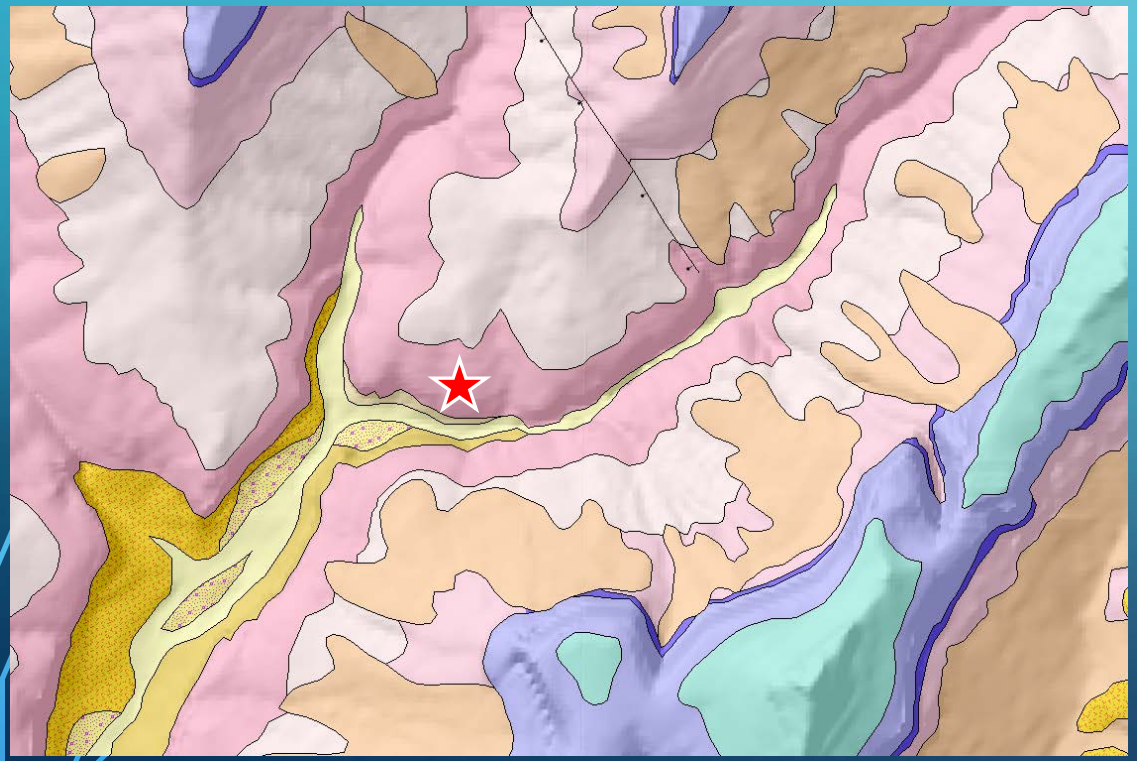


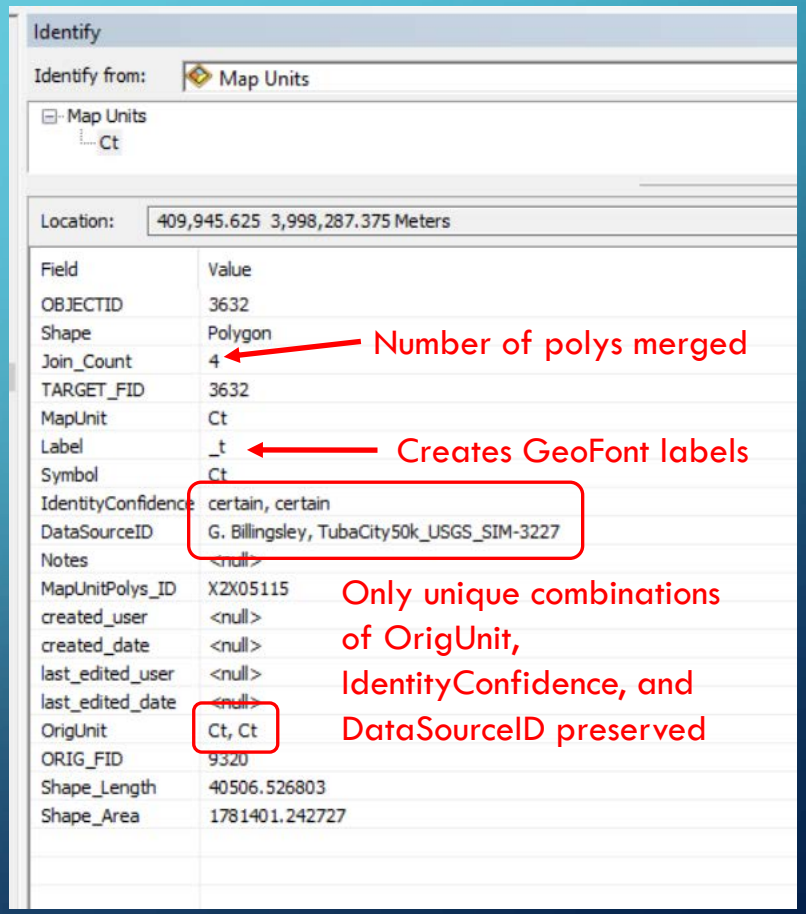
Remove Border “Faults” or Map Boundaries



