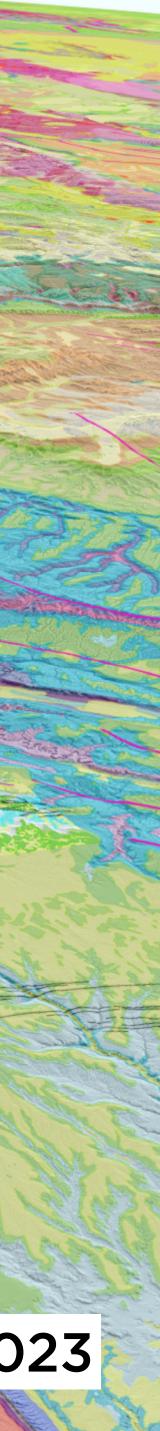
Building a useful (and persistently-identified) digital crust

Daven P. Quinn, UW–Madison Department of Geoscience

https://macrostrat.org/map

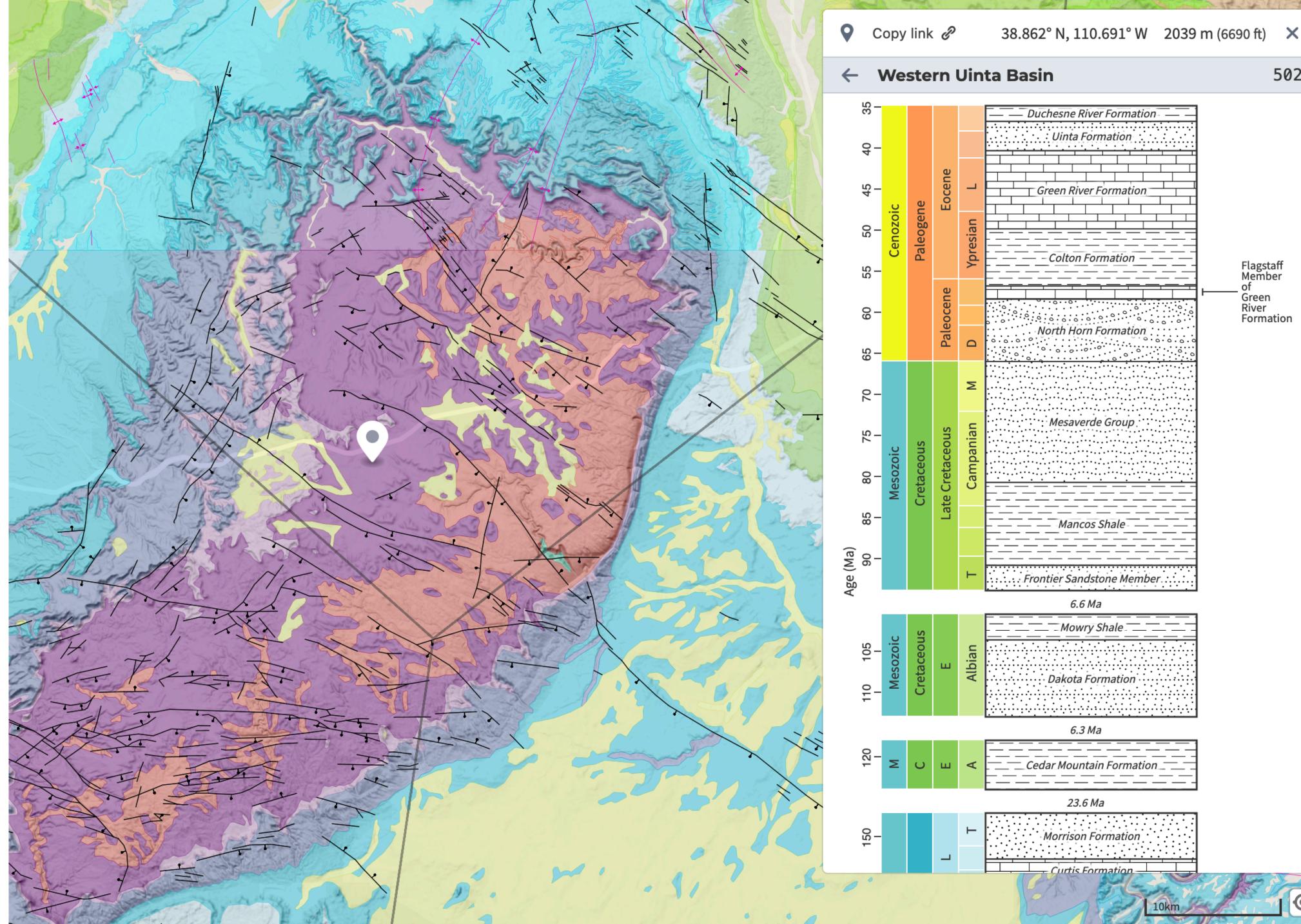






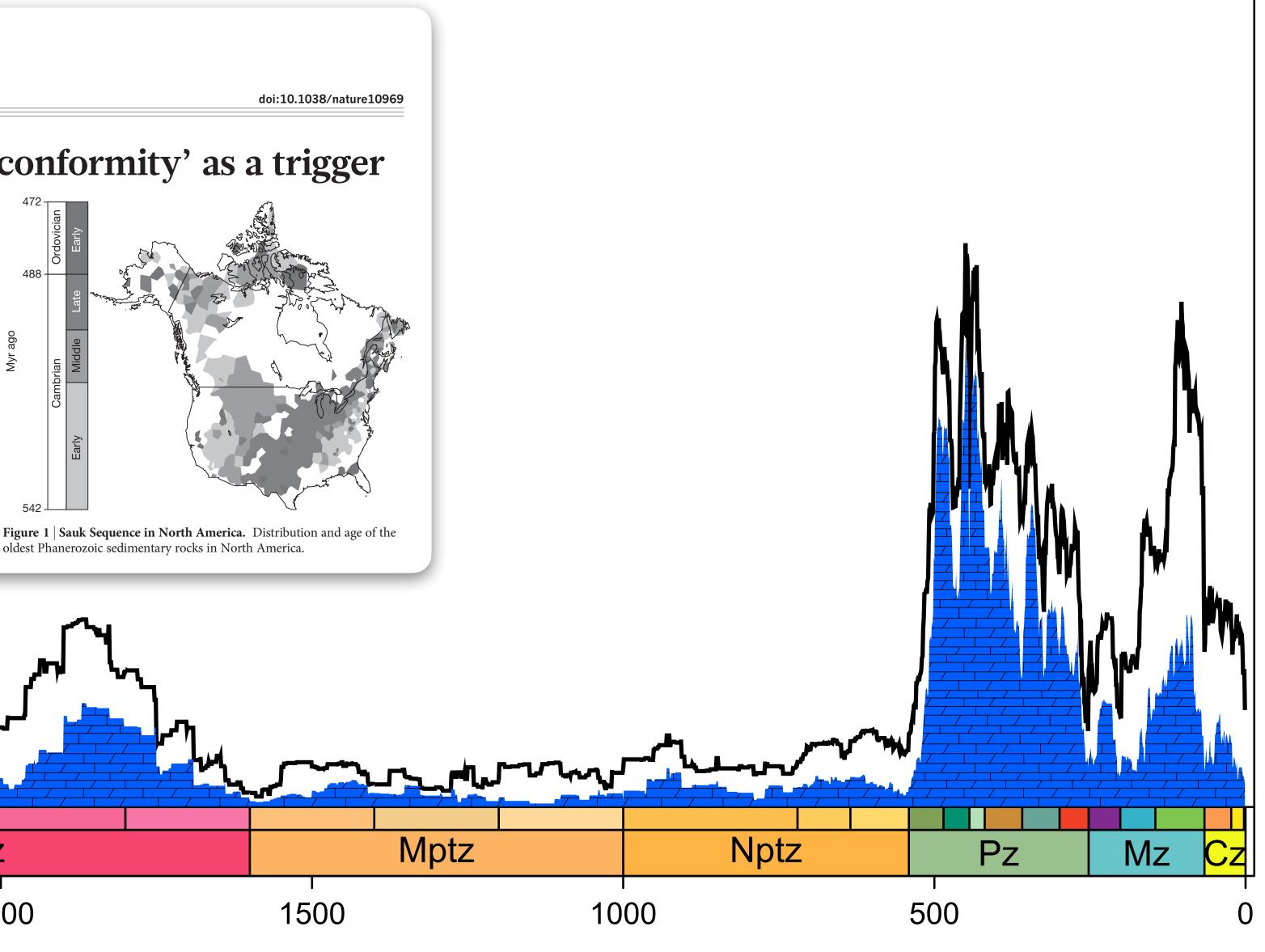
MACROSTRAT

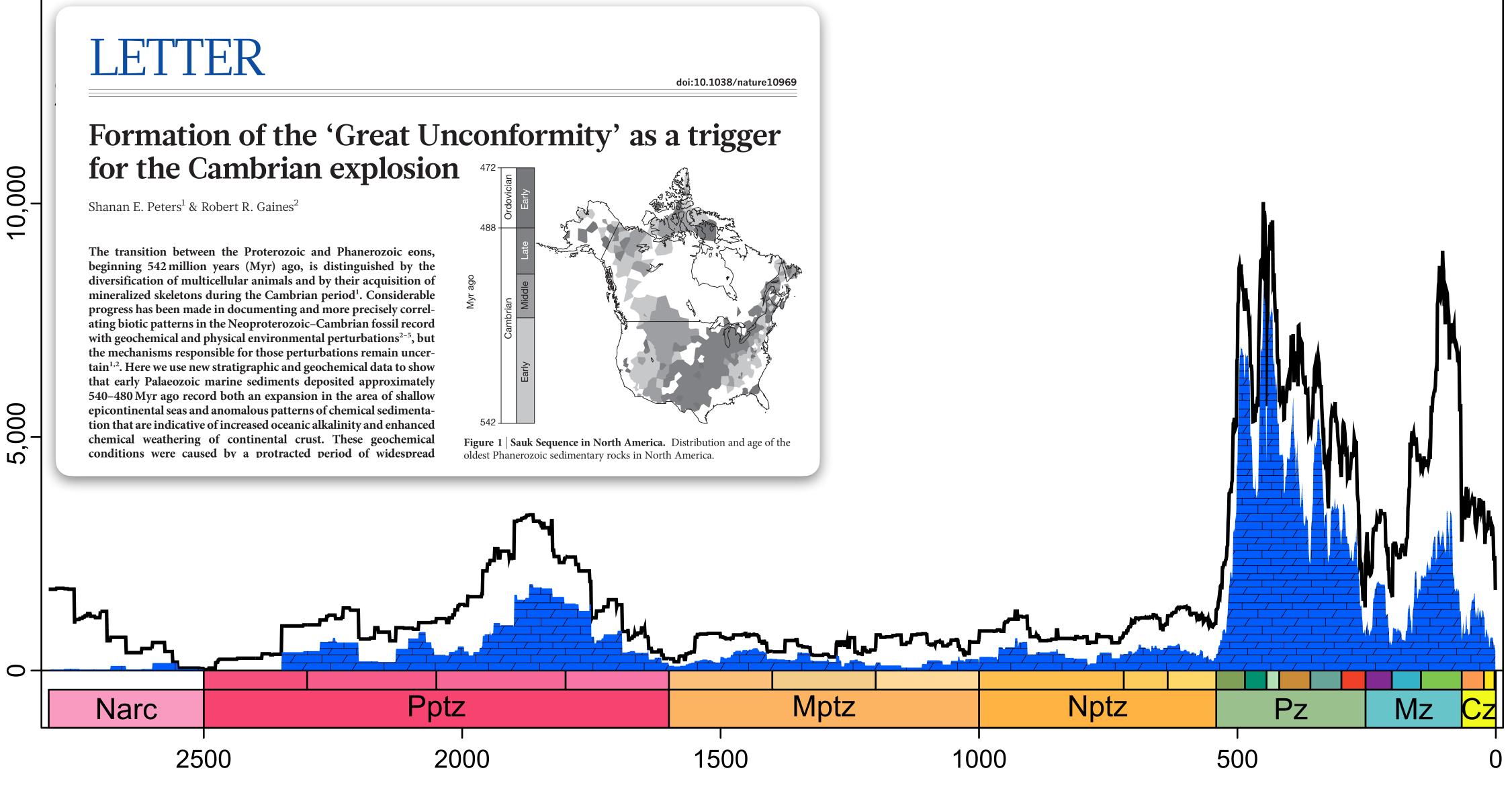
A quantitative, descriptive data system for geological information



