DIGITAL MAPPING TECHNIQUES 2016

The following was presented at DMT'16
(May 22-25, 2016 - Florida Geological Survey,
Tallahassee, FL)

The contents of this document are provisional

See Presentations and Proceedings
from the DMT Meetings (1997-2016)

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

Montana's 1:100K Seamless Geodatabase: Progress and Challenges

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In December 2015, the Montana Bureau of Mines and Geology (MBMG) released its 1:100,000-scale NCGMP09-based geodatabase that seamlessly combines 79 existing (legacy) 1:100,000-scale geologic maps, 5 of which were originally published by the USGS. The geodatabase currently covers approximately 80 percent of Montana (fig. 1). but will eventually include the entire state as additional 1:100,000 geologic maps are completed. The MBMG began creating the geodatabase in 2012 in response to our geologic map users who were requesting a statewide, seamless digital geologic map.

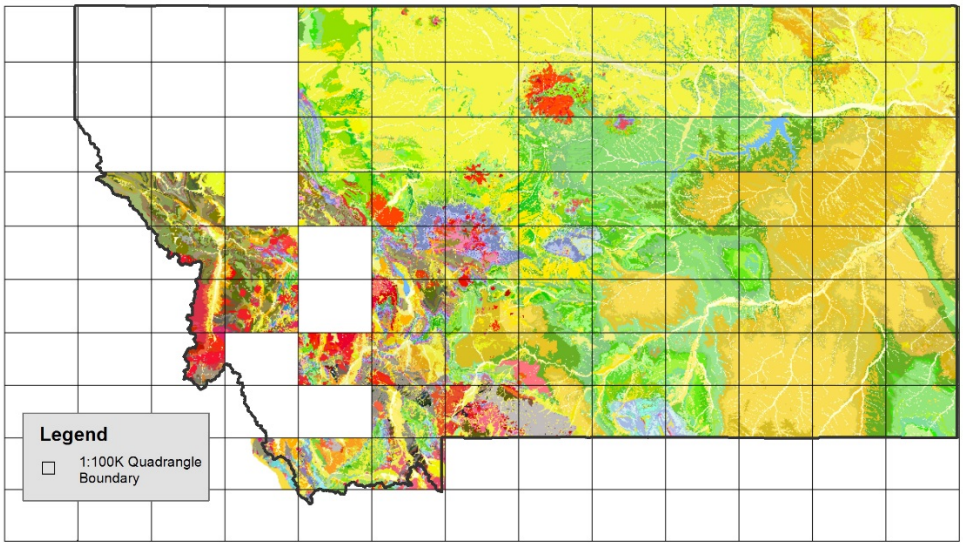
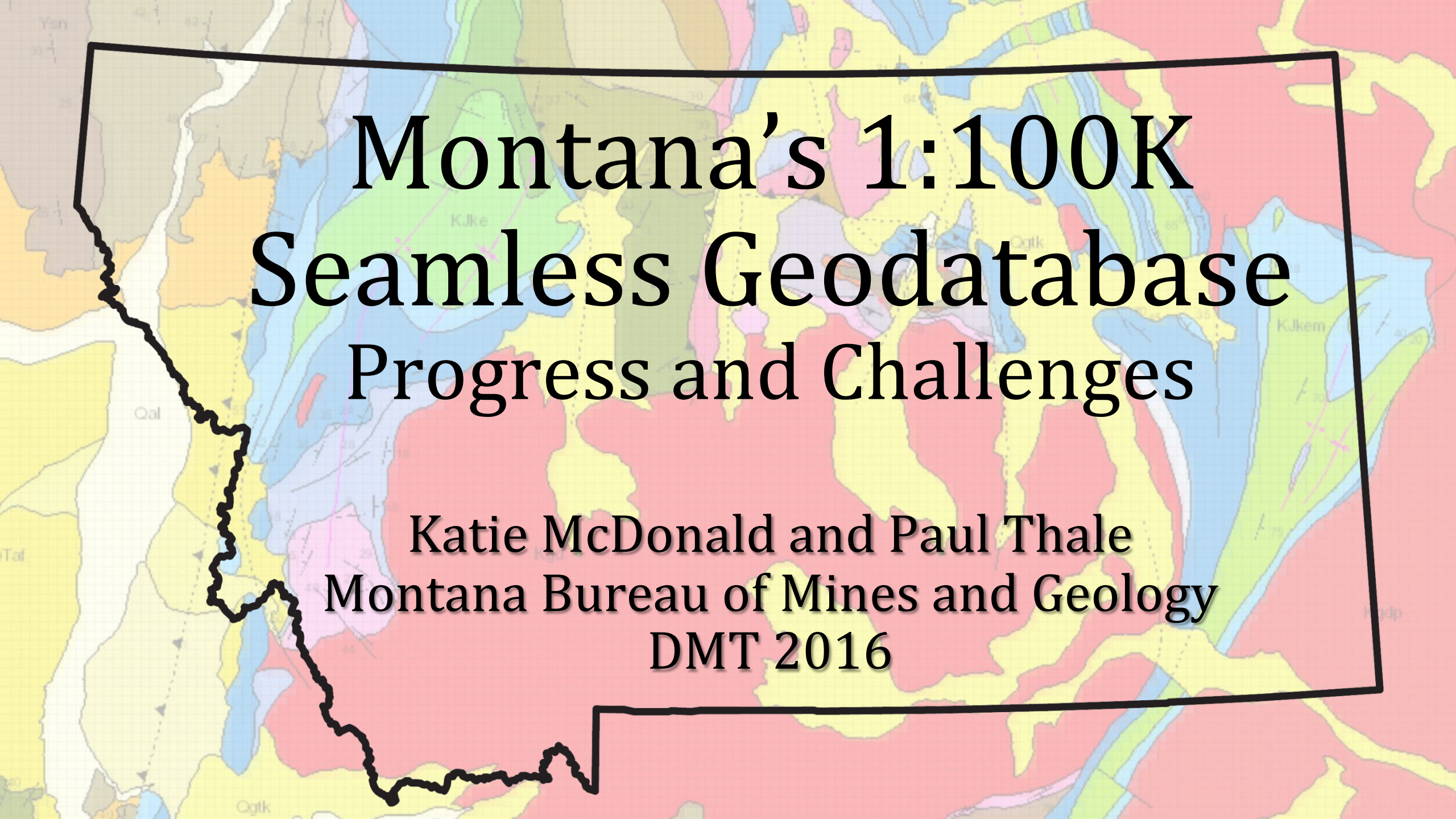


Figure 1. Current extent (May 2016) of Montana's seamless 1:100,000-scale geologic map geodatabase. The geodatabase is available as an ArcGIS map service (www.mbmg.mtech.edu/gis-ArcGISservices.asp) or as an ArcGIS map package (ftp://sun2.mtech.edu/pub/geology/Seamless_geology_100k.mpk).

The seamless geodatabase was created by migrating existing ArcInfo coverages of our legacy geologic maps into the NCGMP09 template. Some major challenges that the MBMG faced while creating the geodatabase included edgematching across map boundaries and distilling a consistent set of codes for the 839 geologic formations in the geodatabase. The feature classes currently available include ContactsAnd Faults, MapUnitPolys, OtherLines (folds axes, dikes, etc), OrientationDataPoints, GlacialAndSurficialLines, and CartographicLines (cross-section lines from original maps). On-going work includes completing the attribute tables, the NCGMP09 DataSourcePolys feature class, the required look-up tables (DataSources, DescriptionOfMapUnits, and Glossary) and general editing of the geologic data.

The seamless geodatabase is available as an ArcGIS map service (www.mbmg.mtech.edu/gis-ArcGISservices.asp) or as an ArcGIS map package (ftp://sun2.mtech.edu/pub/geology/Seamless_geology_100k.mpk). The MBMG also created a geodatabase of its legacy maps to preserve the original geologic data. The legacy data are available in the same web locations as the seamless data. In the future, all map updates and corrections will be to the seamless geodatabase.