THE MERGE SCRIPT

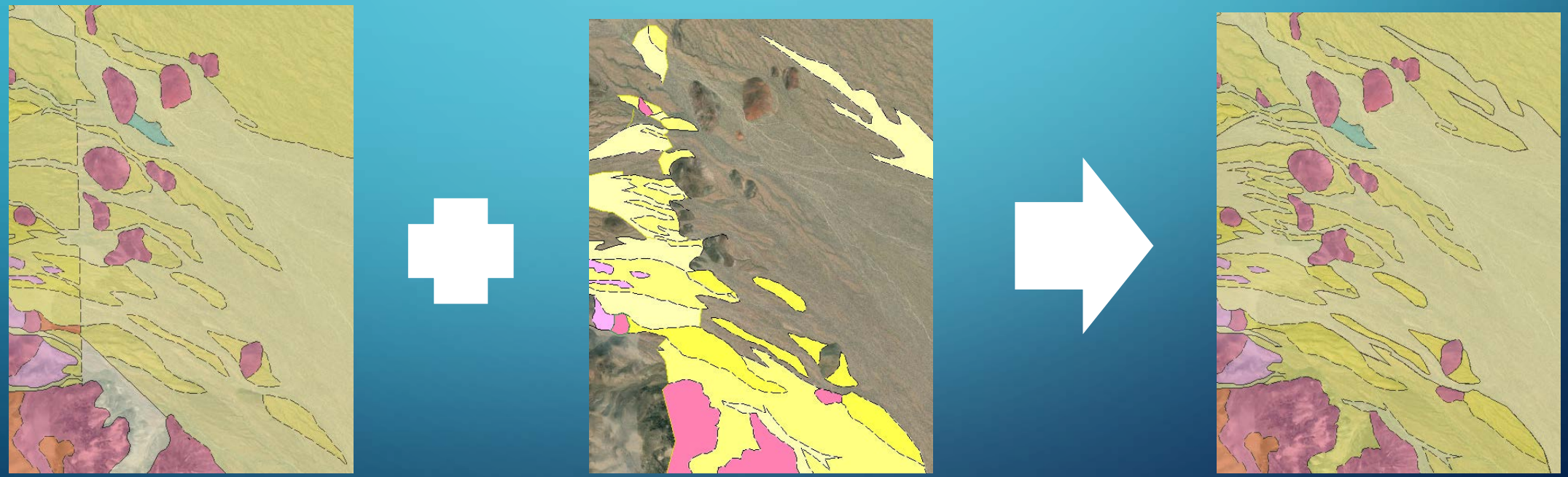
- Original Mapunit, Identity Confidence, and DataSourceIDs are preserved through concatenation