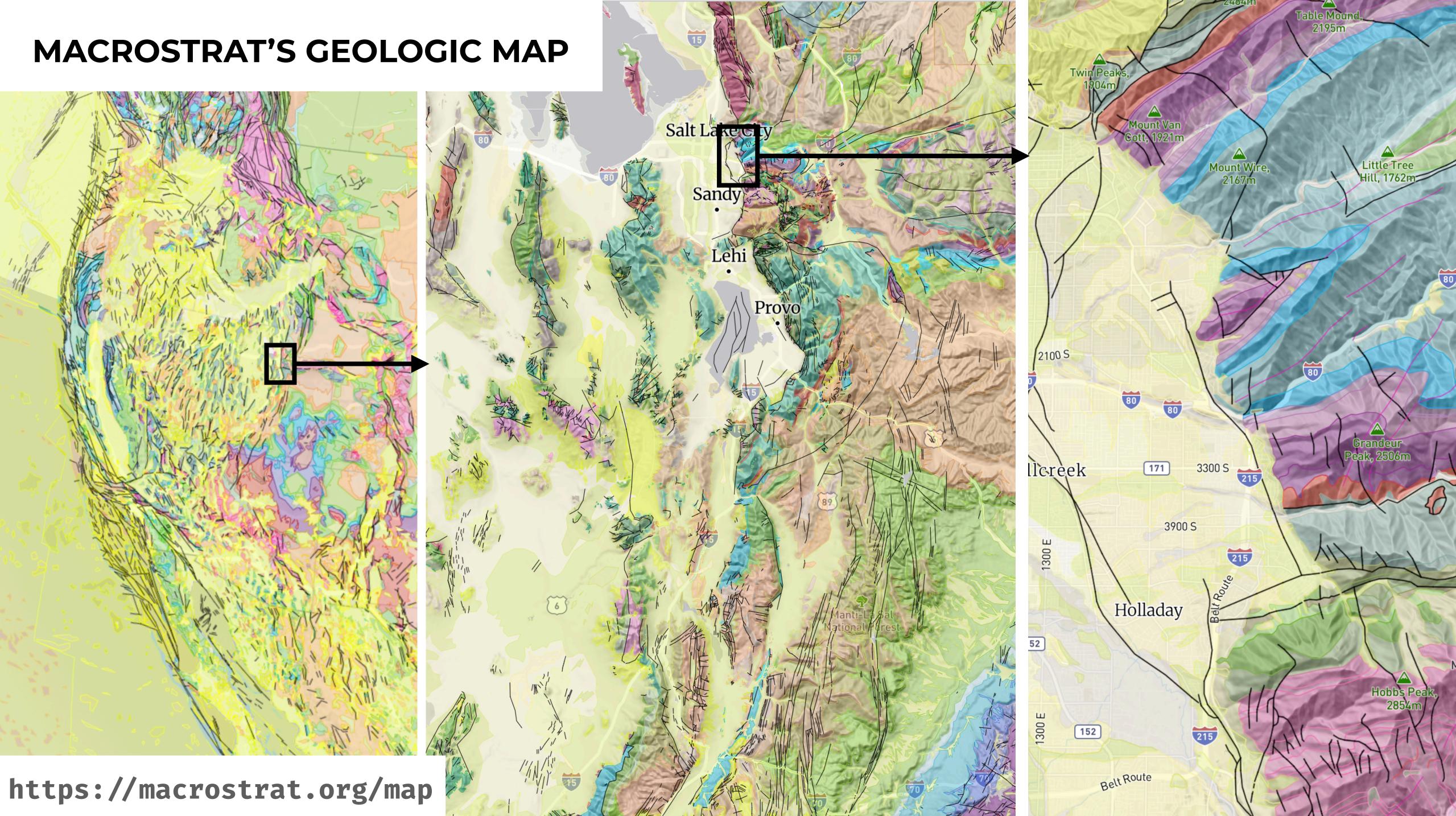


Shallow-marine sedimentary rock area through geologic time

