

DIGITAL MAPPING TECHNIQUES 2025

The following was presented at DMT'25
May 18 - 21, 2025

The contents of this document are provisional

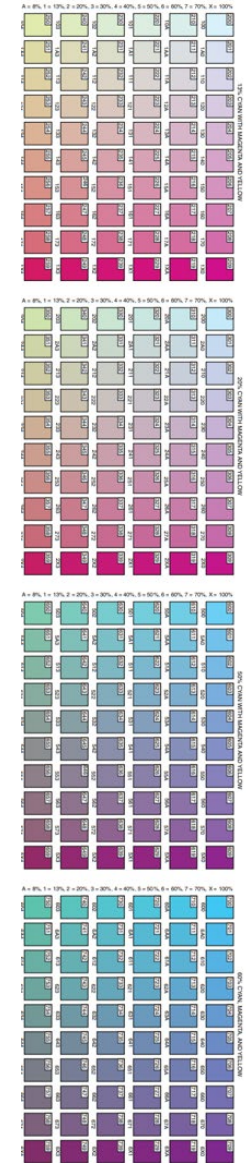
See Presentations and Proceedings
from the DMT Meetings (1997-2025)
<http://ngmdb.usgs.gov/info/dmt/>

COLORS

COLOR OPTIMIZATION METRICS FOR GEOLOGIC MAPS

BEYOND THE BASICS OF GEOLOGIC MAP DATABASE QA/QC

Ally Steinleitner
Digital Mapping Techniques Conference
5/21/2025



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AK GeMS QA/QC focused workflow phases

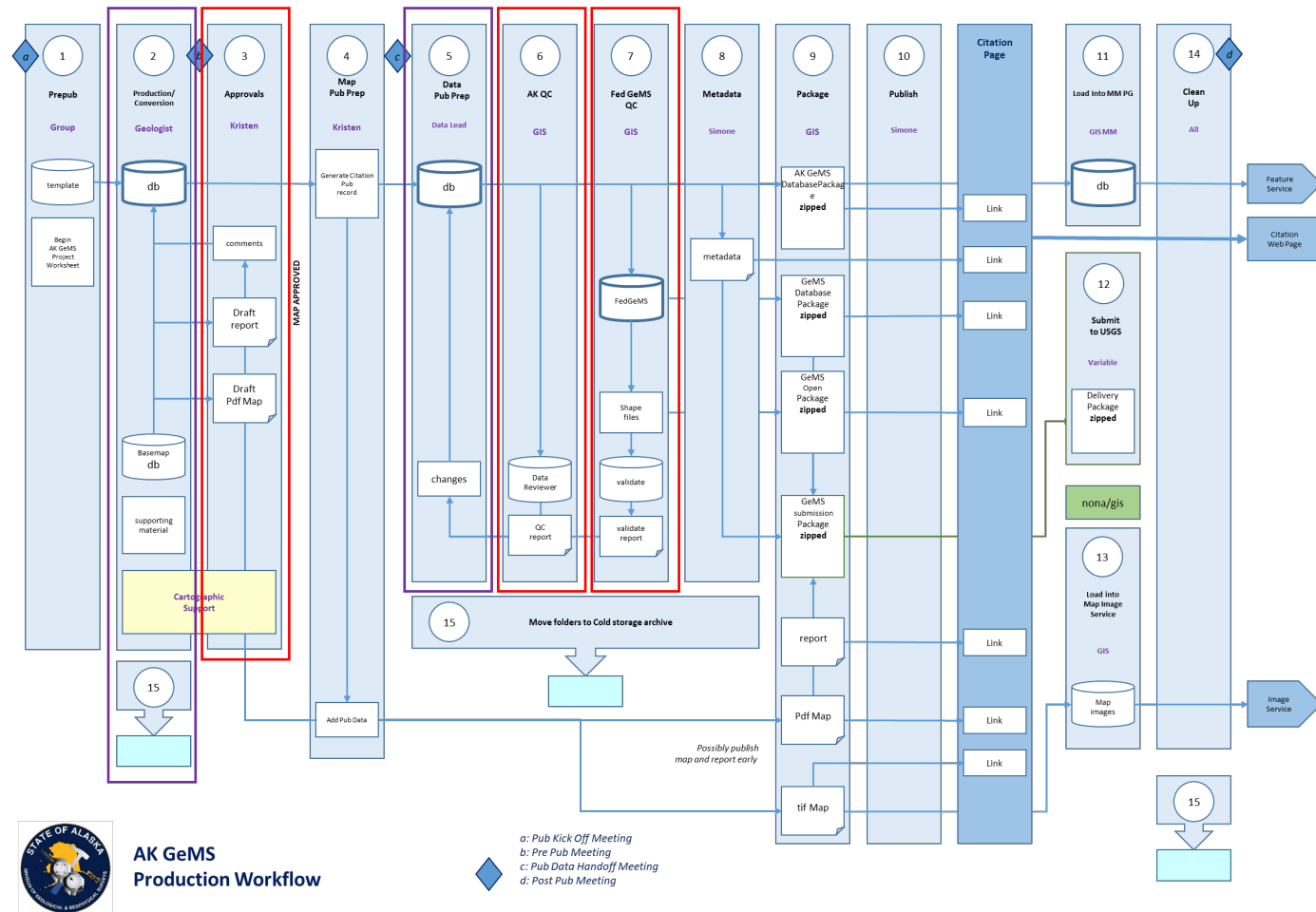
QA (don't make mistakes)

- Phase 2: Production
 - Phases 5: Data Prep
- QC (find mistakes)*
- Phase 3: Approvals
 - Phases 6-7: GeMS QC

QA/QC Accomplished with:

- Data Reviewer
- Python Scripts
- Implementing Attribute Rules

AK GeMS Production Workflow



Currently leveraging Esri advantage Program credits to leverage Tasks and upgrade data reviewer processes to ArcPro 3.x