NEW MAPPING

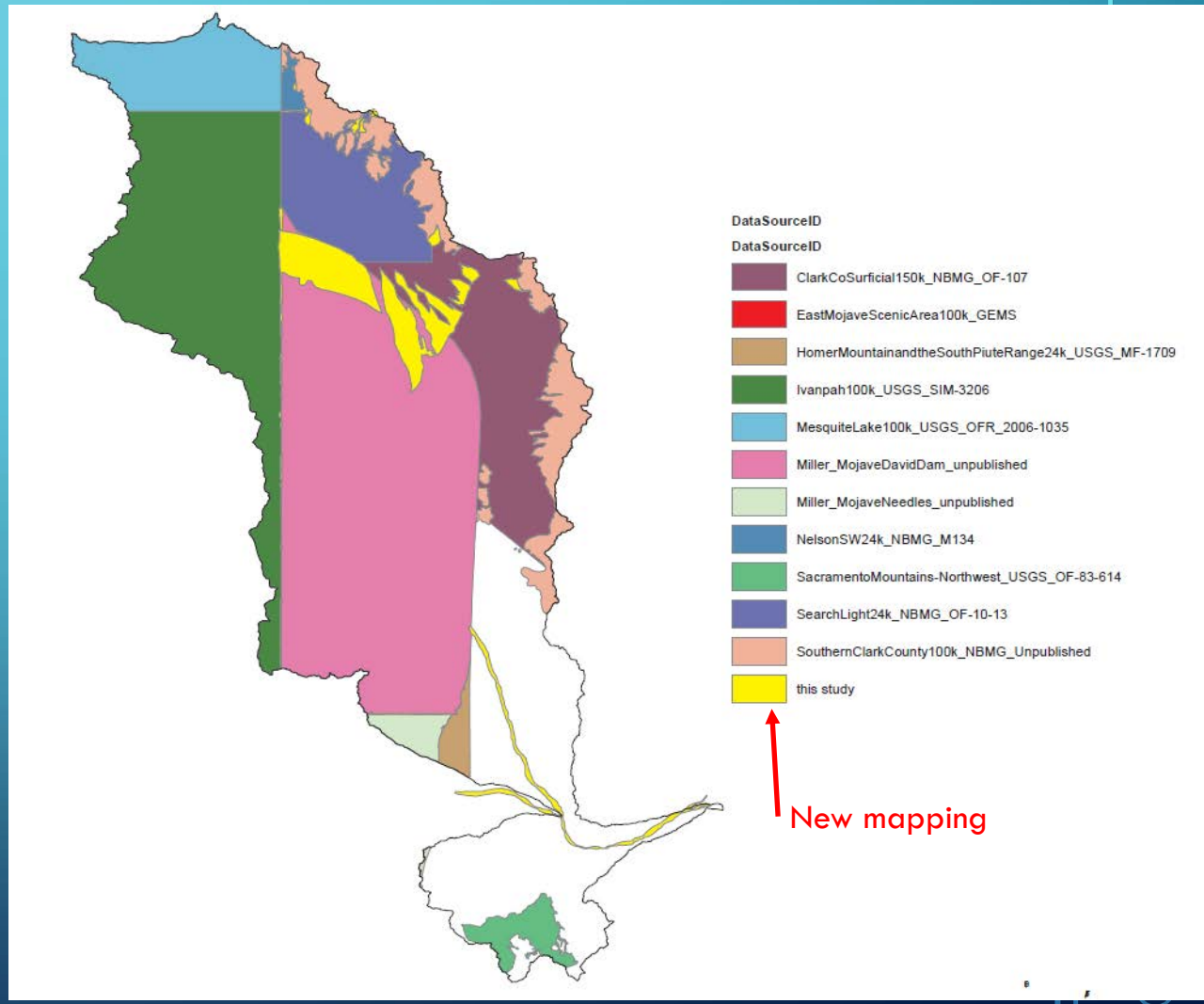
- A separate database contains new mapping and is merged in a similar fashion



NEW MAPPING

- The original source of previous mapping is easy to show
- The extent of new mapping is automatically updated based on the extent of that database