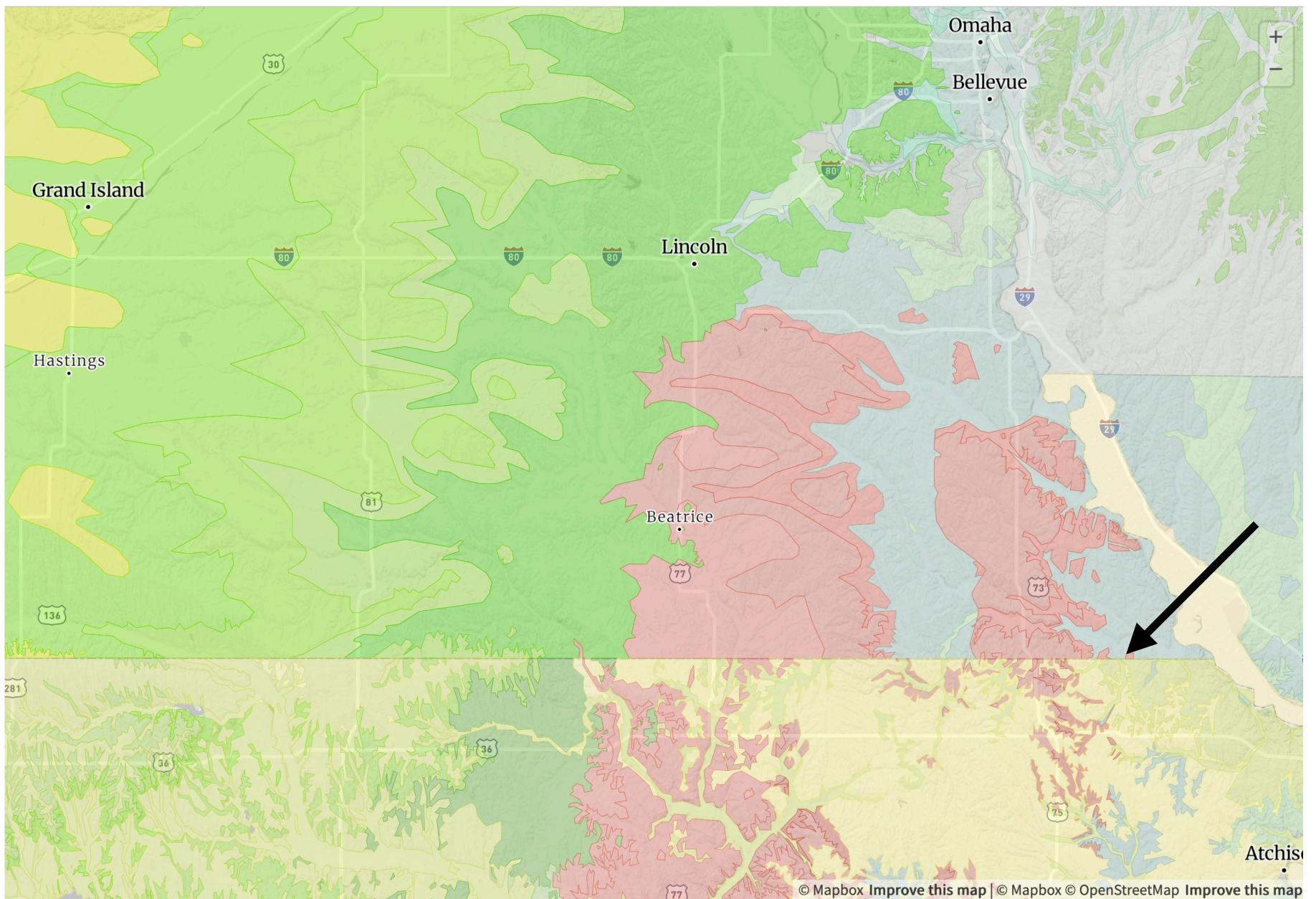




Geologic time (Ma)



Macrostrat's geologic map punts on hard problems!