AK DGGS Color Review

Phase 2

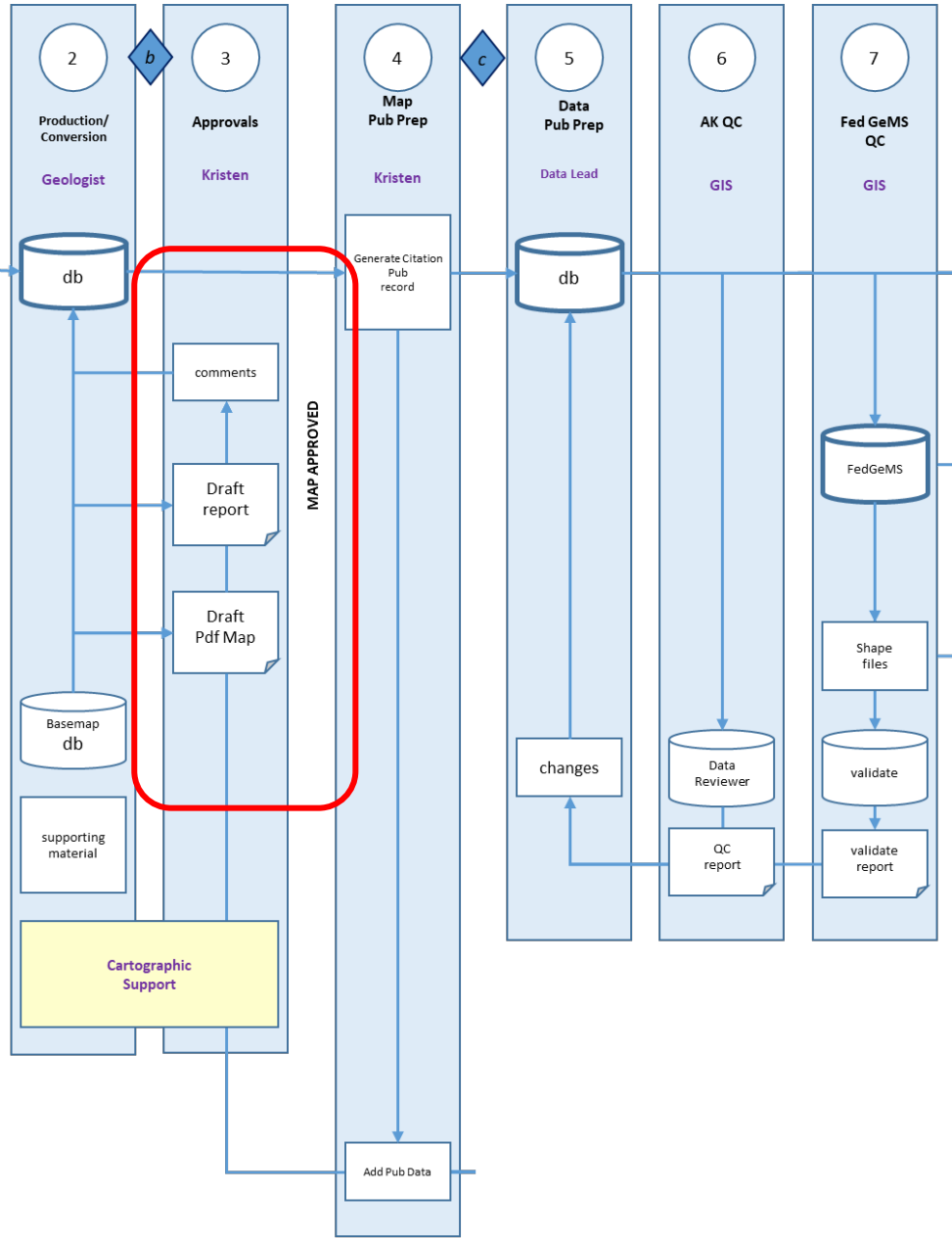
Colors chosen by geologist

Phase 3

Colors checked manually by reviewers

Description Of Map Units Table

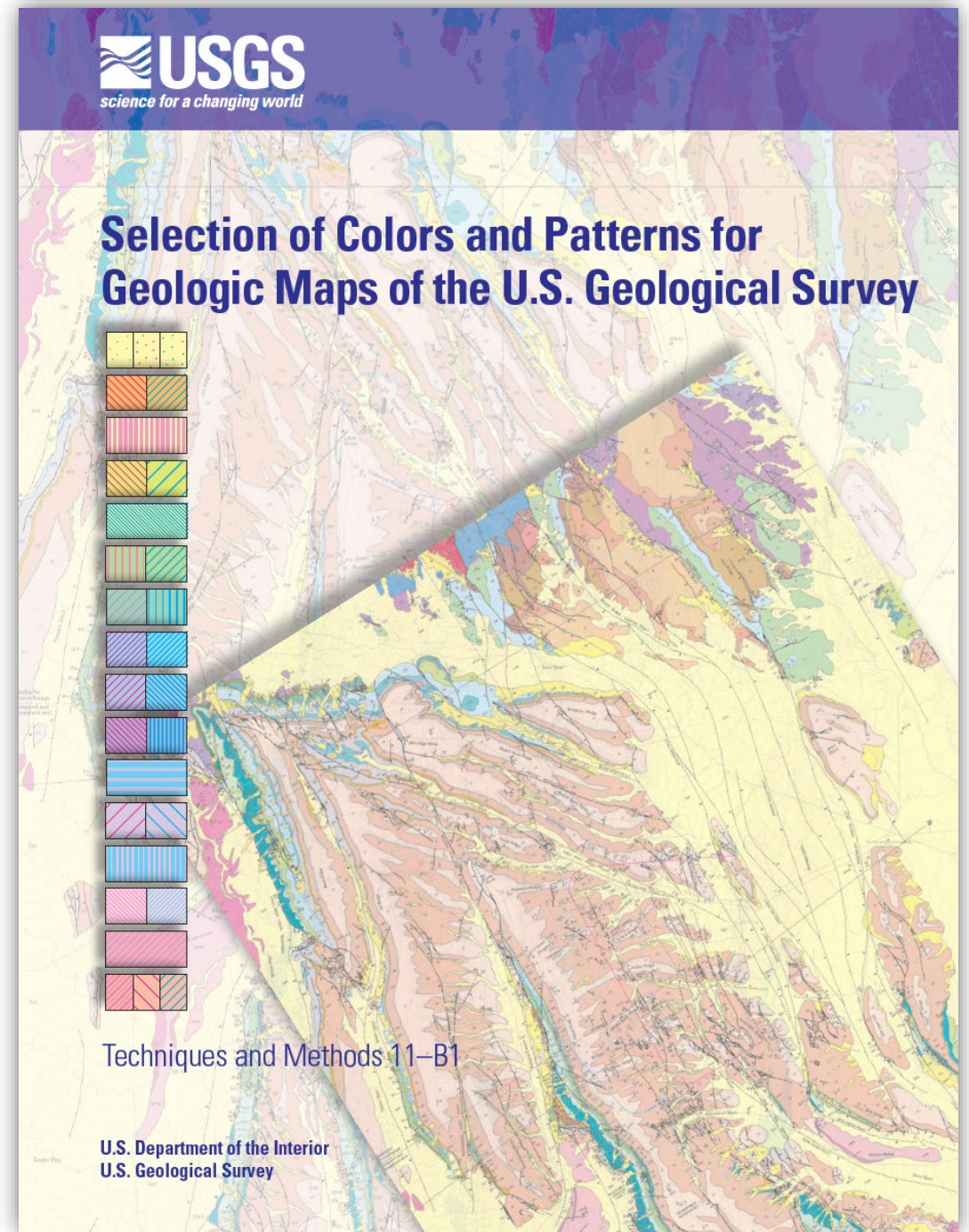
OBJECTID	description_of_map_u...	symbol	map_unit *	name	full_name	age_label	age_type	age_oldest	age_youngest	description
1	[9B2EDCB5-CC28-408B...	<Null>	<Null>	UNCONSOLIDATED DE...	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>
2	[E2F7AD4F-D56E-4A72...	0070	Qs	Surficial deposits	Surficial deposits (Hol...	Holocene	relative	Holocene	Holocene	Consists primarily of al...
3	[3D851138-8A84-4F8D...	<Null>	<Null>	METAMORPHIC AND P...	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>
4	[CAD60F3D-2401-49AB...	2220	pv	Prevolcanic bedrock	Prevolcanic bedrock (T...	Tertiary and Cretaceous	relative	Cretaceous	Tertiary	Consists of the Sitka G...
5	[09703F10-484F-4C52...	<Null>	<Null>	VOLCANIC ROCKS AN...	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>
6	[C1A84F07-988A-491A...	0700	Qcrr	Dacite lava flows of Cr...	Dacite lava flows of Cr...	Holocene	relative	Holocene	Holocene	Dark brownish gray, v...
7	[39A996E3-3919-4FA5...	0030	Qcrp	Pyroclastic-flow depos...	Pyroclastic-flow depos...	Pleistocene	relative	Pleistocene	Pleistocene	Pumiceous lapilli are l...
8	[9B2A6701-A62D-459A...	0150	Qmet	Dacite air-fall tuffs of...	Dacite air-fall tuffs of...	Pleistocene	relative	Pleistocene	Pleistocene	Pumiceous lapilli and...
9	[B5B8C5C4-9B86-4EF1...	0170	Qsma	Basaltic and andesite l...	Basaltic and andesite l...	Pleistocene	relative	Pleistocene	Pleistocene	Post-glacial, heavily ve...
10	[AB24447F-B7DA-4BAB...	04X0	Qmea	Andesite air-fall tuffs...	Andesite air-fall tuffs...	Pleistocene	relative	Pleistocene	Pleistocene	Red-brown and dark...
11	[A82CCE2A-B0AC-4D3...	06X0	Qmed	Andesite dome of Mo...	Andesite dome of Mo...	Pleistocene	relative	Pleistocene	Pleistocene	Porphyritic, holocrysta...
12	[48849150-D49D-4BD0...	2660	Qsca	Andesite air-fall tuffs	Andesite air-fall tuffs (...)	Pleistocene	relative	Pleistocene	Pleistocene	Postglacial. Unit consi...
13	[5A2A1C6D-0E6C-4D75...	4760	Qscb	Basalt and basaltic an...	Basalt and basaltic an...	Pleistocene	relative	Pleistocene	Pleistocene	Postglacial. Unit differ...
14	[952171F2-F8DD-4FA5...	0470	Qcrr	Low-silica rhyolite do...	Low-silica rhyolite do...	Pleistocene	absolute	Pleistocene	Pleistocene	Dark gray, commonly f...
15	[ADB1569B-6D3D-4084...	7300	Qbpy	Younger plagioclase b...	Younger plagioclase b...	Pleistocene	absolute	Pleistocene	Pleistocene	Postglacial(?). Exposed...
16	[F858881D-036D-4470...	2530	Qmec	Andesite lava flows an...	Andesite lava flows an...	Pleistocene	absolute	Pleistocene	Pleistocene	Medium gray or grayis...
17	[730F199E-3EBF-4F10...	X400	Qcra	Andesite lava flows of...	Andesite lava flows of...	Pleistocene	relative	Pleistocene	Pleistocene	Glaciated(?). Gray or gr...
18	[B28F2756-93E0-4530...	0360	Qcea	High-silica andesite la...	High-silica andesite la...	Pleistocene	relative	Pleistocene	Pleistocene	Sparsely porphyritic, t...
19	[1D36D9F7-EB3D-4E37...	3620	Qsla	Andesite lava flows of...	Andesite lava flows of...	Pleistocene	relative	Pleistocene	Pleistocene	Dark gray lava pervasiv...
20	[9D54D0E0-F162-4100...	X560	Qbal	Basaltic andesite lava f...	Basaltic andesite lava f...	Pleistocene	absolute	Pleistocene	Pleistocene	Thinbedded, dark gra...



FGDC Geologic Color Standards

USGS Techniques and Methods 11-B1

- Purpose and use of the map
- Legibility of the map
- Showing contrast and clarity of map units and symbols
- Showing ages or age relationships of map units
- Showing structural relationships of map units
- Matching or approximating colors and patterns used on nearby or adjacent maps to maintain consistency and continuity of colors and patterns among maps in a region



Color Challenges

Large maps with many map units

- Particularly large number of map units of any one geologic age

Guidance :

- select colors that maintain the relative order of colors on the geologic age column but move up and (or) down on the column.
- use the color immediately above the geologic age color for the youngest units, the correct color for the middle units, and the color immediately below the geologic age for the older units.

Suggested Colors for Geologic Maps

Table 1. Suggested colors for geologic maps. CMYK values: A = 8%, 1 = 13%, 2 = 20%, 3 = 30%, 4 = 40%, 5 = 50%, 6 = 60%, 7 = 70%, X = 100%.