Piute Valley

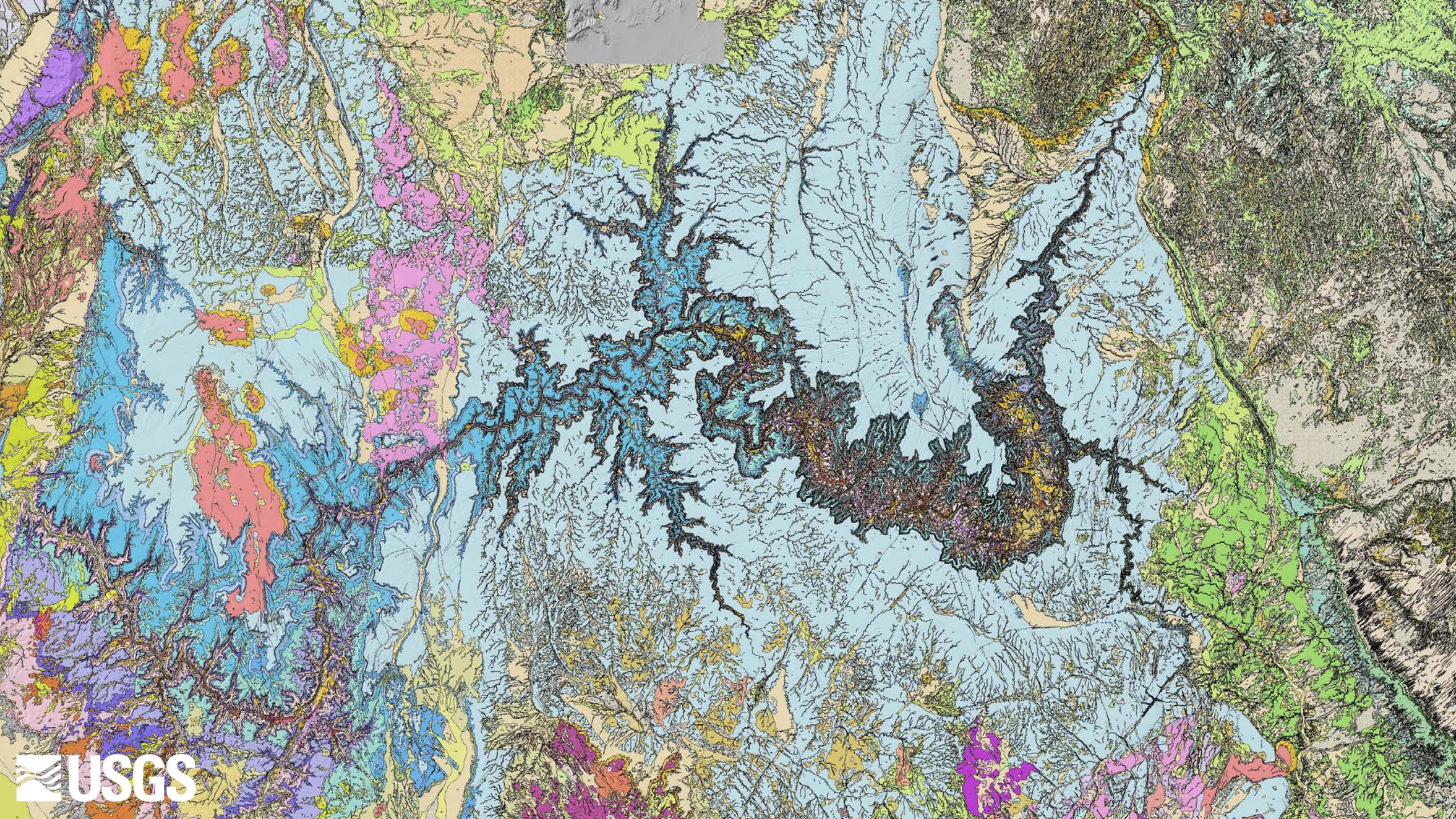


SUMMARY TABLE GENERATED AUTOMATICALLY

Mapunit in the new compilation

Original mapunit(s) in each input map

NewMapUnit	CAMERON	GLENCANYONDAM	GRANDCANYON	LITTLEFIELD
Cm	Cm		Cm	Cm
Dtb	Dtb		Dtb	Dtb
IPMs	IPMs	IPMs	IPMs	IPMs
Je	Je			
Jk	Jk	Jk, Jks		
Jkn	Jkn			
Jm	Jm	Jm		
Jn	Jn	Jn		JTRn
Kd	Kd	Kd		
Km	Km	Km		
Mr	Mr	Mr	Mr	Mr
Pc	Pc	Pc	Pc	
Pe	Pe	Pe	Pe	Pep
Ph	Ph	Ph	Ph	Ph
Pk	Pk, Pkf, Pkh	Pkh, Pkf	Pkh, Pkf	Pkh, Pkf
Qa	Qay	Qa1, Qa2, Qa3, Qa4	Qa1, Qa2, Qa3, Qa4	Qay, Qao
Qg	Qgy	Qg2, Qg1, Qg5-18, Qg3, Qg4	Qg1, Qg3, Qg2, Qg4	Qgy, Qgo
TRm	TRmss, TRmw, TRm, TRmhm	TRmu, TRmlm, TRms	TRm	TRmt, TRml, TRms, TRmm, TRmlt, TRmv, TRmu, TRsu, TRkm, TRmb
Qd	Qd, QTd, Qec	Qd, Qdp, Qdb, Qdlu, Qdl, Qdm	Qd	Qd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ADVANTAGES:

- You can rebuild the compilation, essentially from scratch, at any time
  - e.g. could use in-progress mapping and finalize it later
- Automatically builds a topologically clean database with no intersection "errors" or pseudo nodes
  - Gaps are identified within auto generate topology
- Keeps track of where new and existing mapping was used
- Allows for multiple and iterative visualizations of how map units relate to each other and how map units can be combined to simplify mapping
- Encourages (and facilitates) the update of databases to GeMS format by providing additional functionality