Montana's 1:100K Seamless Geodatabase

Progress and Challenges

Katie McDonald and Paul Thale
Montana Bureau of Mines and Geology
DMT 2016

OUTLINE

- Seamless geodatabase progress
  - "Completed" components
  - Challenges converting to NCGMP09
  - In-progress components
- Accessing the data
- Is seamless data getting used?
- Future work
  - Updates/Revisions

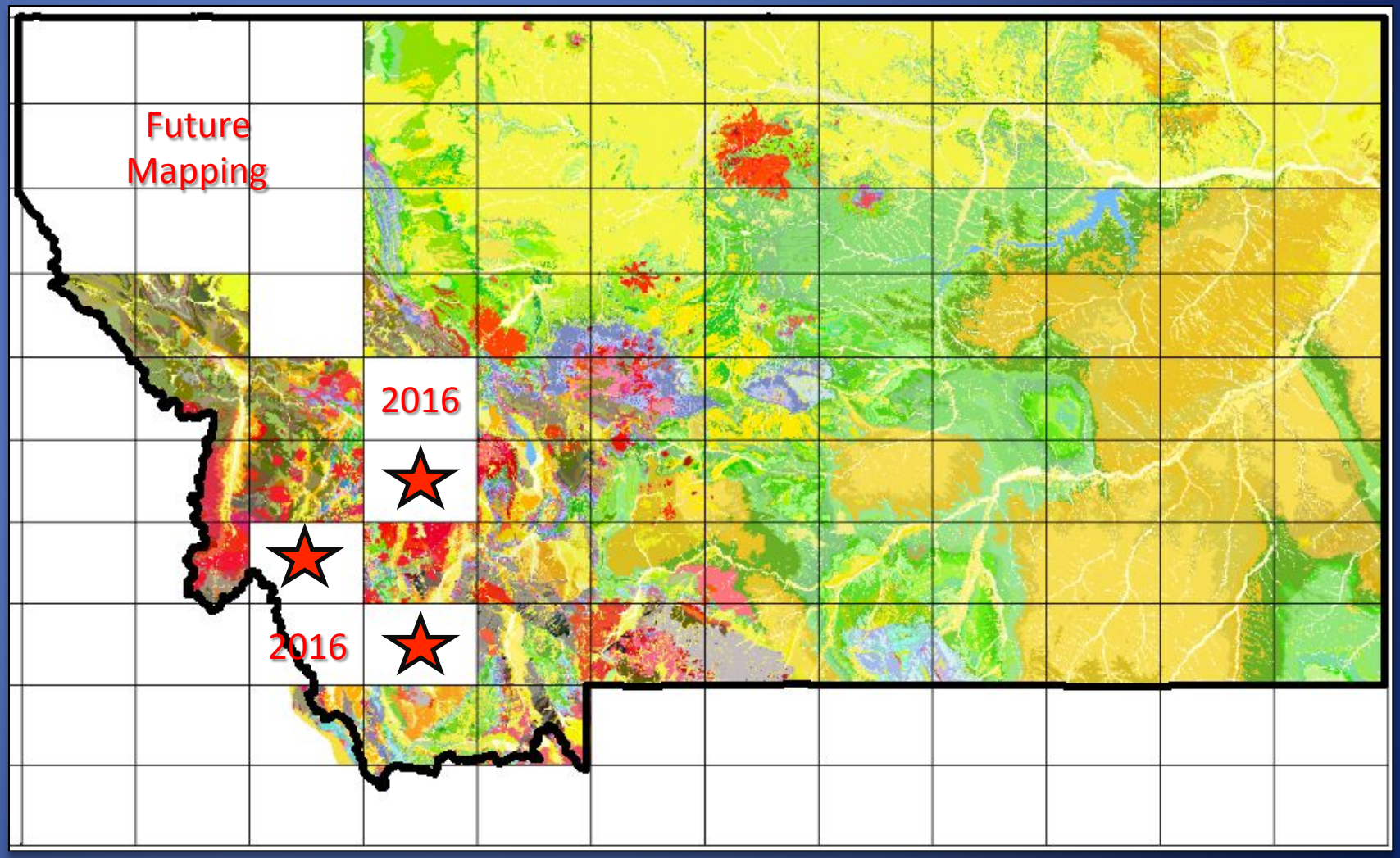
Why

- Regional geologic and hydrologic investigations, seamless geologic data needed
- Long-term goal of STATEMAP advisory committee – entire state at 1:100K

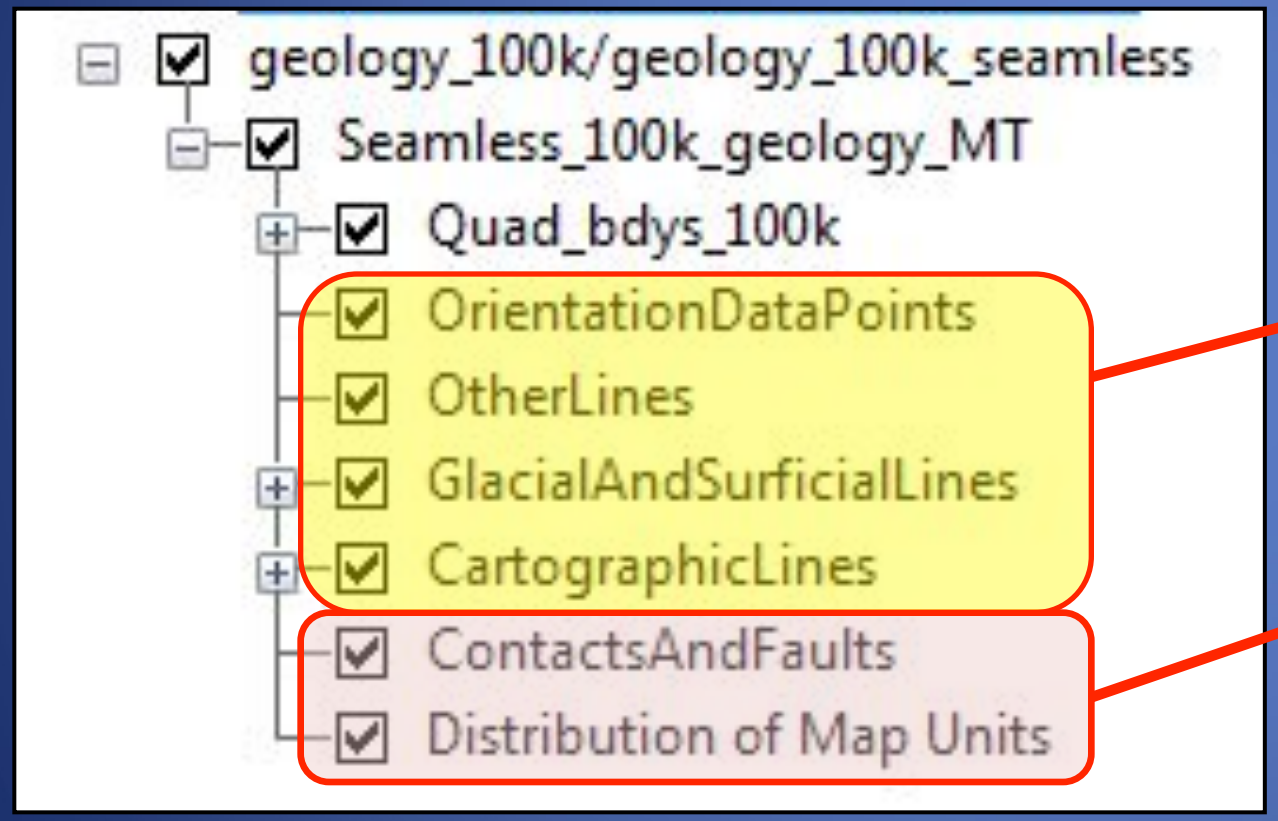
1:100K SEAMLESS GEODATABASE

Status

- Released Dec 2015 (ArcGIS map service)
- NCGMP09 Template
- 79 maps (5 USGS)
- 15 quads to add/map
  - 2 by Fall 2016
  - 3 in progress (★)
  - NW in ~2020