Geologic age	Basic color	Color combination	Selected color samples			
Quaternary Q	Yellow or no color (white)	Tints of yellow (30% and 50% are best to use, except in narrow bands or very small areas) or no color (white).	 0000	 0030	 0050	 00X0
Tertiary T	Orange, yellowish orange, tan, brown	Combinations of yellow and magenta, with proportionally more yellow than magenta.	 A130	 0270	 A570	 16X0
Cretaceous K	Yellow green or olive green	Combinations of yellow and cyan, with proportionally more yellow than cyan; the addition of a small proportion of magenta produces olive greens.	 A030	 3070	 4260	 63X0
Jurassic J	Green	Combinations of yellow and cyan in equal or nearly equal proportions. Note: in theory, this is the correct color for Jurassic; however, in practice it is well to lean toward the conventional "blue greens" when possible.	 3030	 6060	 6160	 X0X0
Triassic R	Blue green	Combinations of yellow and cyan, with proportionally more cyan than yellow.	 30A0	 5030	 6A30	 6240
Permian P	Blue	Tints of cyan; a small proportion of magenta is often needed to increase contrast.	 2000	 5000	 6200	 62A0
Pennsylvanian P	Blue with red	Combinations of cyan and magenta, with a much higher proportion of cyan than magenta.	 3A00	 3200	 53A0	 6400
Mississippian M	Bluish purple	Combinations of cyan and magenta, with the proportion of cyan only slightly higher than magenta.	 1100	 4300	 5400	 6500
Devonian D	Grayish purple	Combinations of equal or nearly equal proportions of magenta and cyan plus a low proportion of yellow.	 32A0	 3310	 54A0	 6410
Silurian S	Reddish purple	Combinations of magenta and cyan, with proportionally more magenta than cyan.	 1200	 1500	 3400	 3620
Ordovician O	Subdued red	Light tints of magenta or combinations of a high proportion of magenta with low proportions of yellow and cyan.	 03A0	 1310	 2410	 2630
Cambrian C	Reddish brown	Combinations of magenta and yellow in equal or nearly equal proportions plus a low proportion of cyan.	 0120	 1430	 1660	 3640
Precambrian* pC	Olive brown, olive, gray, olive blue, reddish olive	Combinations of equal or nearly equal proportions of yellow, magenta, and cyan.	 11A0	 4430	 1240	 3560
			 2140	 5370	 3220	 6430

*Includes Proterozoic and Archean.

Patterns

Help maintain
basic color
scheme on
complex maps

Not factored into
tools at this time

Sedimentary Patterns

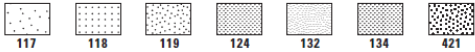
Sedimentary units in general



Shale



Sandstone

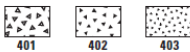


Evaporites (gypsum, salt)



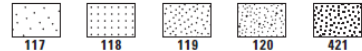
(Print patterns 405 and 406 with one set of lines horizontal)

Breccia, angular conglomerate

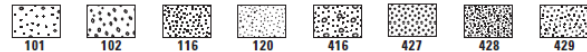


Surficial Patterns

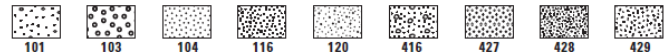
Sand



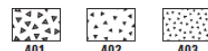
Gravel, sand and gravel



Conglomerate



Talus, breccia, landslides



Glacial moraine



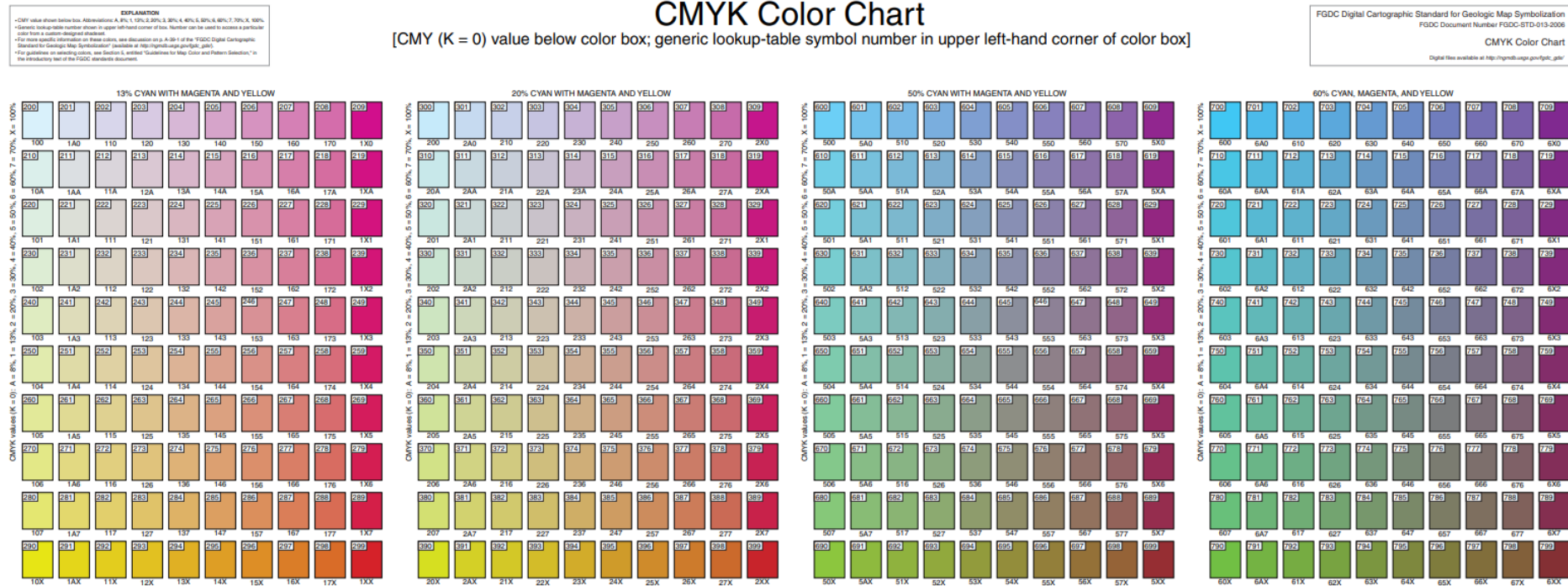
Table 3. Selected examples of **background colors** (CMYK codes shown below color boxes) and various **point patterns** (pattern numbers shown above color boxes) for geologic maps.
CMYK values: A = 8%, 1 = 13%, 2 = 20%, 3 = 30%, 4 = 40%, 5 = 50%, 6 = 60%, 7 = 70%, X = 100%.

Geologic age	Pattern Color									
	C (X000)	M (0X00)	C (5000)	M (0500)	C (X000)	M (0X00)	C (X000)	M (0X00)	K (0005)	
Quaternary Q										
Tertiary T										
Cretaceous K										
Jurassic J										
Triassic T										
Permian P										
Pennsylvanian IP										
Mississippian M										
Devonian D										
Silurian S										
Ordovician O										
Cambrian C										
Proterozoic and Archean Proterozoic*										

*Includes Proterozoic and Archean.

FGDC Key Recommendations

1. CMYK colors that differ by at least 30% for computer driven plotters
2. Colors maintain the relative order of colors on the geologic age column