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LIMITATIONS/ISSUES:

- Still an experimental tool – not fully tested
- Some bugs mostly but incompletely resolved
  - Weird square polygons created sometimes, but can be remove automatically
  - Sliver polygons must be ignored (the script arbitrarily ignores polygons with an area smaller than 10 m^2)
- Concatenation of original mapunits and data sources a departure from strict GeMS
- The Grand Canyon merged map contains 500,000 features takes 2 hours to run
  - The result is hard to use (very slow in ArcMap, Pro, and AGOL)
- Can be modified to work with any feature classes, but initially designed around just Mapunit Polygons, Contacts and Faults and Orientation Points
- Welcome help optimizing, adding features, converting to Pro, and further documenting the script

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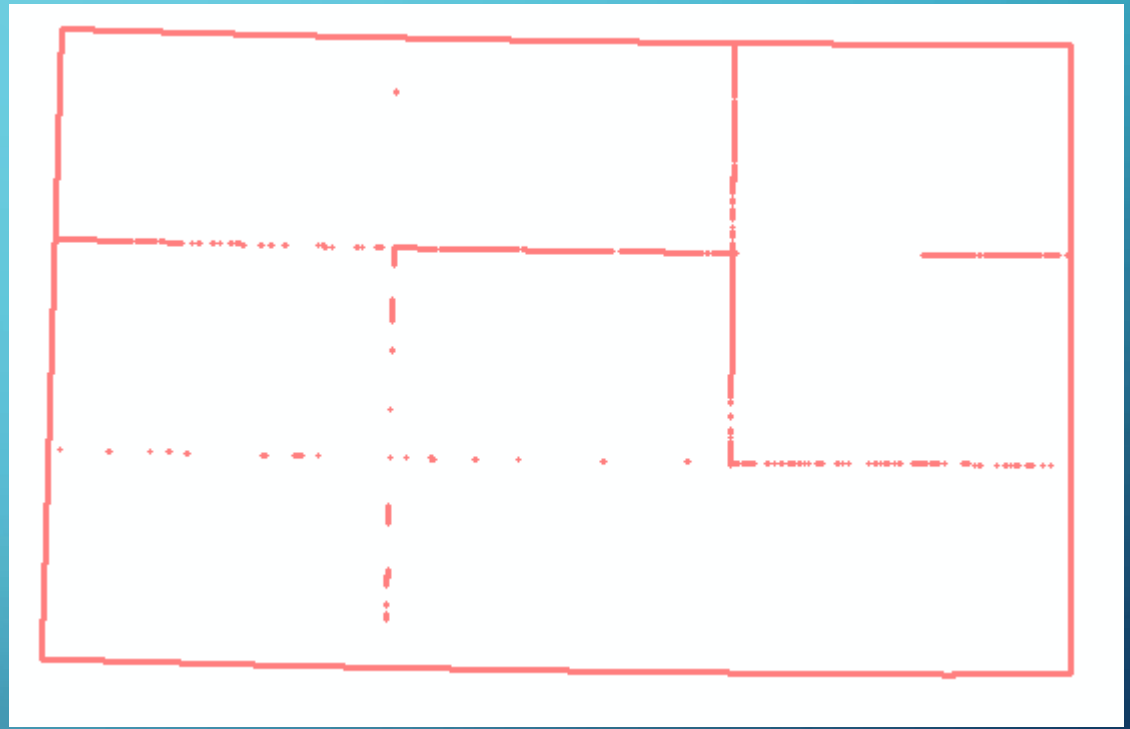
RECOMMENDATION:

- Map 100 m past quad boundaries
  - Tiny silvers between maps are time consuming to fill
  - There were almost a thousand of these for the Grand Canyon maps
  - Most are only a few centimeters wide at the most



Gaps in the Grand Canyon Compilation in red
(from automatically generated topology)

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THIS AND MORE @ GITHUB.COM/RCROW

- Have also upload code to:
  - Extract stand-alone GEMS databases from parts of larger SDE databases
  - Build GEMS non-spatial tables from project-maintained master tables
  - Convert NBMG and ALACARTE databases to “barebones” GEMS
  - Manage complex surficial mapunits in a GEMS structure
  - Backup an SDE database
  - Maintain and update attribute domains across many databases
  - Identify label point issues when using MapUnitPoints
  - Project geologic data onto river profiles
  - etc.
- And lots more not yet ready for github (mainly because it’s hardcoded for project use)
  - Error finding / tracking
  - Well log visualization
  - FGDC Metadata creation
  - etc.

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