CURRENT COMPONENTS

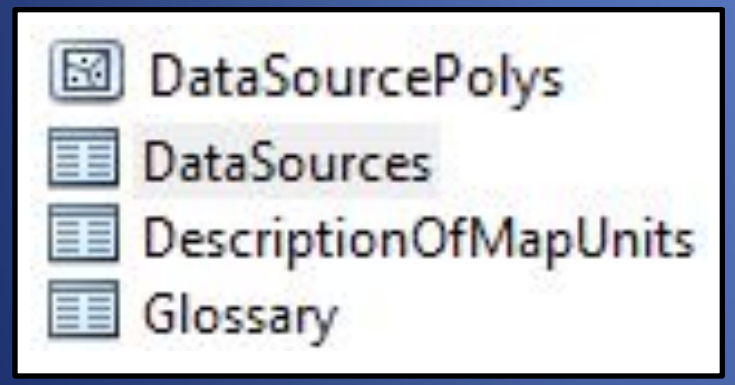


NCGMP09 “as needed” feature class

NCGMP09 “required” feature class

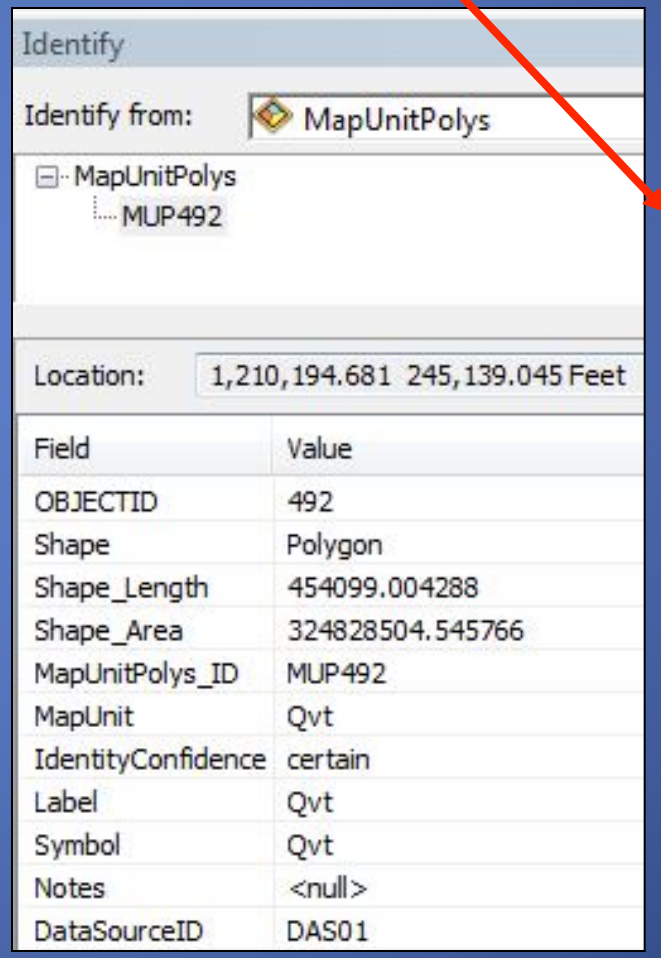
IN-PROGRESS COMPONENTS

NCGMP09 “required” feature classes/tables

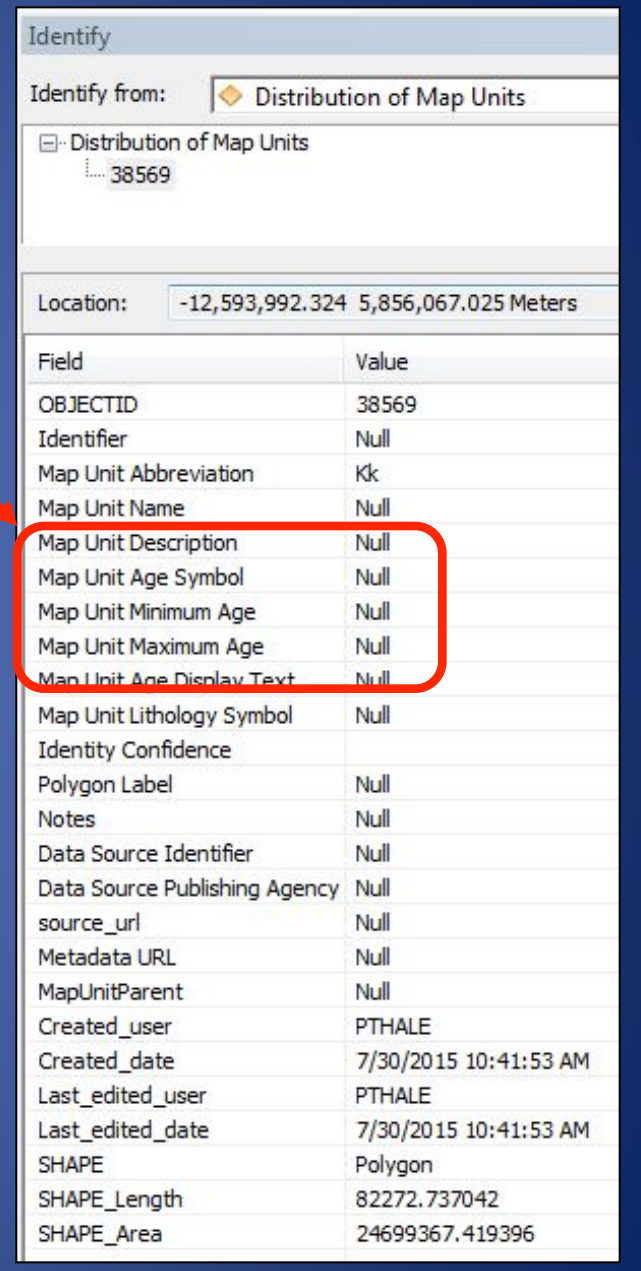


Attribute Tables

- Complete
- Revise??



(from USGS Suquamish quad, WA)



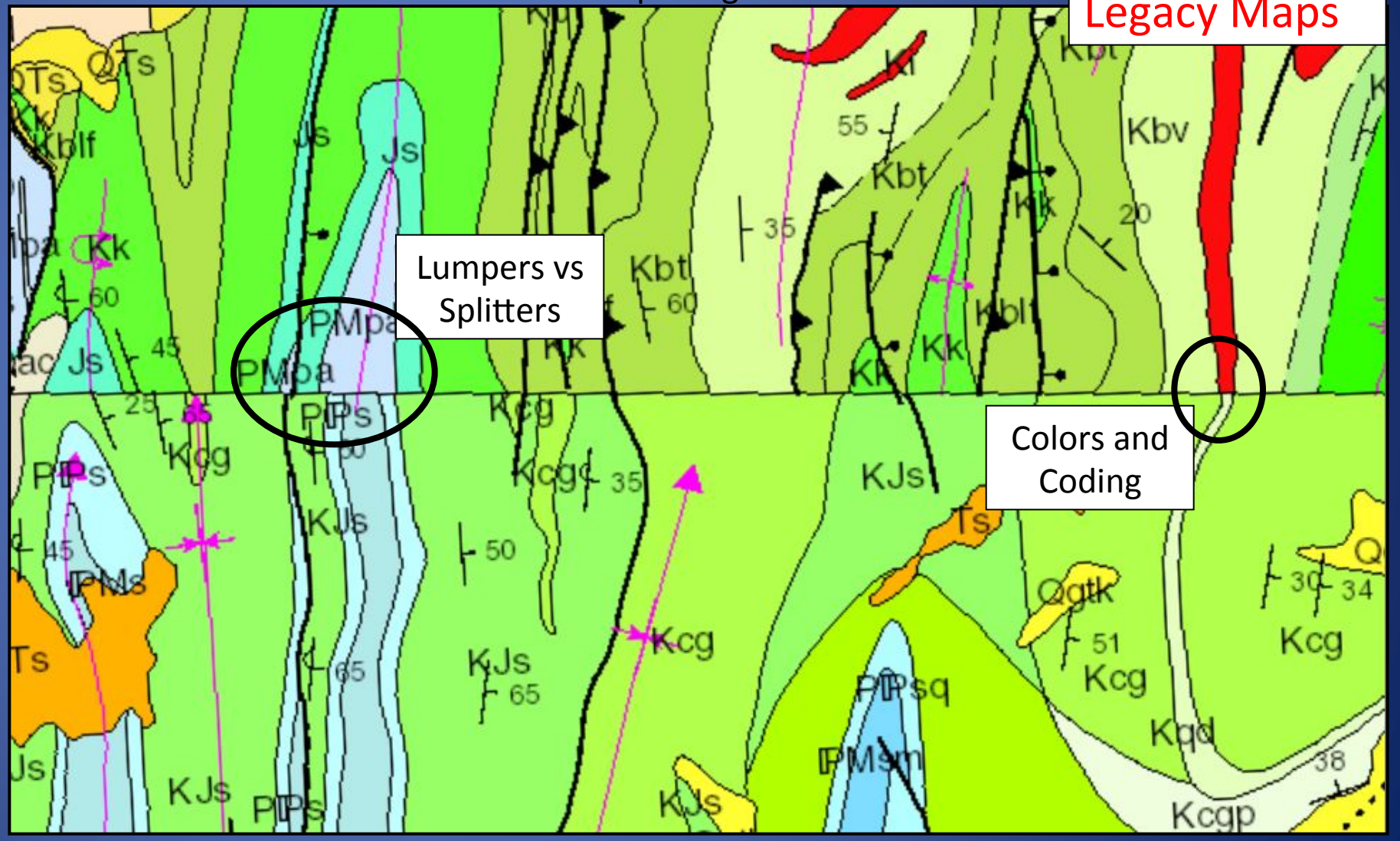
(from MBMG seamless geodatbase)