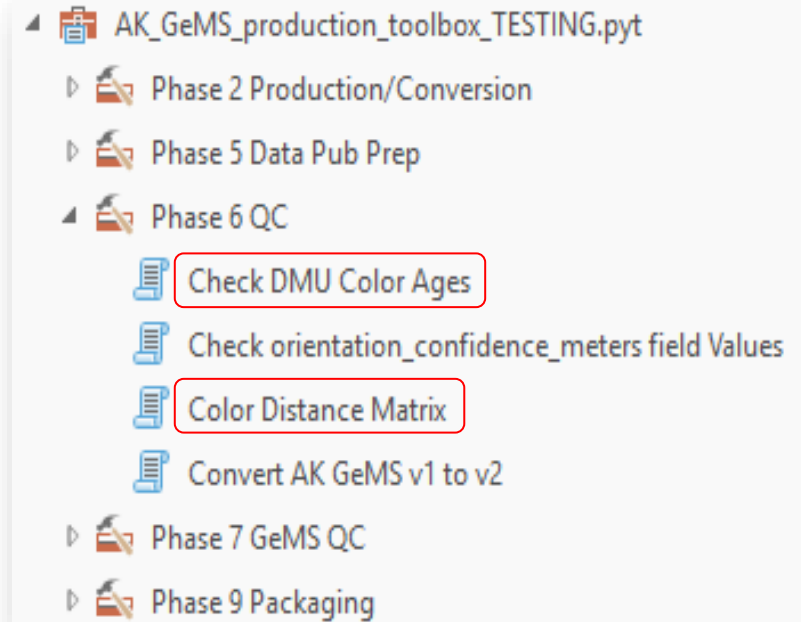
Developing Metrics

1. Human Readability

- Color Distance Matrix Tool

2. Adherence to Color Age Standards

- Check DMU Color Ages Tool

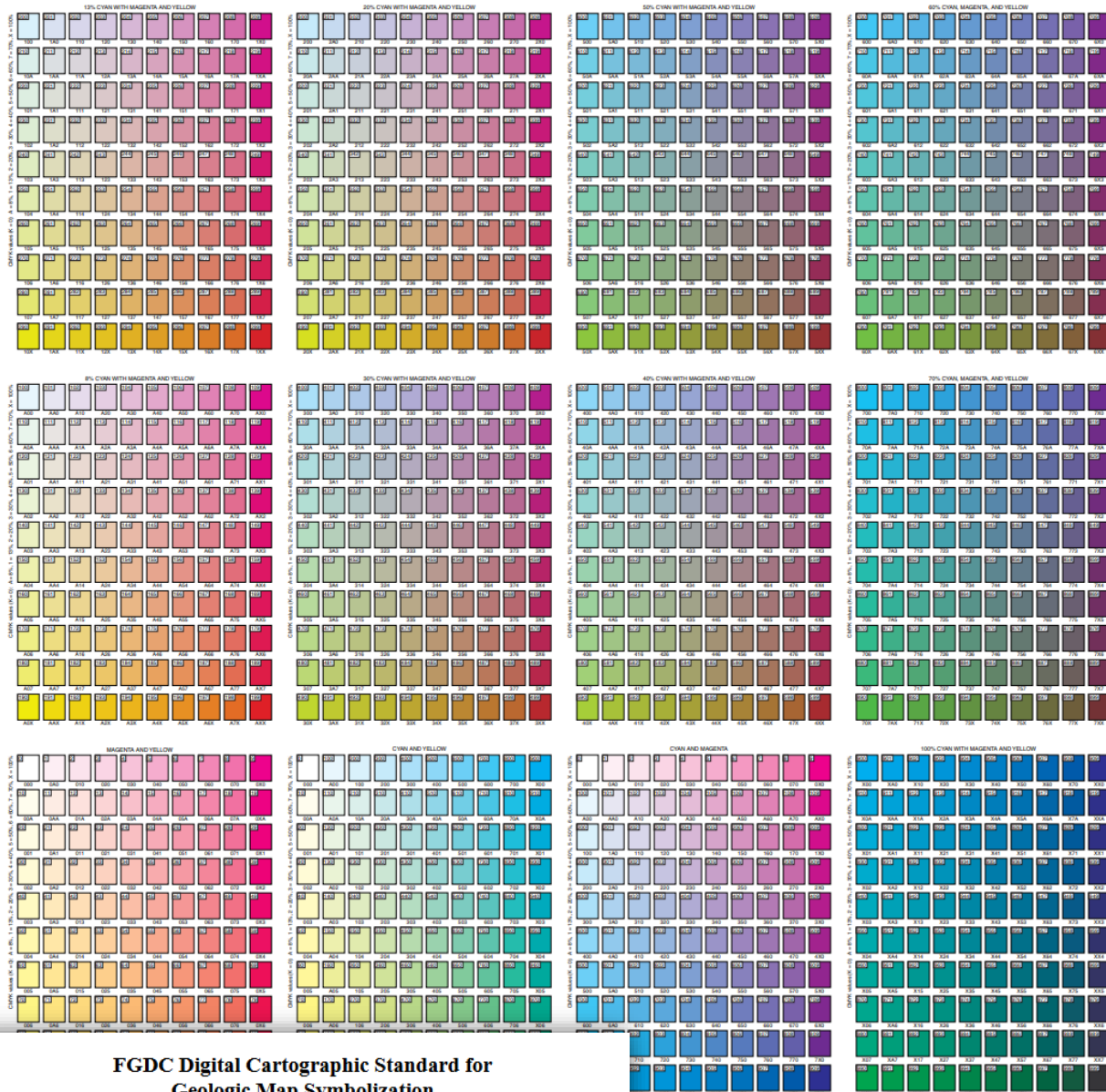


Exist in `AK_GeMS_production_toolbox.pyt`

CMYK Color Chart

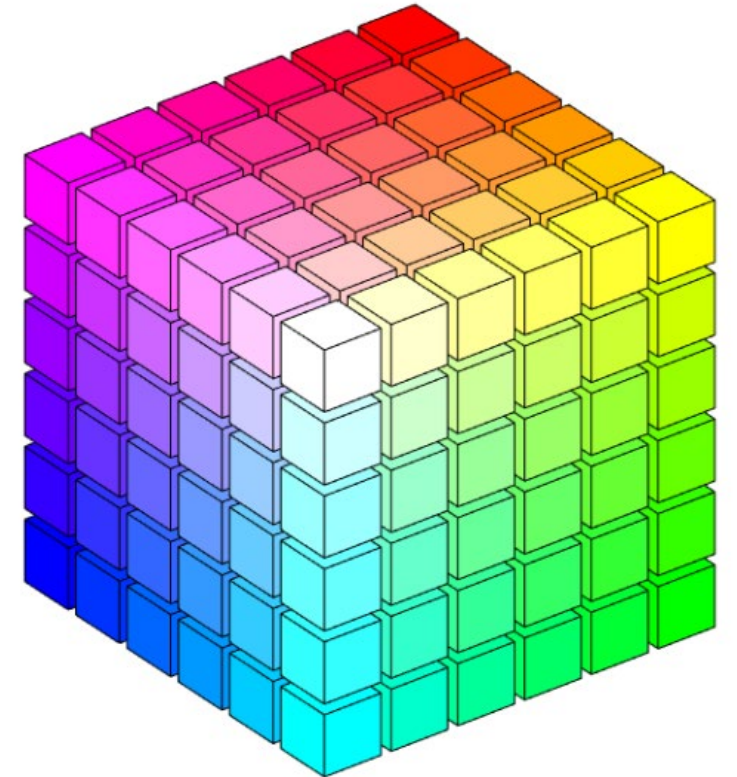
[CMY (K = 0) value below color box; generic lookup-table symbol number in upper left-hand corner of color box]

FGDC Digital Cartographic Standard for Geologic Map Symbolization
 FGDC Document Number: D-250-01-000
 CMYK Color Chart
 Digital file available at: http://geogis.fgdl.gov/fgdl/fgdl_0101_0001.pdf



Magenta

Yellow



Cyan

FGDC Digital Cartographic Standard for
 Geologic Map Symbolization

Color Code Logic

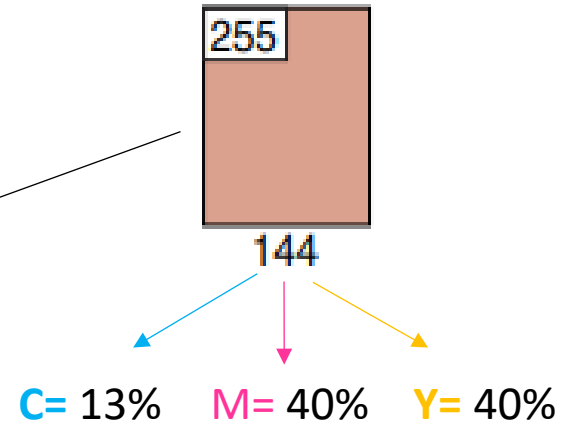
EXPLANATION

CMY value shown below box. Abbreviations: A, 8%; 1, 13%; 2, 20%; 3, 30%; 4, 40%; 5, 50%; 6, 60%; 7, 70%; X, 100%.

13% CYAN WITH MAGENTA AND YELLOW

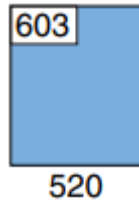
CMYK values (K = 0): A = 8%, 1 = 13%, 2 = 20%, 3 = 30%, 4 = 40%, 5 = 50%, 6 = 60%, 7 = 70%, X = 100%

200	201	202	203	204	205	206	207	208	209
100	1A0	110	120	130	140	150	160	170	1X0
210	211	212	213	214	215	216	217	218	219
10A	1AA	11A	12A	13A	14A	15A	16A	17A	1XA
220	221	222	223	224	225	226	227	228	229
101	1A1	111	121	131	141	151	161	171	1X1
230	231	232	233	234	235	236	237	238	239
102	1A2	112	122	132	142	152	162	172	1X2
240	241	242	243	244	245	246	247	248	249
103	1A3	113	123	133	143	153	163	173	1X3
250	251	252	253	254	255	256	257	258	259
104	1A4	114	124	134	144	154	164	174	1X4
260	261	262	263	264	265	266	267	268	269
105	1A5	115	125	135	145	155	165	175	1X5
270	271	272	273	274	275	276	277	278	279
106	1A6	116	126	136	146	156	166	176	1X6
280	281	282	283	284	285	286	287	288	289
107	1A7	117	127	137	147	157	167	177	1X7
290	291	292	293	294	295	296	297	298	299
10X	1AX	11X	12X	13X	14X	15X	16X	17X	1XX



Color Distance Matrix Tool

Calculate the Euclidean distance between map units on 3D color cube



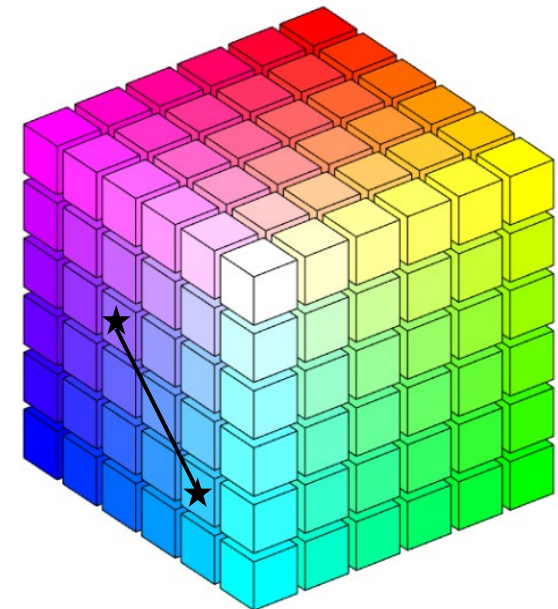
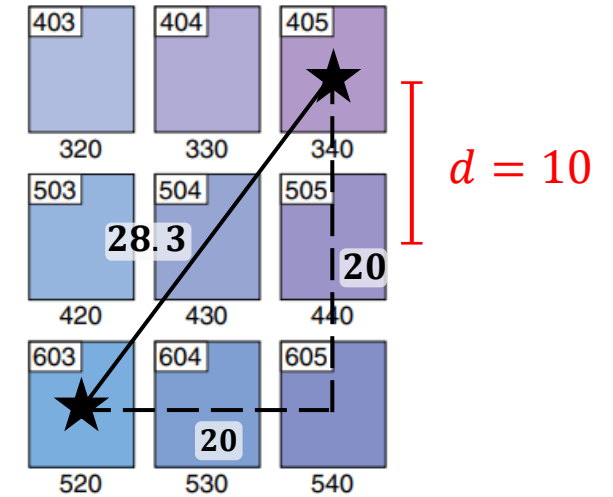
C= 30% M= 40% Y= 0%