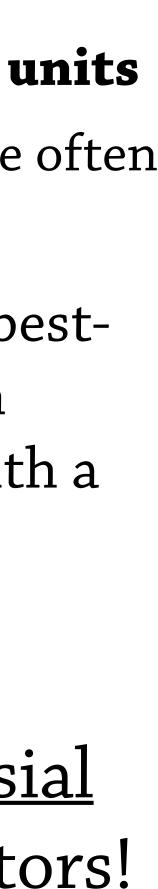


• NOT seamless map units

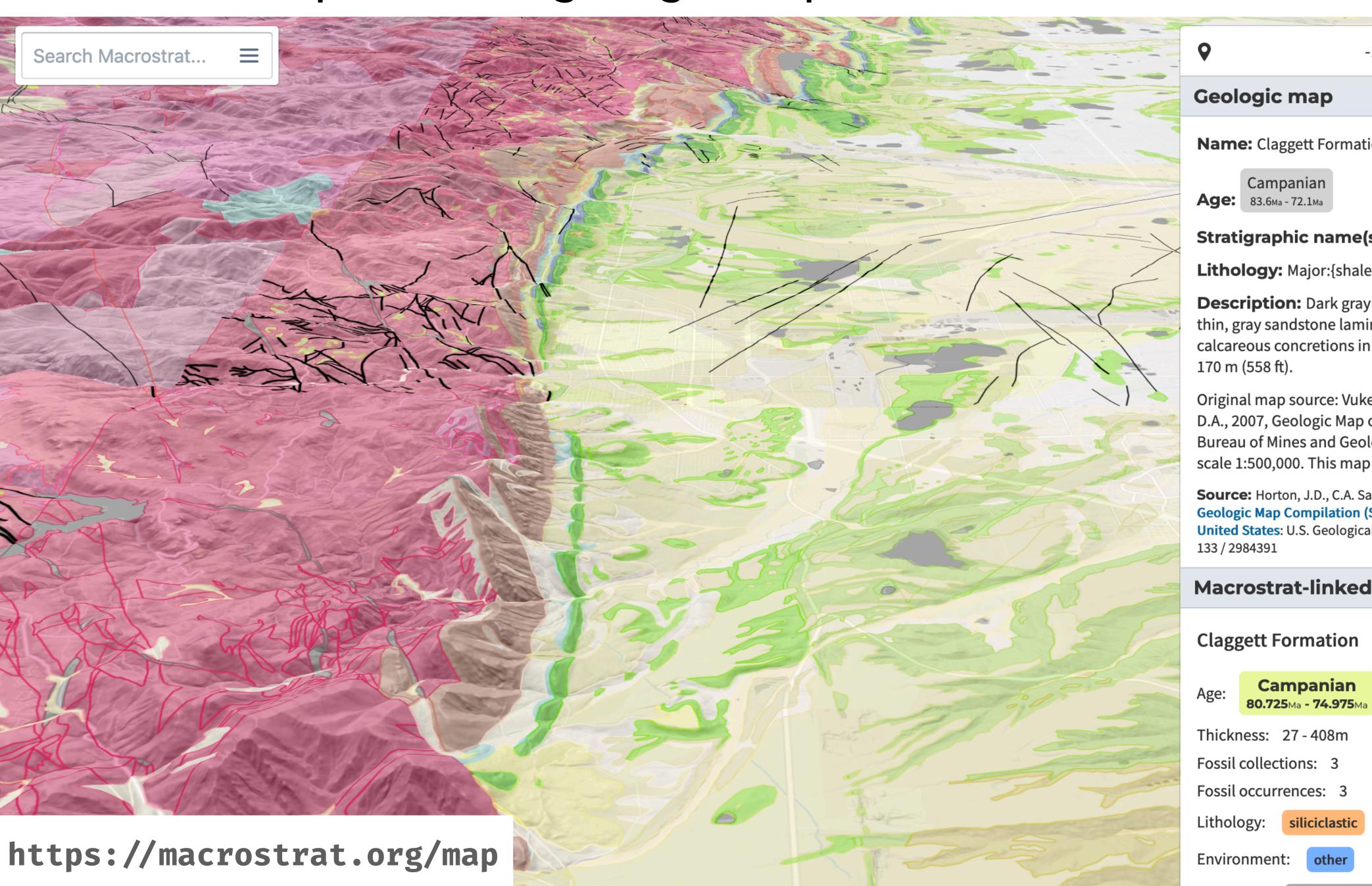
• Source boundaries are often quite apparent

Not a single map...a besteffort harmonization across many maps with a variety of core assumptions

<u>This is controversial</u> among data curators!



Macrostrat – A platform for geological exploration



Web interface

-110.6935, 48.2710 881m | 2890ft 🛛 🗙

Name: Claggett Formation

Stratigraphic name(s): Claggett Formation

Lithology: Major:{shale}, Minor:{sandstone}

Description: Dark gray to gray shale that weathers brown, with thin, gray sandstone laminae and beds in upper or middle part and calcareous concretions in lower part. Marine. Thickness as much as

Original map source: Vuke, S.M., Porter, K.W., Lonn, J.D., and Lopez, D.A., 2007, Geologic Map of Montana - Compact Disc: Montana Bureau of Mines and Geology: Geologic Map 62-C, 73 p., 2 sheets, scale 1:500,000. This map was digitized in 2012 as a r... 🗸

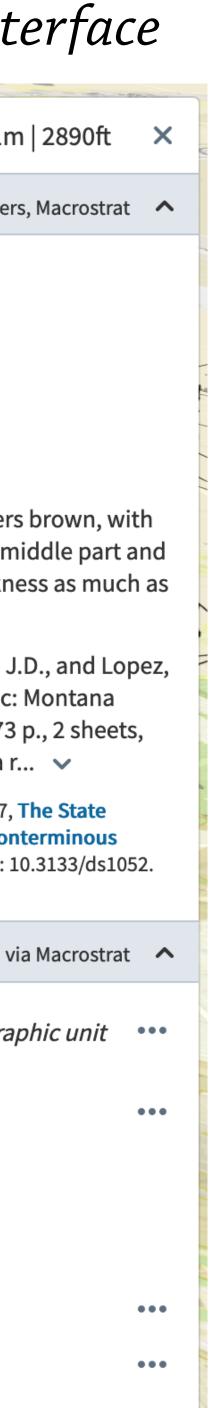
Source: Horton, J.D., C.A. San Juan, and D.B. Stoeser, 2017, The State Geologic Map Compilation (SGMC) geodatabase of the conterminous United States: U.S. Geological Survey Data Series 1052, doi: 10.3133/ds1052.

Macrostrat-linked data

Matched stratigraphic unit

Refined using the Macrostrat age model.