Challenges - Contacts, Faults, Polygons

- ArcInfo Coverages to ArcMap feature classes
- Edgematching
- Colors
- Codes

~ 3 years
GIS & Geologist

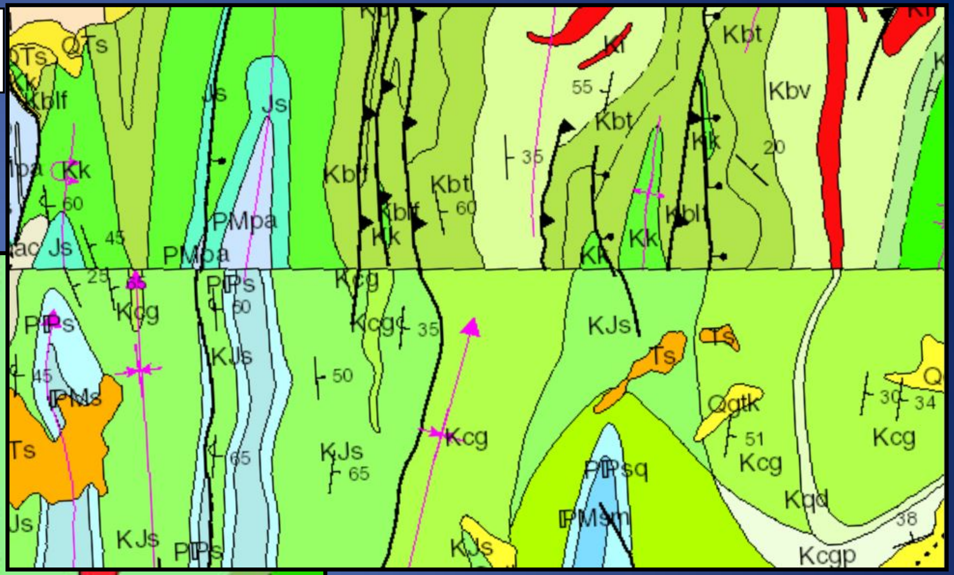
Philipsburg 1:100K



Missoula East 1:100K

Better!

Legacy Maps



Missoula East

Philipsburg

Seamless Map

MapUnitPolys

- 839 Map Units
  - Quaternary alluvium (Qal) to Archean ultramafic rocks
- 114,840 Polygons
  - 8,327 Qal – most common
- 15 more maps to add!

Bitterroot River

Description of Map Units (DMU) Table

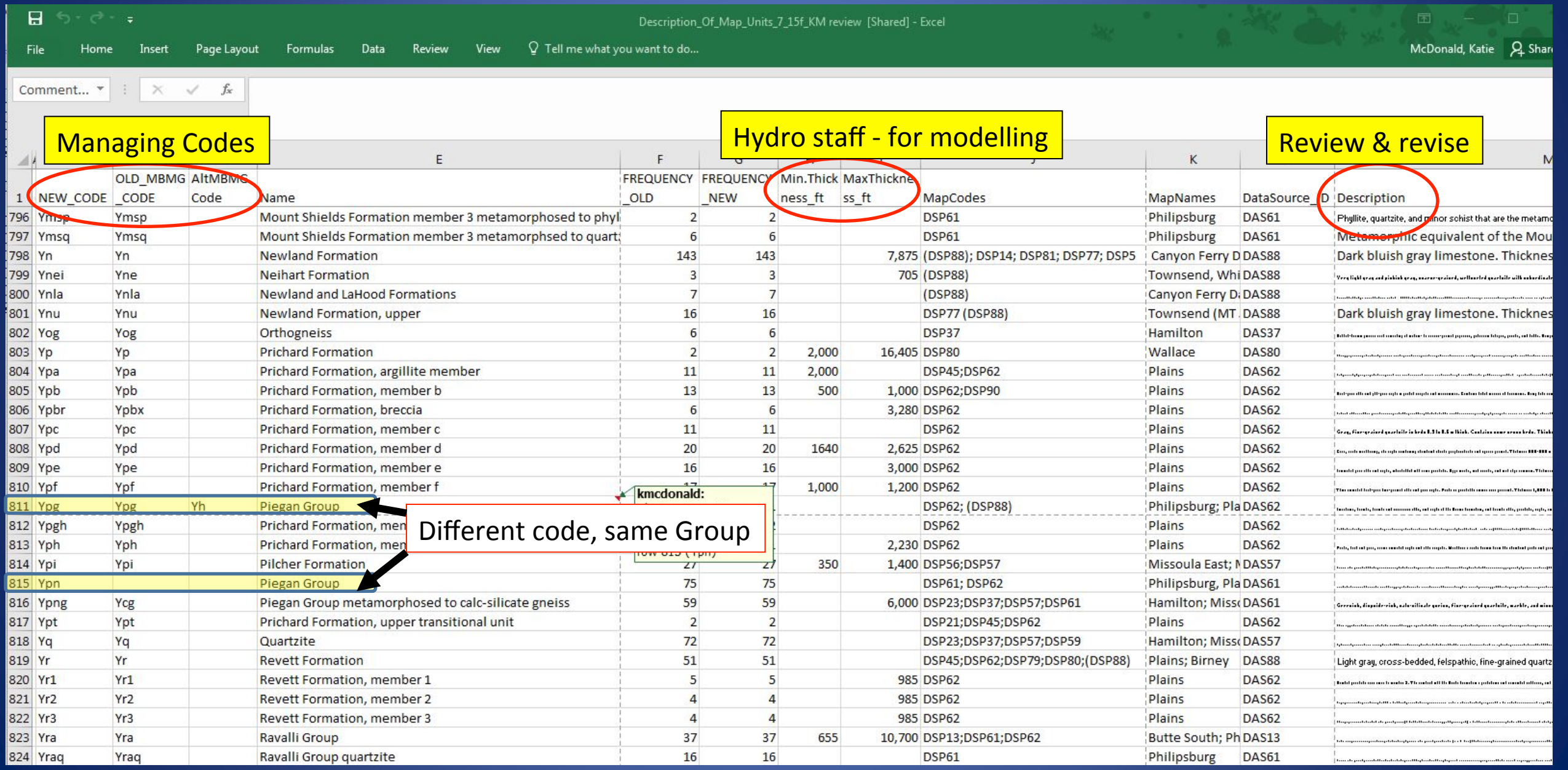
NCGMP09 Fields

- Map Unit
- Label
- Name
- Full Name
- Age
- Description
- General Lithology
- General Lithology Confidence

MBMG additional fields (???)

- Name
  - Supergroup, Group, Formation, Member
- Age
  - Era, Eon, Period, Epoch
- Rock Class
  - Sedimentary, Igneous, Metamorphic …
- Thickness
  - Minimum, Maximum
- Map
  - Map(s) where unit occurs

MBMG "DMU" table (in-progress)