C= 50% M= 20% Y= 0%

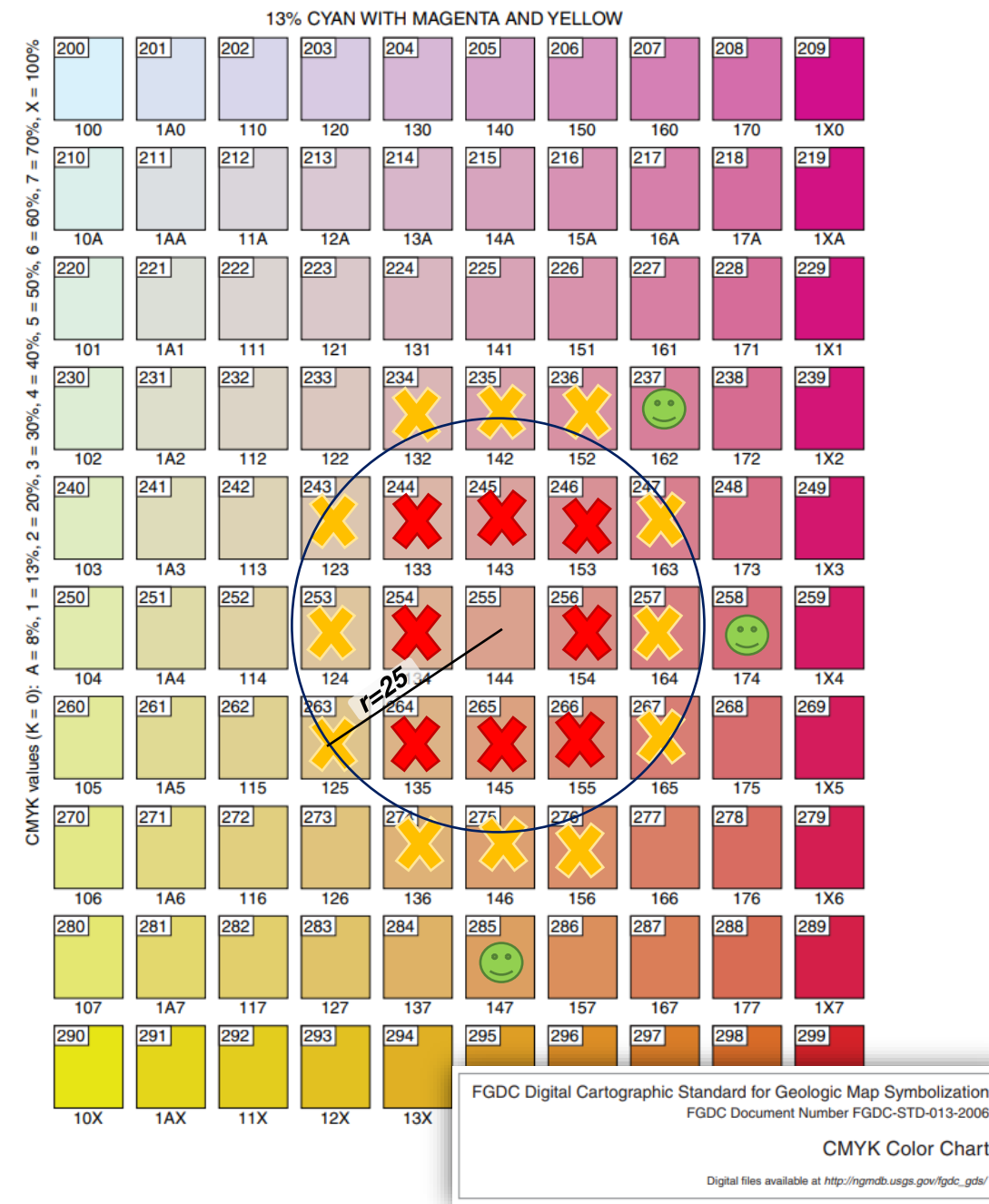
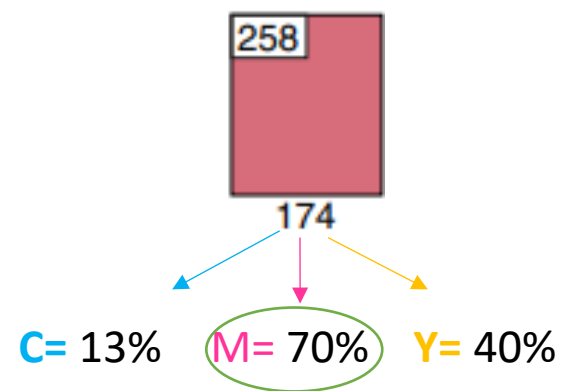
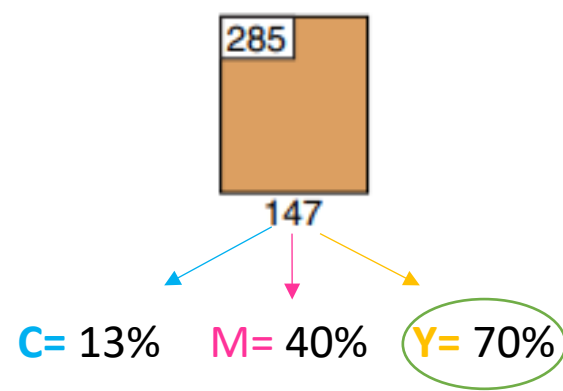
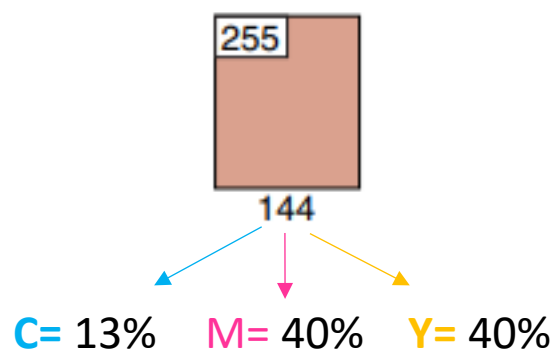
$$\text{distance} = \sqrt{(C1 - C2)^2 + (M1 - M2)^2 + (Y1 - Y2)^2}$$

$$d = \sqrt{(30 - 50)^2 + (40 - 20)^2 + (0 - 0)^2}$$

$$d = 28.3$$

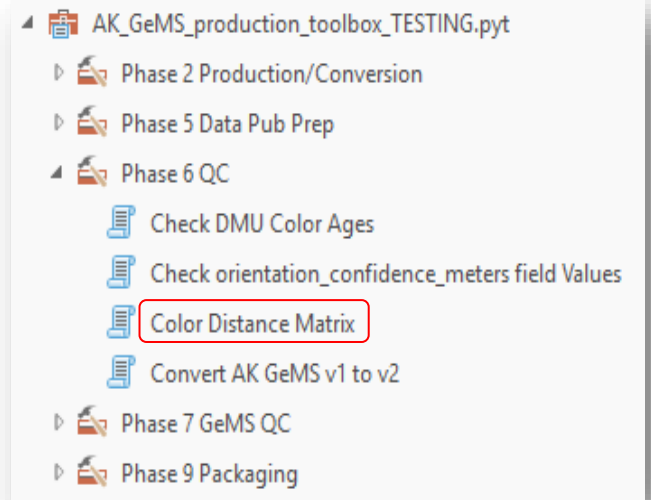


FGDC CMYK Color Chart



Color Distance Matrix Tool

- Distance matrix of the Euclidean distance between colors in DMU
- Average Euclidean distance between colors for a map



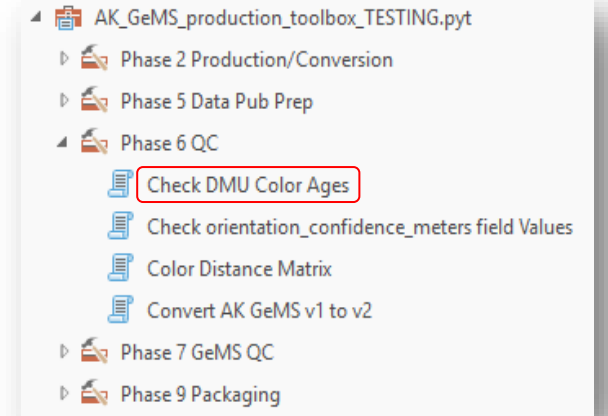
Map Unit	0010 Qal	0040 Qg	2030 Ksbls	3A40 Ksblb	2040 Ksblr	3150 Ktu	1050 Ks	4160 Kn	4240 Kt	Nearest Map Unit Color
Qal										
Qg	27									Qal
Ksbls	26.2	22.4								Qg
Ksblb	41.1	31	16.2							Ksbls
Ksblr	33.6	20	10	12.8						Ksbls
Ktu	49.4	34.2	25.9	11.2	19.2					Ksblb
Ks	39.2	16.4	21.2	21.3	12.2	21.4				Ksblr
Kn	63.1	46.6	38.3	22.9	31.1	14.1	31.6			Ktu
Kt	52.2	44.7	30	15.6	28.3	15.8	35.1	21.2		Ksblb
Average Dist	41.475	30.75714	23.6	16.76	22.7	17.1	33.35	21.2		25.86777