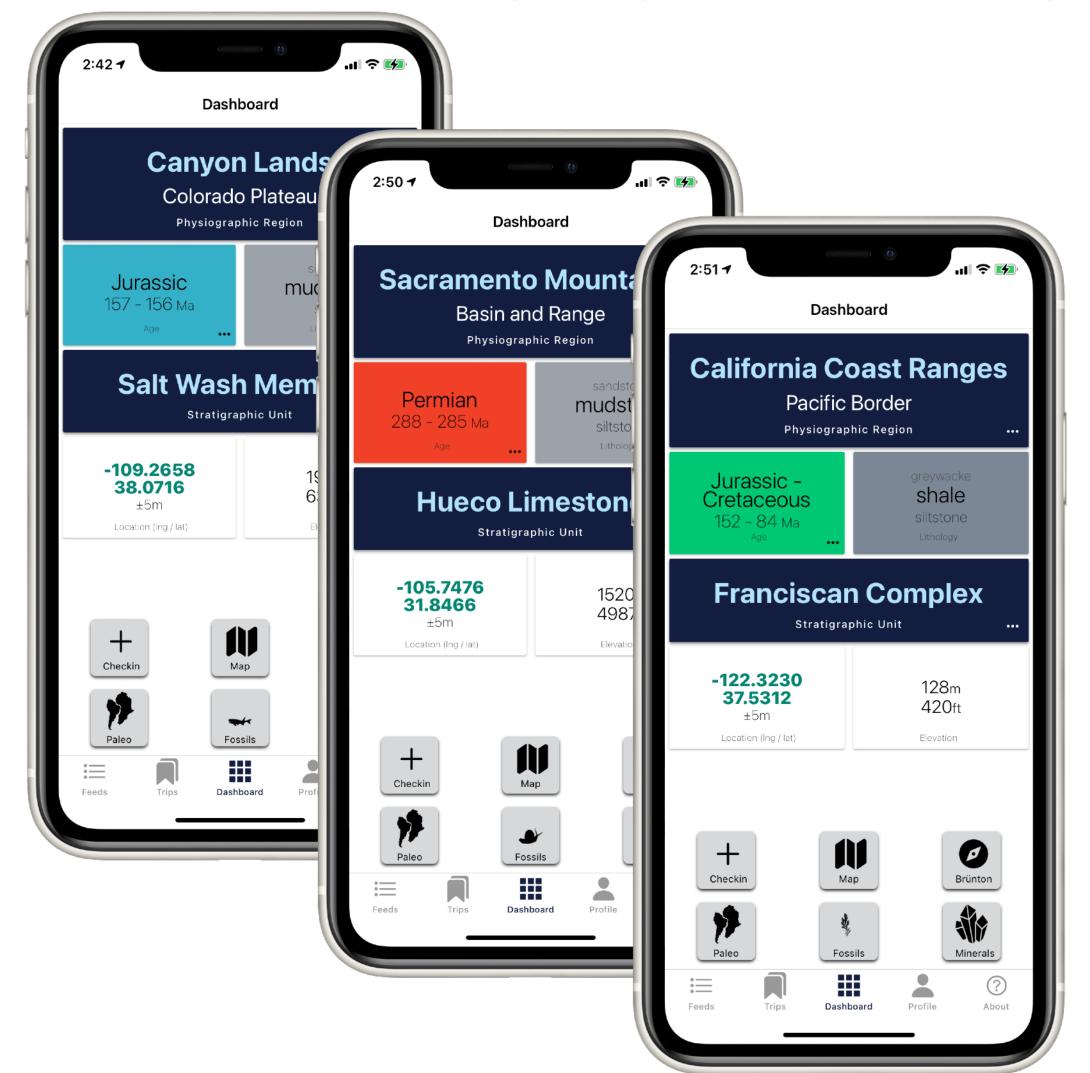
via providers, Macrostrat 🔷





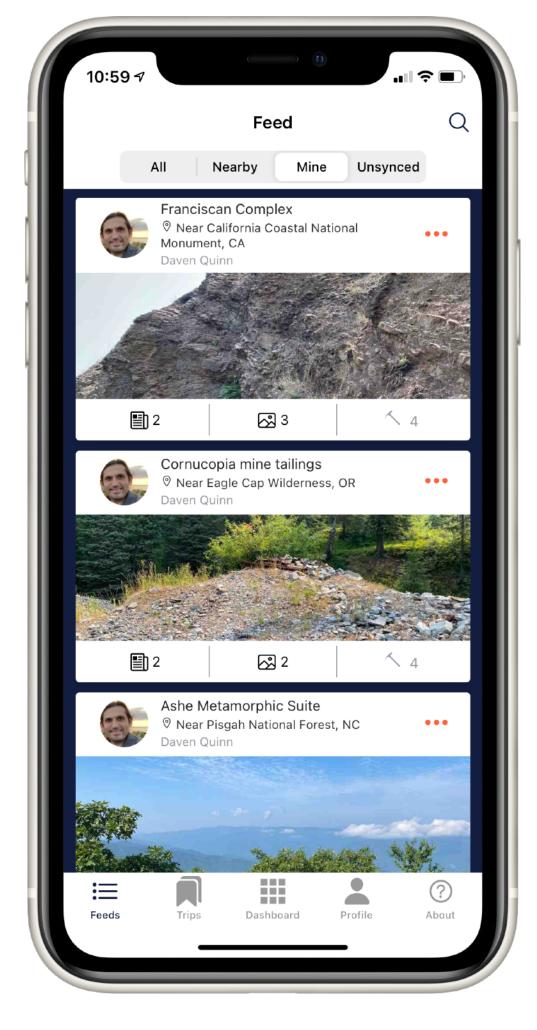
Rockd https://rockd.org

Understand your geological surroundings Explore Macrostrat's map





View and contribute local observations

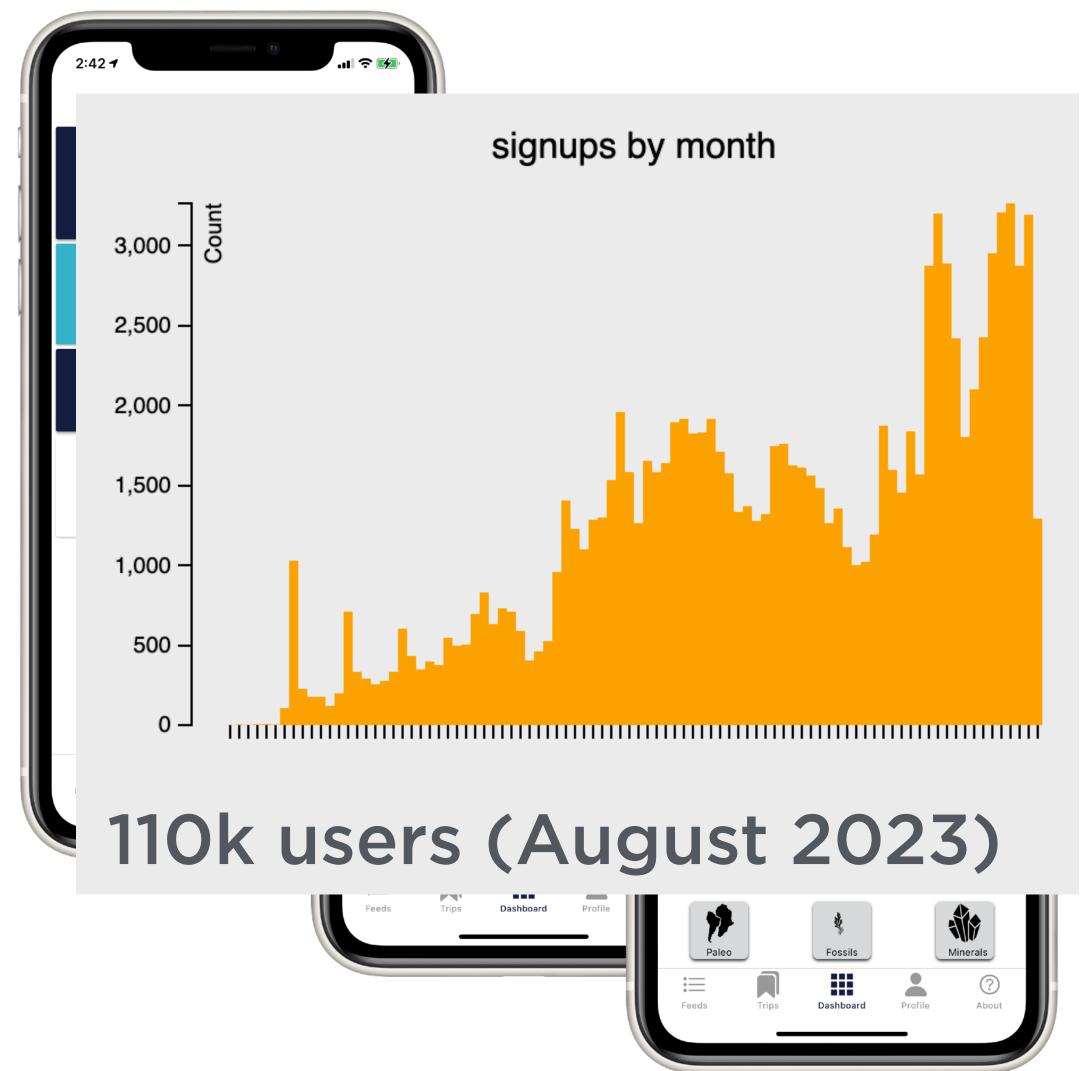






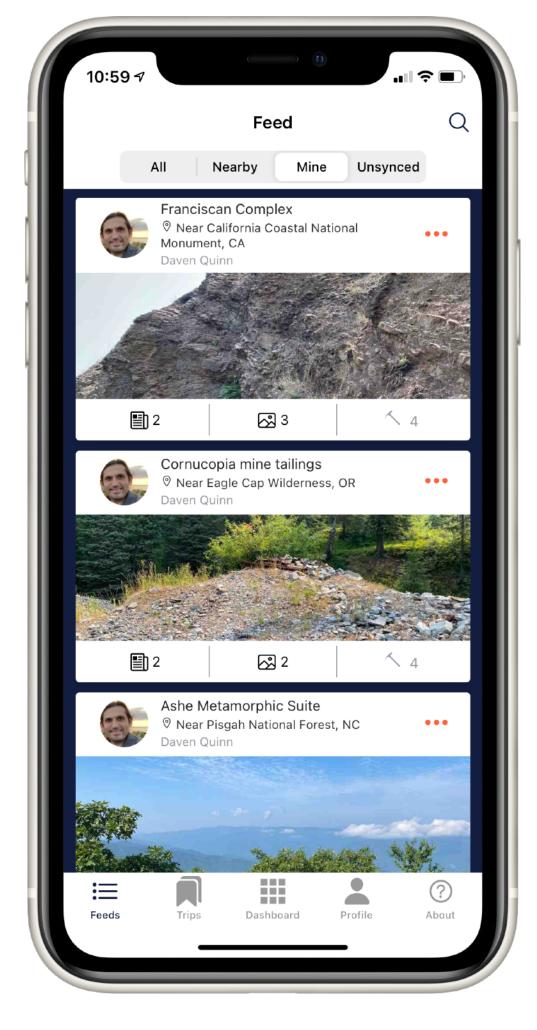
Rockd https://rockd.org