	NEW_CODE	OLD_MBMG_CODE	AltMBMG Code	Name	FREQUENCY_OLD	FREQUENCY_NEW	Min.Thickness_ft	MaxThickness_ft	MapCodes	MapNames	DataSource_ID	Description
796	Ymsp	Ymsp		Mount Shields Formation member 3 metamorphosed to phyl	2	2			DSP61	Philipsburg	DAS61	Phyllite, quartzite, and minor schist that are the metamo
797	Ymsq	Ymsq		Mount Shields Formation member 3 metamorphsed to quart	6	6			DSP61	Philipsburg	DAS61	Metamorphic equivalent of the Mou
798	Yn	Yn		Newland Formation	143	143		7,875	(DSP88); DSP14; DSP81; DSP77; DSP5	Canyon Ferry D	DAS88	Dark bluish gray limestone. Thicknes
799	Ynei	Yne		Neihart Formation	3	3		705	(DSP88)	Townsend, Whi	DAS88	
800	Ynla	Ynla		Newland and LaHood Formations	7	7			(DSP88)	Canyon Ferry D	DAS88	
801	Ynu	Ynu		Newland Formation, upper	16	16			DSP77 (DSP88)	Townsend (MT	DAS88	Dark bluish gray limestone. Thicknes
802	Yog	Yog		Orthogneiss	6	6			DSP37	Hamilton	DAS37	
803	Yp	Yp		Prichard Formation	2	2	2,000	16,405	DSP80	Wallace	DAS80	
804	Ypa	Ypa		Prichard Formation, argillite member	11	11	2,000		DSP45;DSP62	Plains	DAS62	
805	Ypb	Ypb		Prichard Formation, member b	13	13	500	1,000	DSP62;DSP90	Plains	DAS62	
806	Ypbr	Ypbx		Prichard Formation, breccia	6	6		3,280	DSP62	Plains	DAS62	
807	Ypc	Ypc		Prichard Formation, member c	11	11			DSP62	Plains	DAS62	
808	Ypd	Ypd		Prichard Formation, member d	20	20	1640	2,625	DSP62	Plains	DAS62	
809	Ype	Ype		Prichard Formation, member e	16	16		3,000	DSP62	Plains	DAS62	
810	Ypf	Ypf		Prichard Formation, member f			1,000	1,200	DSP62	Plains	DAS62	
811	Ypg	Ypg	Yh	Piegan Group					DSP62; (DSP88)	Philipsburg; Pla	DAS62	
812	Ypgh	Ypgh		Prichard Formation, mem					DSP62	Plains	DAS62	
813	Yph	Yph		Prichard Formation, mem				2,230	DSP62	Plains	DAS62	
814	Ypi	Ypi		Pilcher Formation	27	27	350	1,400	DSP56;DSP57	Missoula East; M	DAS57	
815	Ypn			Piegan Group	75	75			DSP61; DSP62	Philipsburg, Pla	DAS61	
816	Ypng	Ycg		Piegan Group metamorphosed to calc-silicate gneiss	59	59		6,000	DSP23;DSP37;DSP57;DSP61	Hamilton; Miss	DAS61	
817	Ypt	Ypt		Prichard Formation, upper transitional unit	2	2			DSP21;DSP45;DSP62	Plains	DAS62	
818	Yq	Yq		Quartzite	72	72			DSP23;DSP37;DSP57;DSP59	Hamilton; Miss	DAS57	
819	Yr	Yr		Revett Formation	51	51			DSP45;DSP62;DSP79;DSP80;(DSP88)	Plains; Birney	DAS88	Light gray, cross-bedded, felspathic, fine-grained quartz
820	Yr1	Yr1		Revett Formation, member 1	5	5		985	DSP62	Plains	DAS62	
821	Yr2	Yr2		Revett Formation, member 2	4	4		985	DSP62	Plains	DAS62	
822	Yr3	Yr3		Revett Formation, member 3	4	4		985	DSP62	Plains	DAS62	
823	Yra	Yra		Ravalli Group	37	37	655	10,700	DSP13;DSP61;DSP62	Butte South; Ph	DAS13	
824	Yraq	Yraq		Ravalli Group quartzite	16	16			DSP61	Philipsburg	DAS61	

Unit Descriptions

- Cut and paste from existing maps
- How much detail???
- Hyperlink to original map??

Tan: Andesite

Andesite sills that pre-date folding in the Tobacco Root Mountains.

Tre: Renova Formation

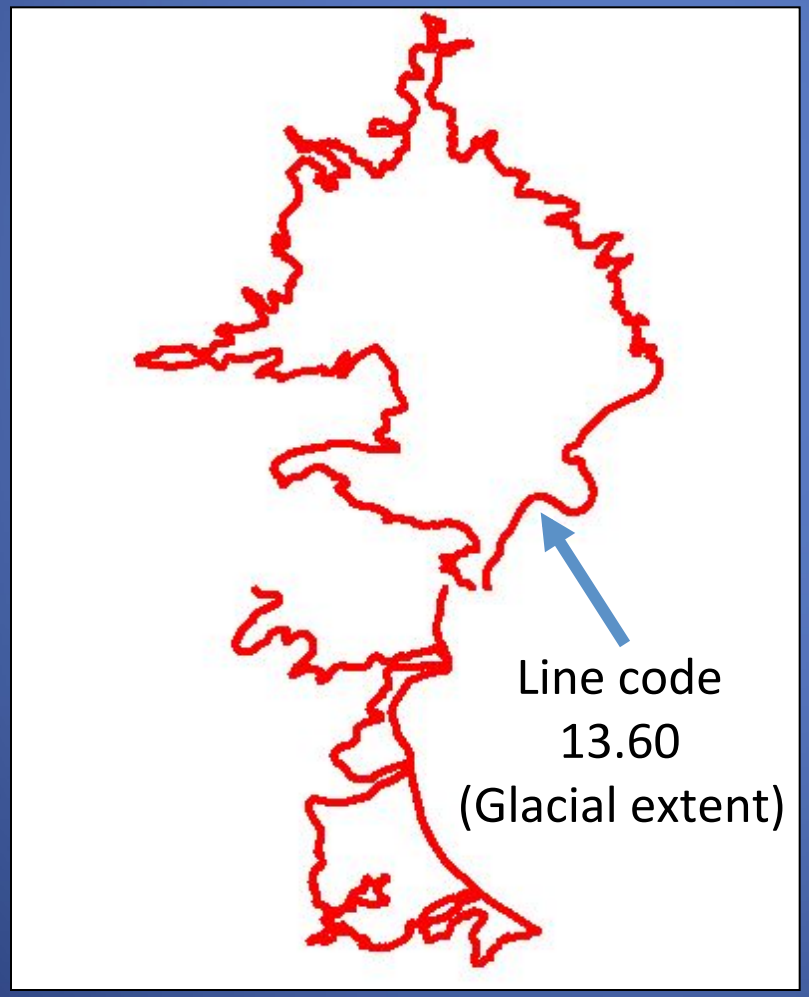
Melrose area: Light orangish pink and very light gray, tuffaceous, sandy siltstone, and fine-grained sandstone, tuff, and bentonitic mudstone, with sparse lenses of coarser clasts, primarily volcanic that range from granules to small cobbles. Contains Chadronian (Eocene) vertebrate fossils in the Trapper Creek area (Tabrum and Nichols, 2001) and unidentifiable fossil bone fragments to the south. Thickness about 150 m (500 ft; Richards and Pardee, 1925). Sassman Gulch area: (Tysdal and others, 1994) Light gray to pale yellowish brown and grayish orange-pink sandstone, siltstone, and local claystone. Sandstone, fine- to coarse-grained, calcareous in some areas, and locally contains boulders as large as 25 cm (10 in) in diameter. Rochester area: Light yellowish to medium brown, slightly bentonitic mudstone with flecks of organic matter.

Reviewing and Editing

- Same data in different feature classes
- Coding mistakes – correct code is 13.60

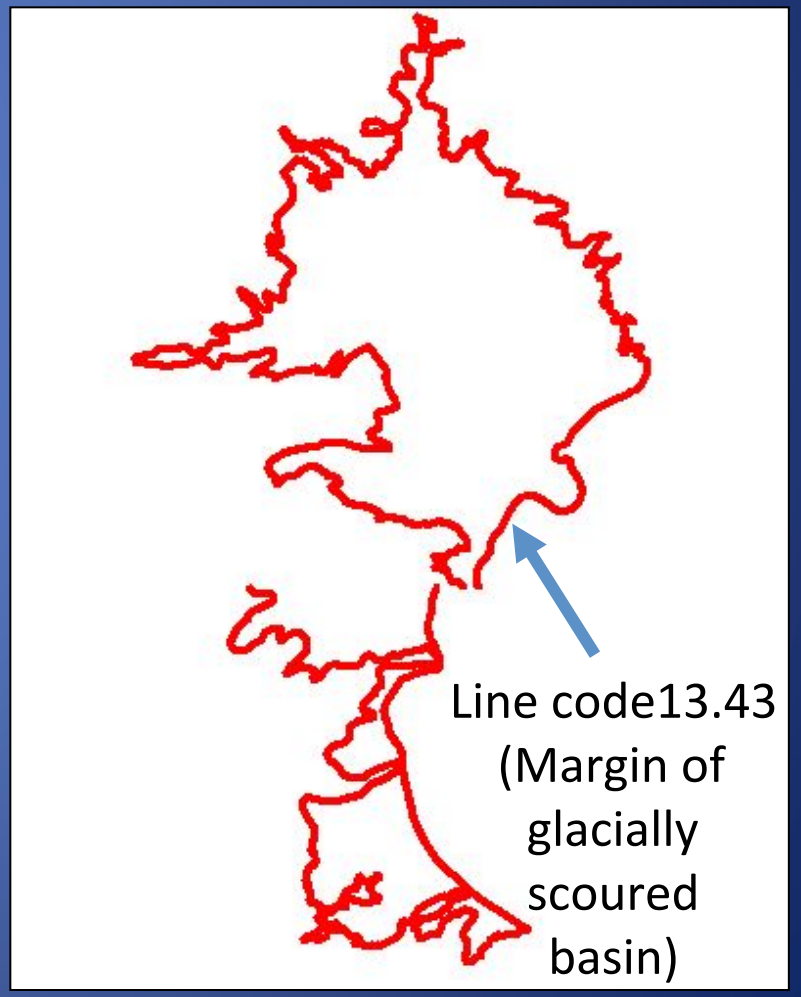
OtherLines

Dikes, lineaments, folds, veins, unconformity, terrace, silcrete, scarp, glacial extent, glacial channel, glacial lake margin