COLOR
DISTANCE
MATRIX
TOOL

DEMO

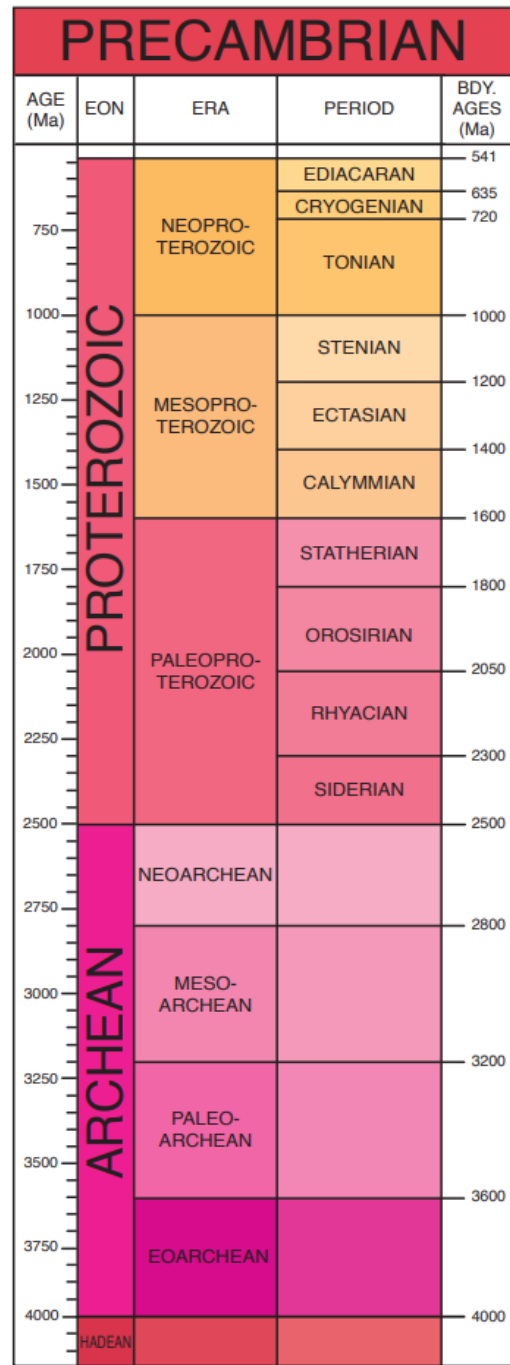
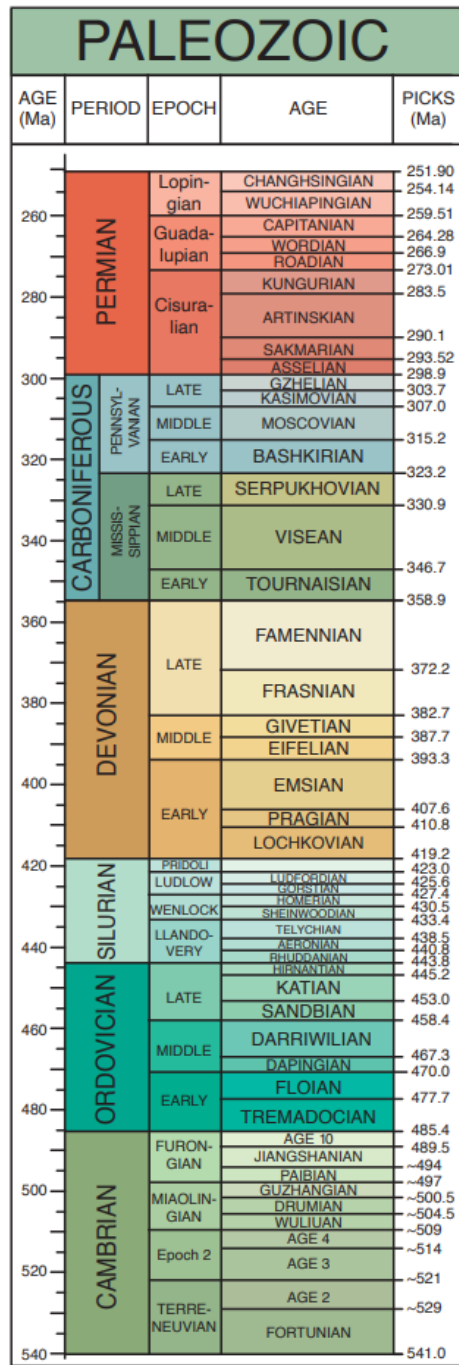
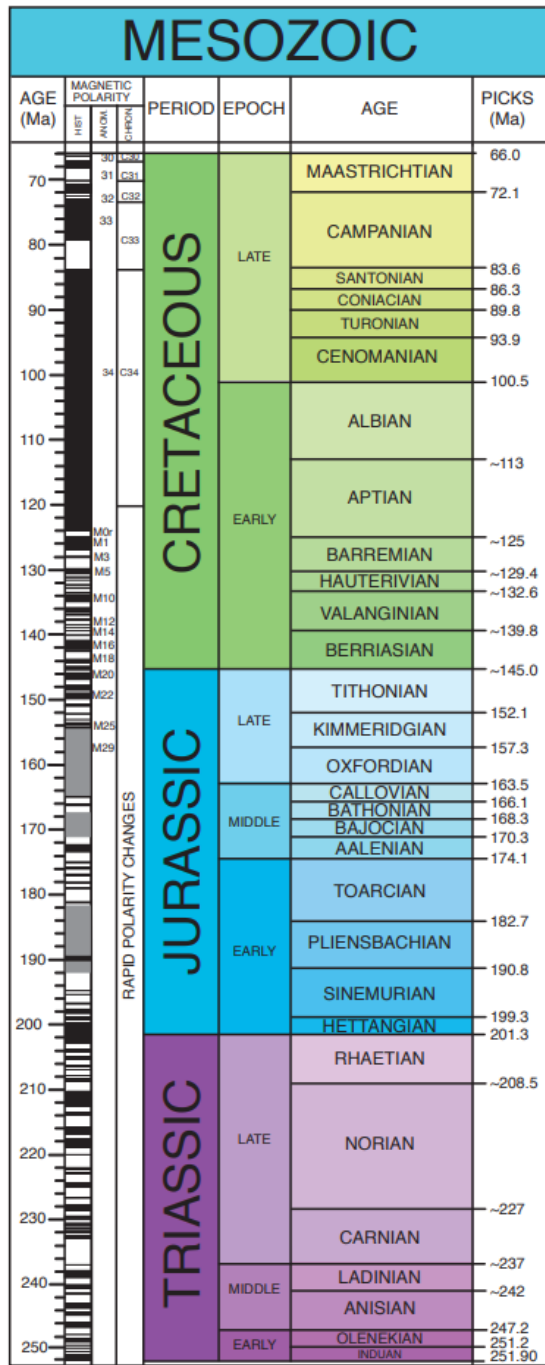
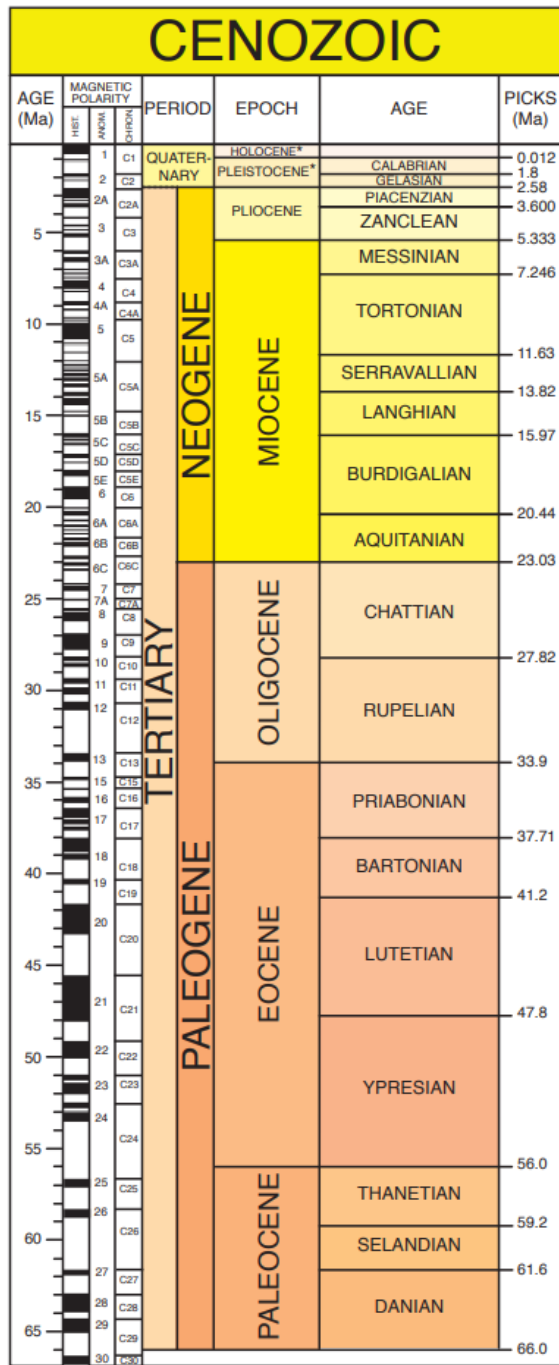
Check DMU Color Ages Tool

A	B	C	D	E	F	G
Map Unit	Age Oldest	Age Youngest	Style Age	Match Status	Distance	Symbol
Qb	Quaternary	Quaternary	Igneous; Volcanic	MATCH	0	0XX0
Ds	Devonian	Devonian	Mississippian	MISMATCH	1	6500
Dm	Devonian	Devonian	Mississippian	MISMATCH	1	2200
EKs	Cretaceous	Cretaceous	Quaternary	MISMATCH	3	0000
LKg	Cretaceous	Cretaceous	Igneous; Volcanic	MATCH	0	0X30
DOg	Devonian	Ordovician	Silurian	MATCH	0	4600
Omg	Ordovician	Ordovician	Cretaceous	MISMATCH	9	63X0
DOx	Devonian	Ordovician	Ordovician	MATCH	0	0420
DOi	Devonian	Ordovician	Permian	MISMATCH	4	6200
DOms	Devonian	Ordovician	Igneous; Volcanic	MISMATCH	0	XA0
DOm	Devonian	Ordovician	Permian	MISMATCH	4	2000
DOq	Devonian	Ordovician	Ordovician	MATCH	0	07A0
DOqs	Devonian	Ordovician	Igneous; Volcanic	MISMATCH	0	X70
DOsq	Devonian	Ordovician	Cambrian	MISMATCH	1	0750
DOs	Devonian	Ordovician	Cambrian	MISMATCH	1	0AA0
Osg	Ordovician	Ordovician	Jurassic	MISMATCH	8	A020
Oi	Ordovician	Ordovician	Jurassic	MISMATCH	8	6040
DOu	Devonian	Precambrian	Precambrian; Proterozoic; Archean	MATCH	0	2A20
PzPh	Paleozoic	Proterozoic	Precambrian; Proterozoic; Archean	MISMATCH	4	770
PzPa	Paleozoic	Proterozoic	Precambrian; Proterozoic; Archean	MISMATCH	3	450
--- OVERALL ACCURACY REPORT ---						
Total Units	20					
Matches	6					
Mismatches	14					



Results

1. Percent of map unit record whose age matches
2. How far off mismatched records DMU ages are from FDGC age standard



Standardize DMU Ages

Suggested Colors for Geologic Maps

Table 1. Suggested colors for geologic maps. CMYK values: A = 8%, 1 = 13%, 2 = 20%, 3 = 30%, 4 = 40%, 5 = 50%, 6 = 60%, 7 = 70%, X = 100%.