Understand your geological surroundings Explore Macrostrat's map





View and contribute local observations





GETTING MORE GEOLOGICAL INFORMATION INTO THIS FRAMEWORK

Detrital-zircon geochronology

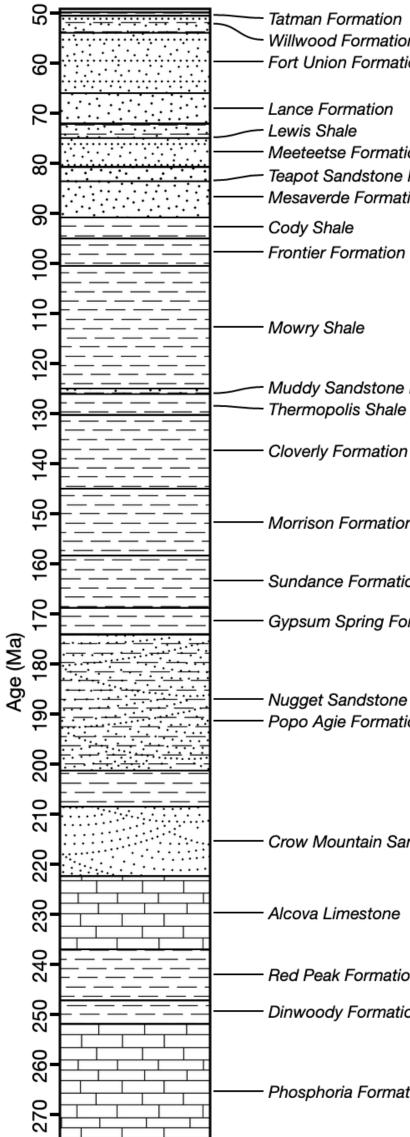
Lance Formation 3.5 2.5 0.5 1.5 Age (Ga) **Meeteetse Formation** 1.5 2.5 3.5 0.5 2 3 Age (Ga) **Mesaverde Formation**

1.5

Age (Ga)

0.5

Bighorn Basin



3.5

2.5