GlacialAnd SurficialLines

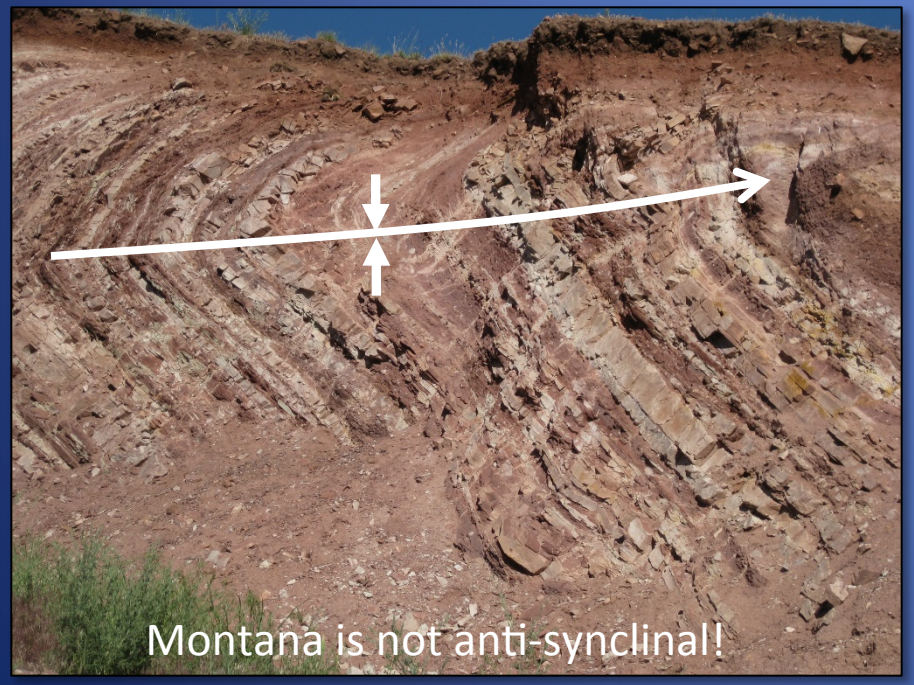
Glacial extent, glacial channel, glacial lake margin

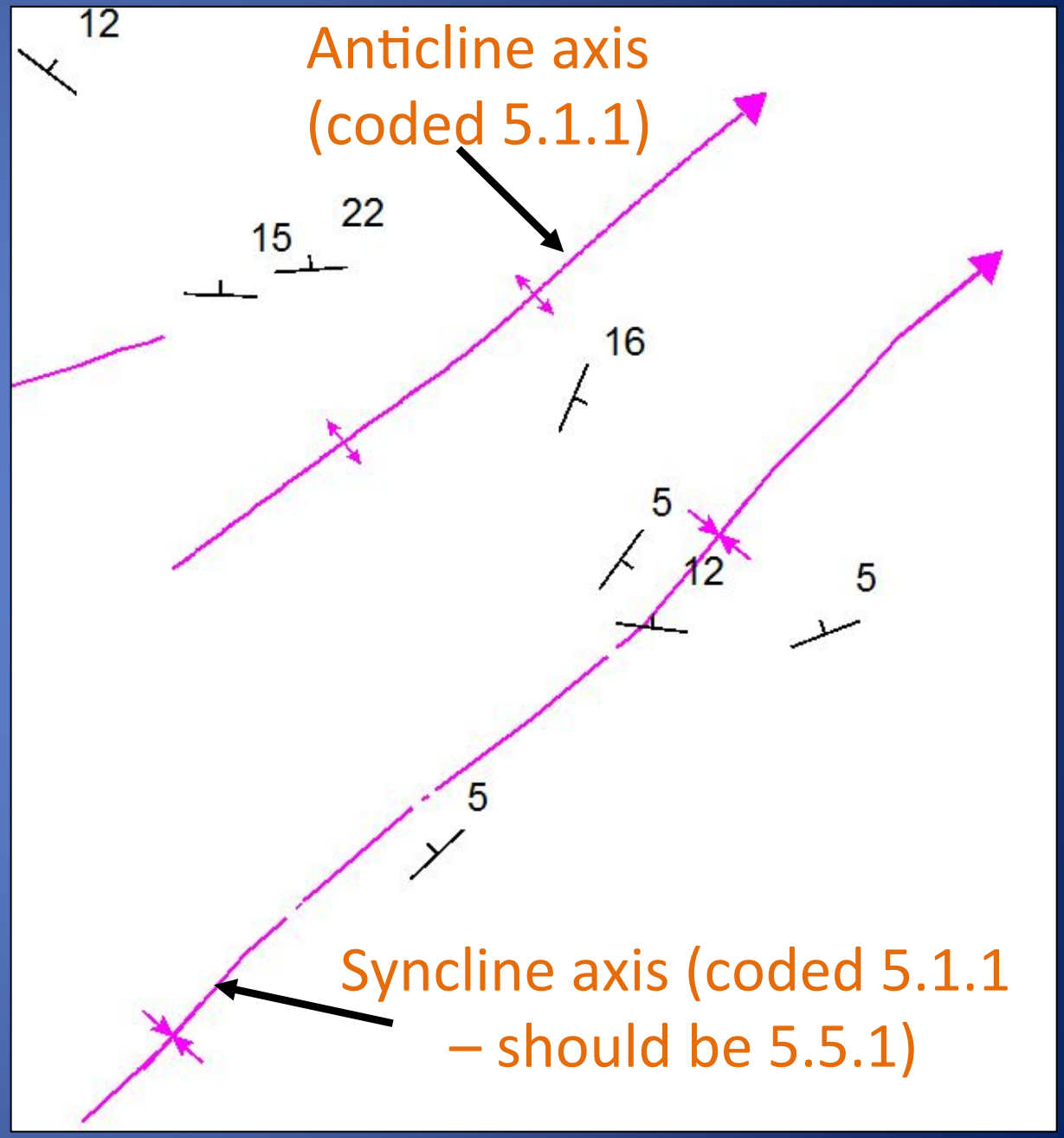


OtherLines – more edits

Folds

- All fold axes currently coded 5.1.1 (anticline)
- Decorations (points) – correct symbols
- Will correct line codes