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Cretaceous K	Yellow green or olive green	Combinations of yellow and cyan, with proportionally more yellow than cyan; the addition of a small proportion of magenta produces olive greens.	 A030	 3070	 4260	 63x0
Jurassic J	Green	Combinations of yellow and cyan in equal or nearly equal proportions. Note: in theory, this is the correct color for Jurassic; however, in practice it is well to lean toward the conventional “blue greens” when possible.	 3030	 6060	 6160	 x0x0
Triassic T̄	Blue green	Combinations of yellow and cyan, with proportionally more cyan than yellow.	 30A0	 5030	 6A30	 6240
Permian P	Blue	Tints of cyan; a small proportion of magenta is often needed to increase contrast.	 2000	 5000	 6200	 62A0
Pennsylvanian P̄	Blue with red	Combinations of cyan and magenta, with a much higher proportion of cyan than magenta.	 3A00	 3200	 53A0	 6400
Mississippian M	Bluish purple	Combinations of cyan and magenta, with the proportion of cyan only slightly higher than magenta.	 1100	 4300	 5400	 6500
Devonian D	Grayish purple	Combinations of equal or nearly equal proportions of magenta and cyan plus a low proportion of yellow.	 32A0	 3310	 54A0	 6410
Silurian S	Reddish purple	Combinations of magenta and cyan, with proportionally more magenta than cyan.	 1200	 1500	 3400	 3620
Ordovician O	Subdued red	Light tints of magenta or combinations of a high proportion of magenta with low proportions of yellow and cyan.	 03A0	 1310	 2410	 2630
Cambrian C̄	Reddish brown	Combinations of magenta and yellow in equal or nearly equal proportions plus a low proportion of cyan.	 0120	 1430	 1660	 3640
Precambrian* pC̄	Olive brown, olive, gray, olive blue, reddish olive	Combinations of equal or nearly equal proportions of yellow, magenta, and cyan.	 11A0	 4430	 1240	 3560
			 2140	 5370	 3220	 6430

*Includes Proterozoic and Archean.

	map_unit *	symbol	age_label	age_oldest	age_youngest
6	Jdap	0X00	Jurassic	Jurassic	Jurassic
7	pMm	6540	Pre-Mississippian	Pre-Mississippian	Pre-Mississippian
8	Jdfi	0X00	Jurassic	Jurassic	Jurassic
9	Jcp	0X00	Jurassic	Jurassic	Jurassic
10	Tg	04X0	Tertiary	Tertiary	Tertiary
11	pMg	4450	Pre-Mississippian	Pre-Mississippian	Pre-Mississippian
12	pMq	4660	Pre-Mississippian	Pre-Mississippian	Pre-Mississippian
13	pMoq	4760	Pre-Mississippian	Pre-Mississippian	Pre-Mississippian
14	MJdf	0X00	Jurassic or pre-Mississippian	Jurassic or pre-Mississi...	Jurassic or pre-Mississi...
15	JKdl	0X00	Jurassic or younger	Jurassic or younger	Jurassic or younger
16	uPzst	3330	upper Paleozoic	upper Paleozoic	upper Paleozoic
17	uPzv	5550	upper Paleozoic	upper Paleozoic	upper Paleozoic
18	Jdhg	0X00	Jurassic	Jurassic	Jurassic
19	uPzl	6550	upper Paleozoic	upper Paleozoic	upper Paleozoic
20	MDag	3760	Mississippian to Devonian	Devonian	Mississippian
21	Jc	0320	Jurassic	Jurassic	Jurassic
22	MDog	3750	Mississippian to Devonian	Devonian	Mississippian
23	Jt	2X40	Jurassic	Jurassic	Jurassic
24	pMqgs	2240	Pre-Mississippian	Pre-Mississippian	Pre-Mississippian
25	pMaf	2320	Pre-Mississippian	Pre-Mississippian	Pre-Mississippian
26	pMam	4540	Pre-Mississippian	Pre-Mississippian	Pre-Mississippian
27	pMa	3320	Pre-Mississippian	Pre-Mississippian	Pre-Mississippian
28	pMsg	3460	Pre-Mississippian	Pre-Mississippian	Pre-Mississippian
29	uPzmg	6550	upper Paleozoic	upper Paleozoic	upper Paleozoic
30	Jg	0X00	Jurassic?	Jurassic?	Jurassic?
31	TJcp	7XX0	Jurassic to Tertiary?	Jurassic	Tertiary?

- Clean up DMU ages: lower cases, ?s, adjectives
- Map all potential ages to FGDC Ages

Suggested Colors for Geologic Maps

Table 1. Suggested colors for geologic maps. CMYK values: A = 8%, 1 = 13%, 2 = 20%, 3 = 30%, 4 = 40%, 5 = 50%, 6 = 60%, 7 = 70%, X = 100%.

	Geologic age	Basic color	Color combination	Selected color samples			
1	Quaternary Q	Yellow or no color (white)	Tints of yellow (30% and 50% are best to use, except in narrow bands or very small areas) or no color (white).				
2	Tertiary T	Orange, yellowish orange, tan, brown	Combinations of yellow and magenta, with proportionally more yellow than magenta.				
3	Cretaceous K	Yellow green or olive green	Combinations of yellow and cyan, with proportionally more yellow than cyan; the addition of a small proportion of magenta produces olive greens.				
4	Jurassic J	Green	Combinations of yellow and cyan in equal or nearly equal proportions. Note: in theory, this is the correct color for Jurassic; however, in practice it is well to lean toward the conventional "blue greens" when possible.				
5	Triassic R	Blue green	Combinations of yellow and cyan, with proportionally more cyan than yellow.				
6	Permian P	Blue	Tints of cyan; a small proportion of magenta is often needed to increase contrast.				
7	Pennsylvanian P	Blue with red	Combinations of cyan and magenta, with a much higher proportion of cyan than magenta.				
8	Mississippian M	Bluish purple	Combinations of cyan and magenta, with the proportion of cyan only slightly higher than magenta.				
9	Devonian D	Grayish purple	Combinations of equal or nearly equal proportions of magenta and cyan plus a low proportion of yellow.				
10	Silurian S	Reddish purple	Combinations of magenta and cyan, with proportionally more magenta than cyan.				
11	Ordovician O	Subdued red	Light tints of magenta or combinations of a high proportion of magenta with low proportions of yellow and cyan.				
12	Cambrian €	Reddish brown	Combinations of magenta and yellow in equal or nearly equal proportions plus a low proportion of cyan.				
13	Precambrian* p€	Olive brown, olive, gray, olive blue, reddish olive	Combinations of equal or nearly equal proportions of yellow, magenta, and cyan.				

*Includes Proterozoic and Archean.

Symbol: A640

Description of Map Units Symbol Age: Tertiary

map_unit *	symbol	age_label	age_oldest	age_youngest
Tg	A640	Tertiary	Tertiary	Tertiary