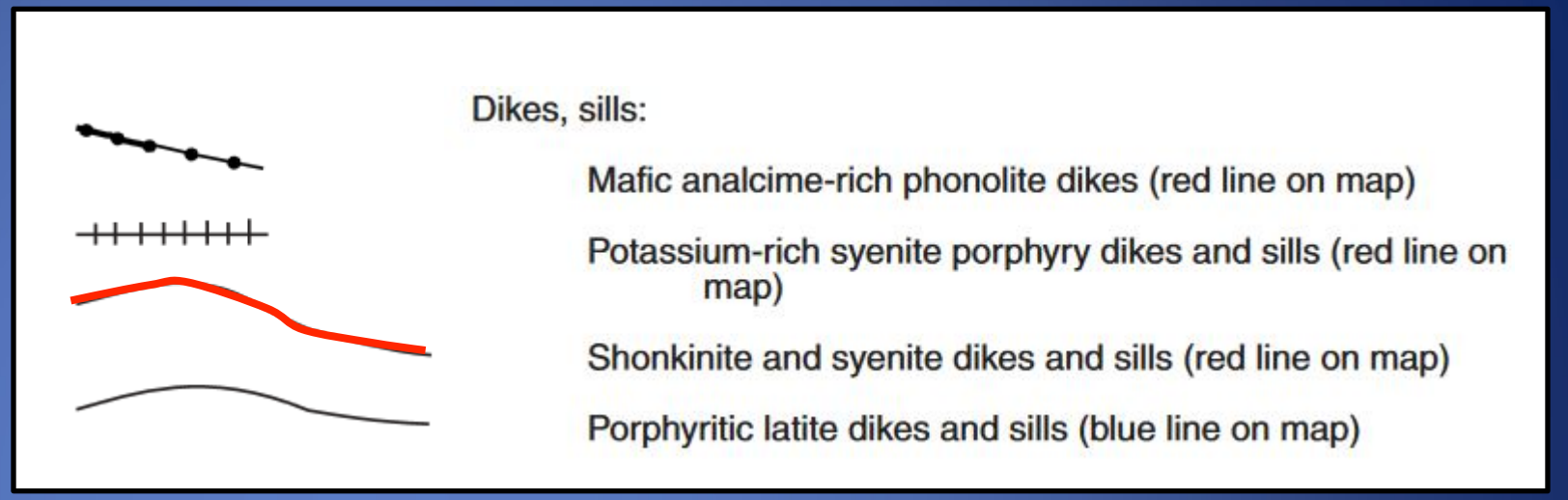


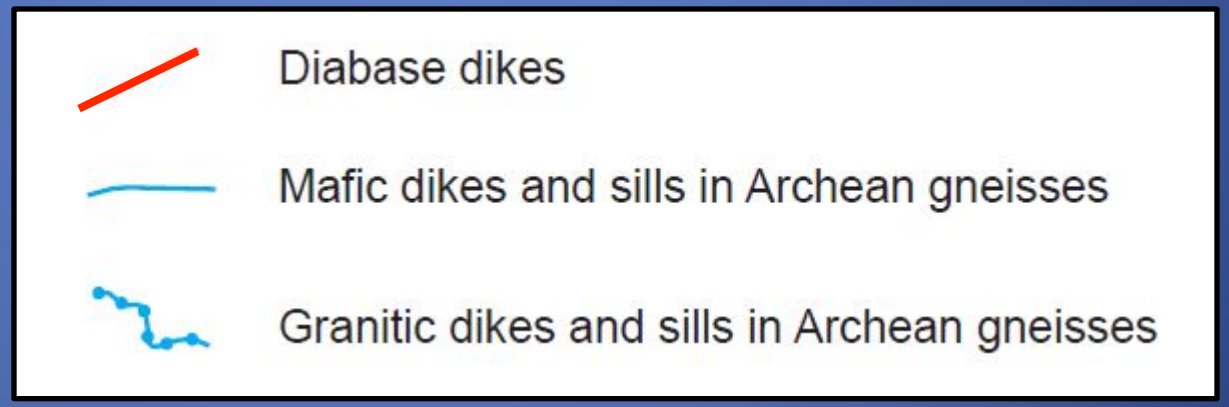
OtherLines –More Editing/Decisions

Dikes

- Legacy Maps
  - Same line type, different meanings
  - Concealed dikes
- NCGMP09/FGDC
  - 6 line type choices
  - No concealed dike symbol

- Using “Notes” column in attribute table to capture information if no FGDC symbol



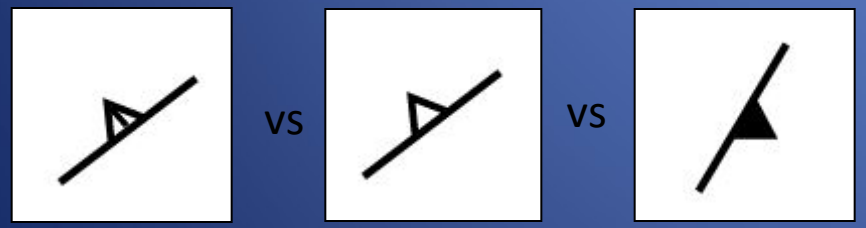


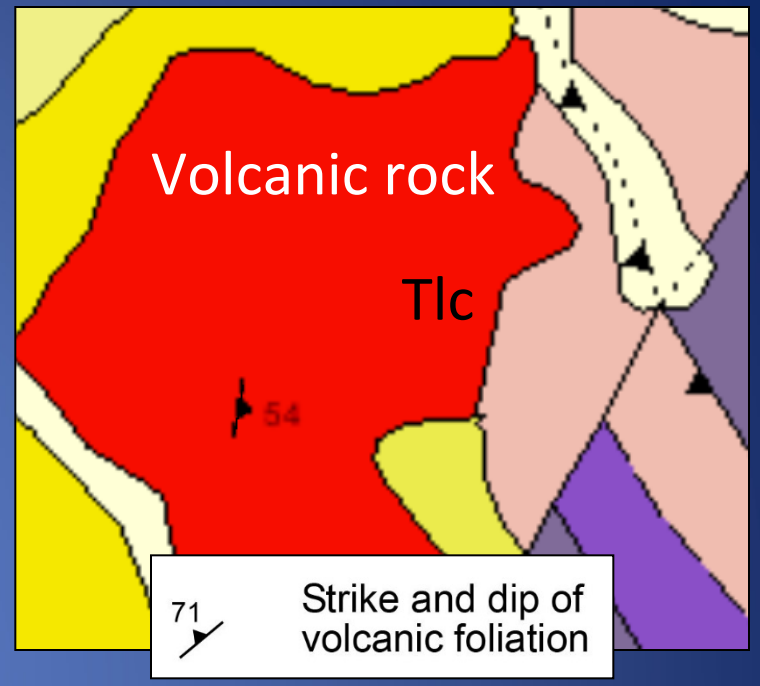
Legends from Legacy Maps

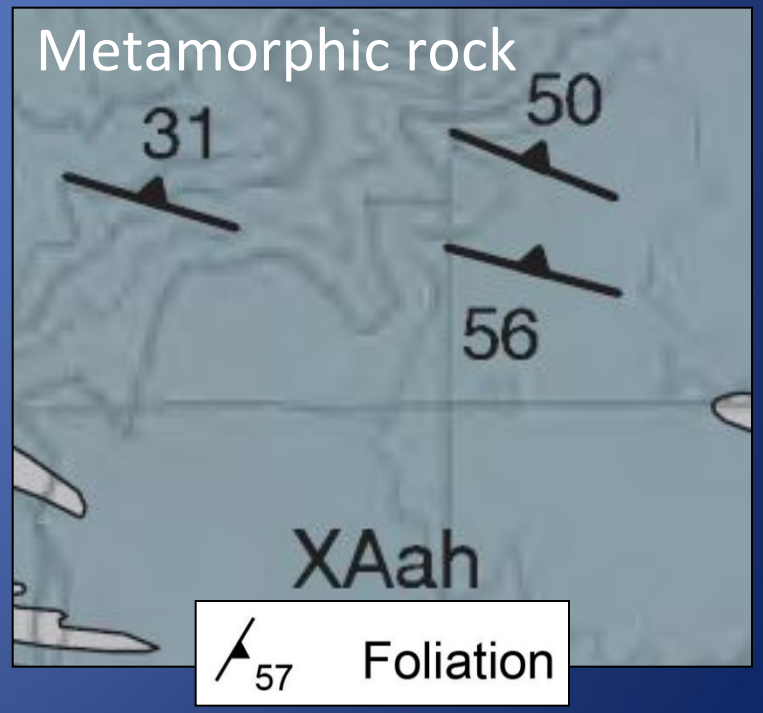
Point Data Editing

- Legacy maps (pre 2013)
  - One symbol for foliation
  - In seamless, all coded 8.3.2 (= secondary, metamorphic or tectonic foliation)

- Seamless, using NCGMP09/FGDC template
  - Many choices
  - Need to capture author's intent from legacy maps, e.g. volcanic flow foliation