FGDC Standard Symbol Age: Cambrian

Name	Type	Category
 A640	Polygon symbol	Cambrian

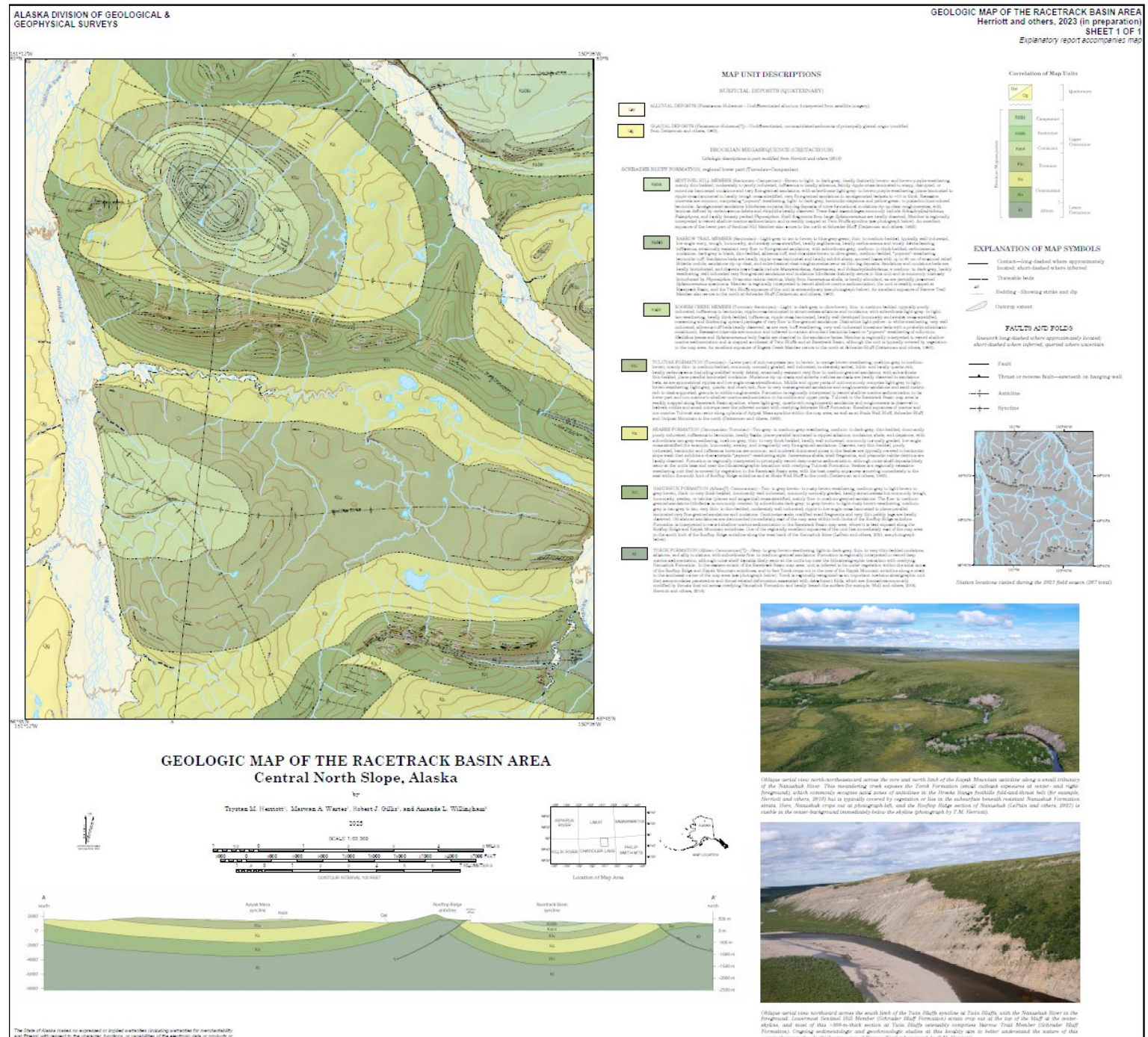
= Age Mismatch of 10

CHECK DMU COLOR AGES TOOL

DEMO

Color Distance Assessment

- **Color Age Assessment**
 - **10/10** Match



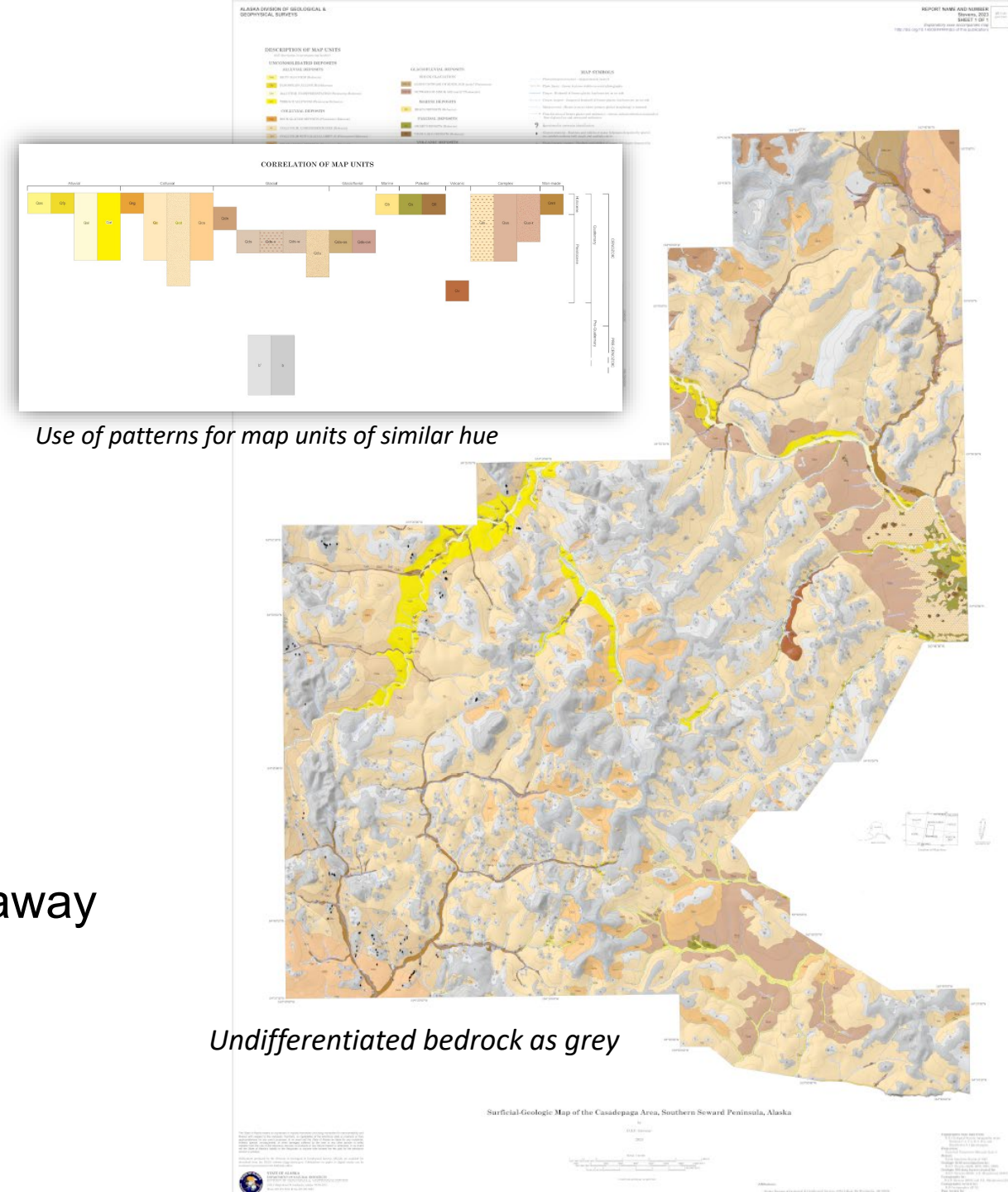
High Legibility, Low Age Accuracy

Color Distance Assessment

- Average Distance= **59.9**
- **24/24** Map Units= Great (>30)

Color Age Assessment

- Map Units with correct age: **5/25**
- Map Units with incorrect age: **20**
 - 9** map units within **3** age categories
 - 11** map units more than **10** categories away



Color Metrics

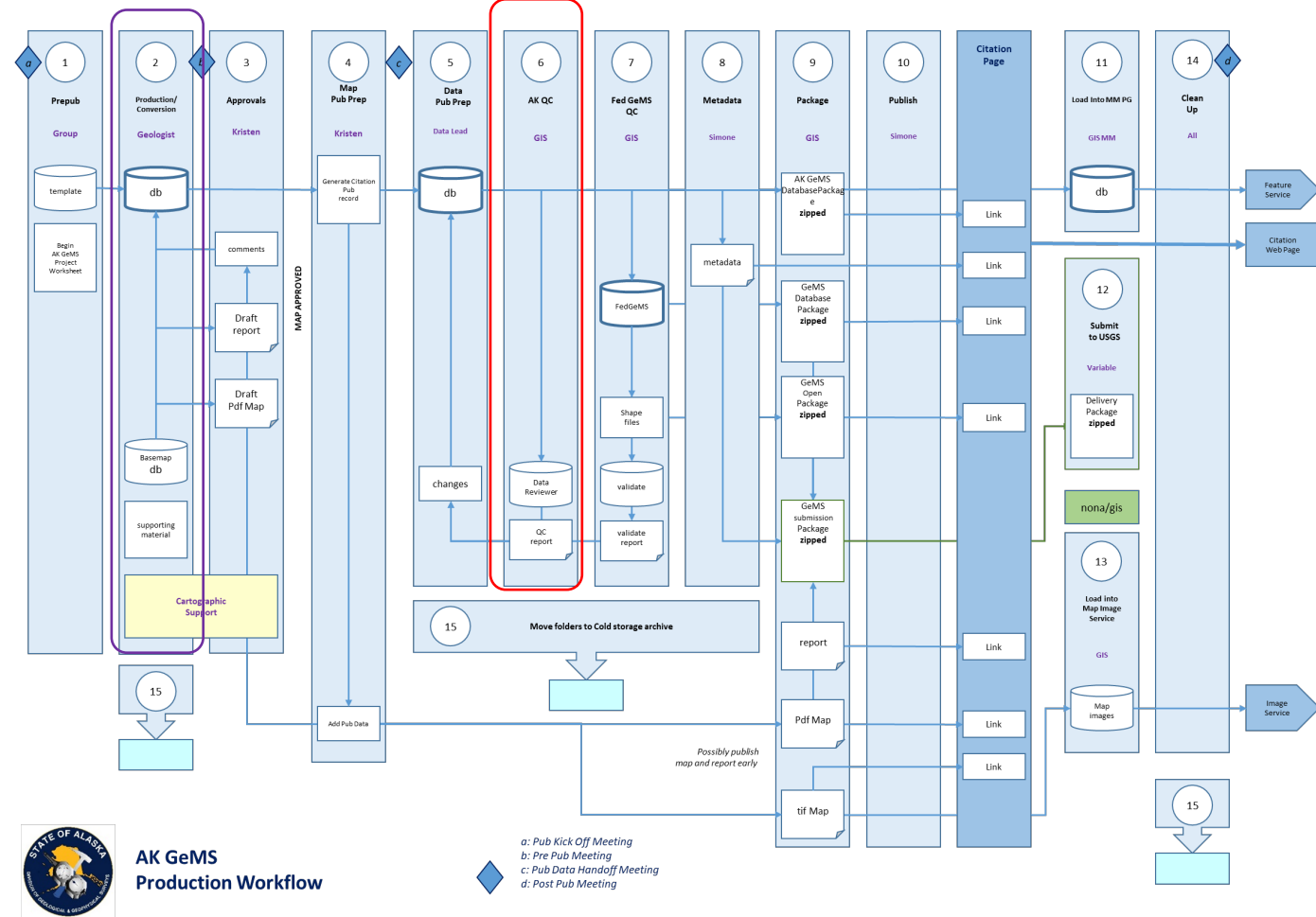
Phase 2

Aid geologists in database and map production

Phase 6

More robust QC

AK GeMS Production Workflow



QUESTIONS

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