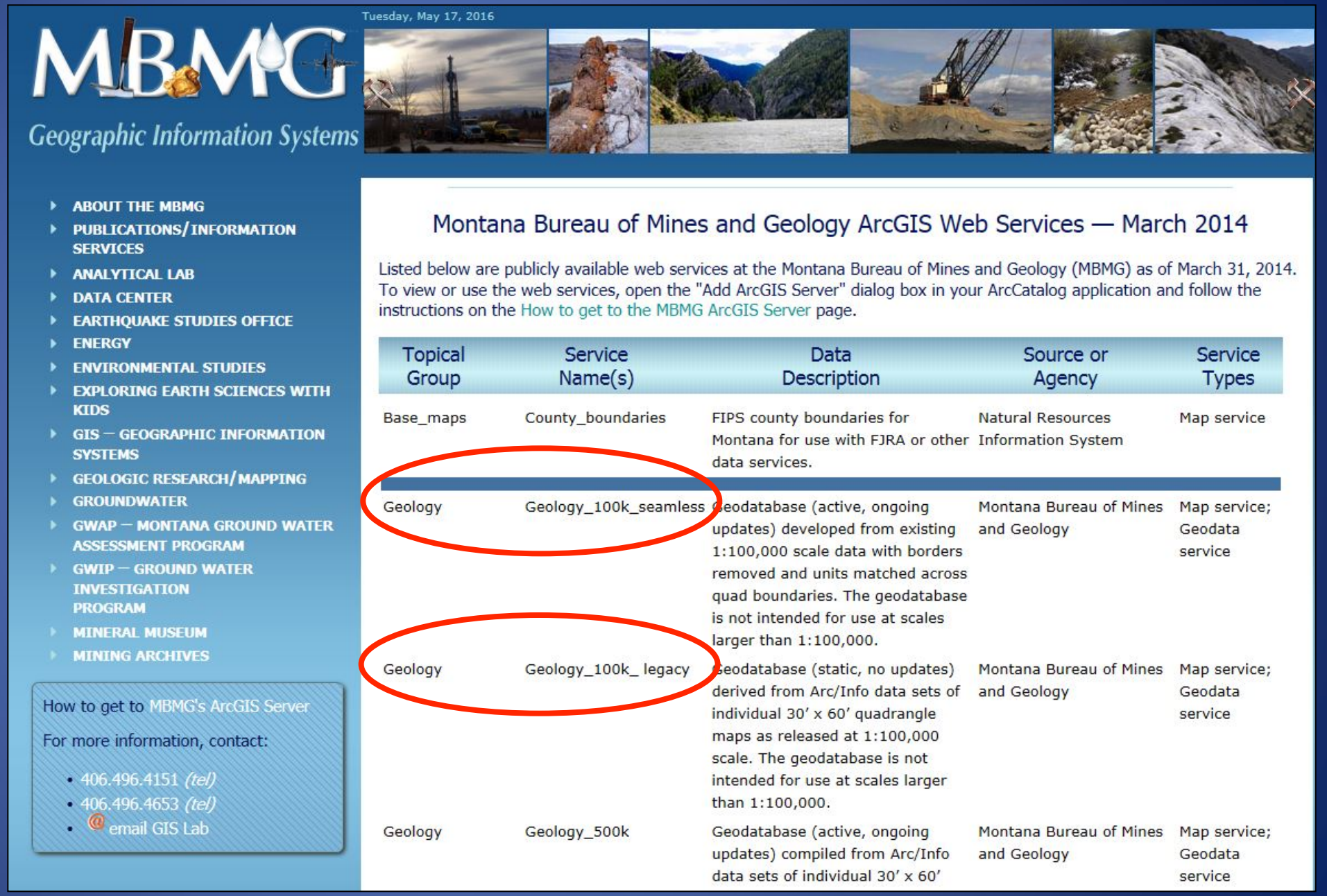


WHERE

www.mbmg.mtech.edu/gis-ArcGISservices.asp

Also available as a Map Package via FTP site

ftp://sun2.mtech.edu/pub/geology/Seamless_geology_100k.mpk



MBMG Geographic Information Systems

Tuesday, May 17, 2016

- ABOUT THE MBMG
- PUBLICATIONS/INFORMATION SERVICES
- ANALYTICAL LAB
- DATA CENTER
- EARTHQUAKE STUDIES OFFICE
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- ENVIRONMENTAL STUDIES
- EXPLORING EARTH SCIENCES WITH KIDS
- GIS – GEOGRAPHIC INFORMATION SYSTEMS
- GEOLOGIC RESEARCH/MAPPING
- GROUNDWATER
- GWAP – MONTANA GROUND WATER ASSESSMENT PROGRAM
- GWIP – GROUND WATER INVESTIGATION PROGRAM
- MINERAL MUSEUM
- MINING ARCHIVES

How to get to MBMG's ArcGIS Server

For more information, contact:

- 406.496.4151 *(tel)*
- 406.496.4653 *(tel)*
- email GIS Lab

Montana Bureau of Mines and Geology ArcGIS Web Services — March 2014

Listed below are publicly available web services at the Montana Bureau of Mines and Geology (MBMG) as of March 31, 2014. To view or use the web services, open the "Add ArcGIS Server" dialog box in your ArcCatalog application and follow the instructions on the How to get to the MBMG ArcGIS Server page.

Topical Group	Service Name(s)	Data Description	Source or Agency	Service Types
Base_maps	County_boundaries	FIPS county boundaries for Montana for use with FJRA or other data services.	Natural Resources Information System	Map service
Geology	Geology_100k_seamless	Geodatabase (active, ongoing updates) developed from existing 1:100,000 scale data with borders removed and units matched across quad boundaries. The geodatabase is not intended for use at scales larger than 1:100,000.	Montana Bureau of Mines and Geology	Map service; Geodata service
Geology	Geology_100k_ legacy	Geodatabase (static, no updates) derived from Arc/Info data sets of individual 30' x 60' quadrangle maps as released at 1:100,000 scale. The geodatabase is not intended for use at scales larger than 1:100,000.	Montana Bureau of Mines and Geology	Map service; Geodata service
Geology	Geology_500k	Geodatabase (active, ongoing updates) compiled from Arc/Info data sets of individual 30' x 60'	Montana Bureau of Mines and Geology	Map service; Geodata service

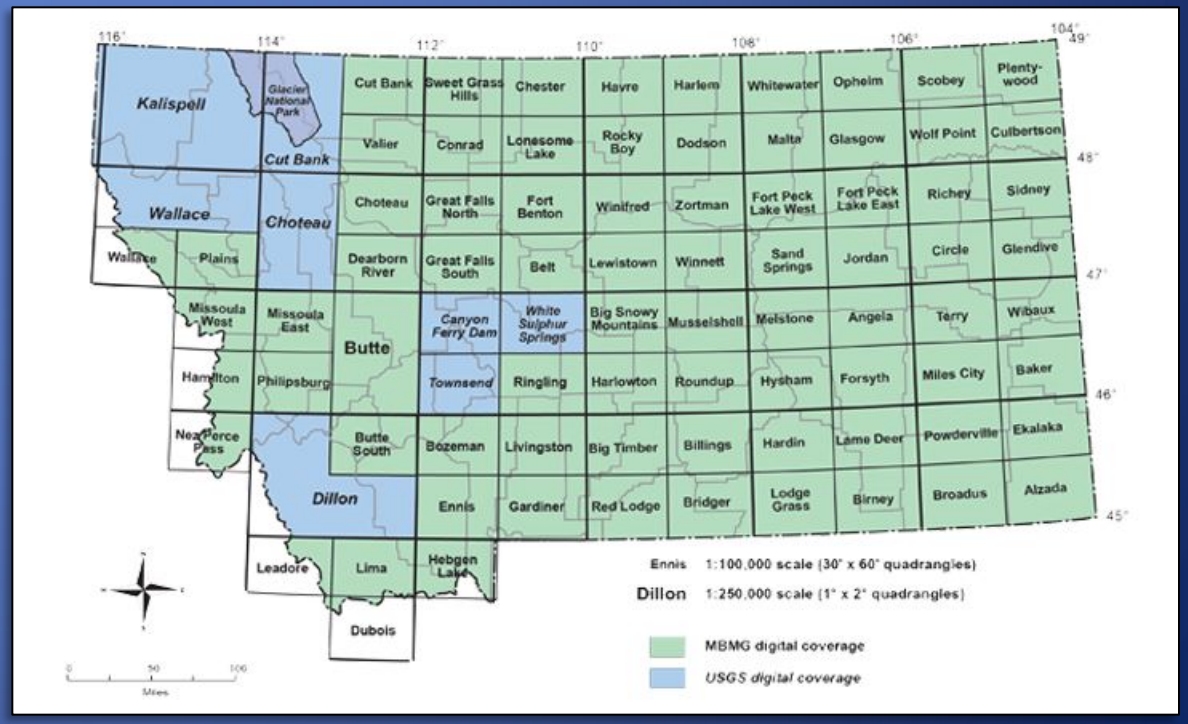
Is seamless geodatabase getting used?

Web Service "Hits" - 2016

Month	MBMG	Public
January	464	658
February	310	722
March	841	1656
April	394	738
May	18	277
Total	2027	4051

LEGACY USAGE (Jan – May 2016)

- 20,764 – Pdfs/digital downloads for 68 of 79 1:100K maps



FUTURE WORK

- Finish tables, edit existing data
- Developing a policy for revisions (monthly? quarterly?)
  - Revisions will be to seamless geodatabase, not legacy digital data
- Add additional data
  - Age dates
  - Geochemical analyses
  - Fossil locations
  - Other data??

Tuff (age date pending) – Dillon 1:100K

Coprolites – Ringling 1:100K

QUESTIONS

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MBMG
Montana Bureau of Mines and Geology