Tatman Formation Willwood Formation Fort Union Formation

Lance Formation Meeteetse Formation Teapot Sandstone Member Mesaverde Formation

Muddy Sandstone Member Thermopolis Shale

Cloverly Formation

Morrison Formation

Sundance Formation

Gypsum Spring Formation

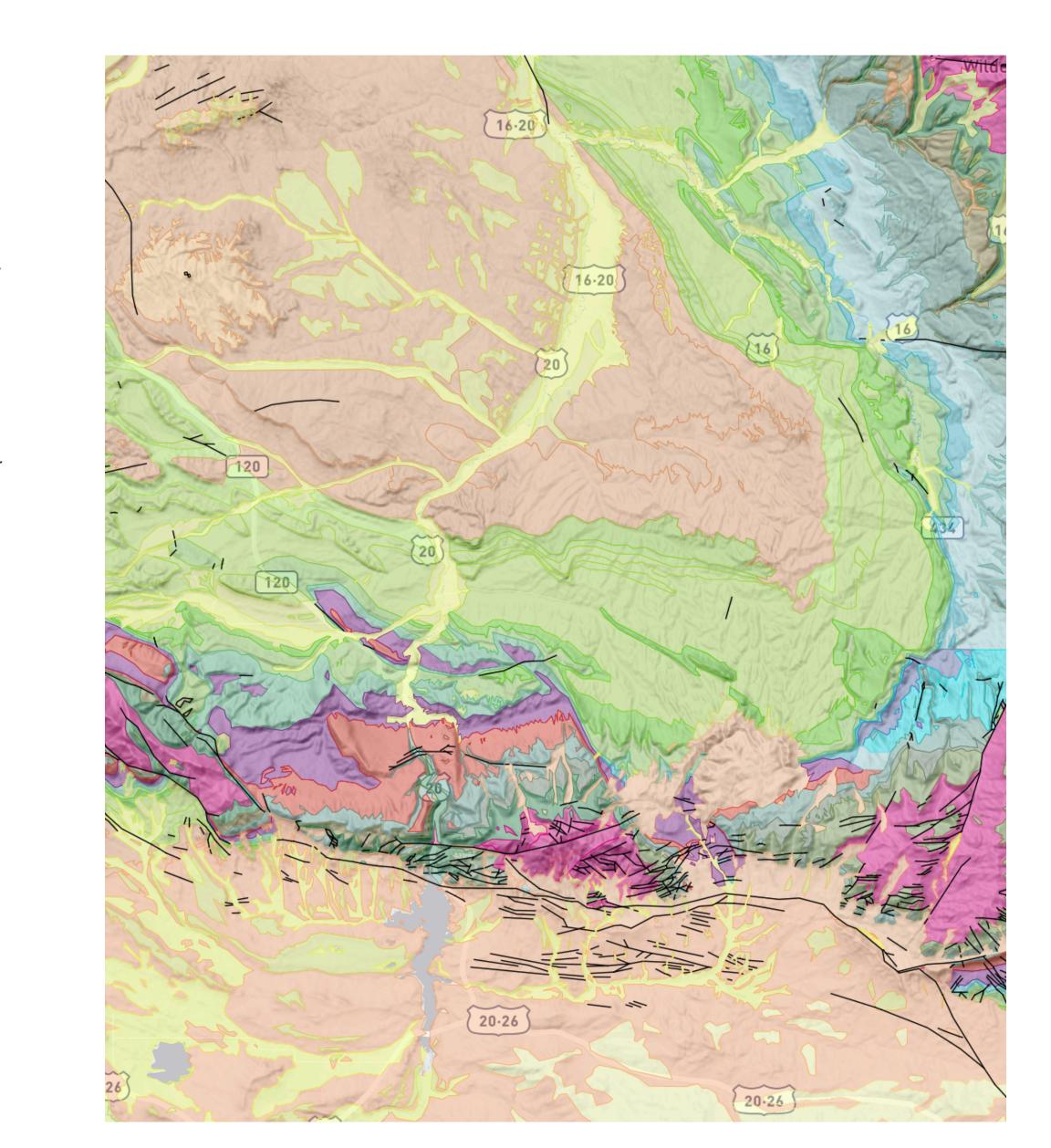
Nugget Sandstone Popo Agie Formation

Crow Mountain Sandstone

Alcova Limestone

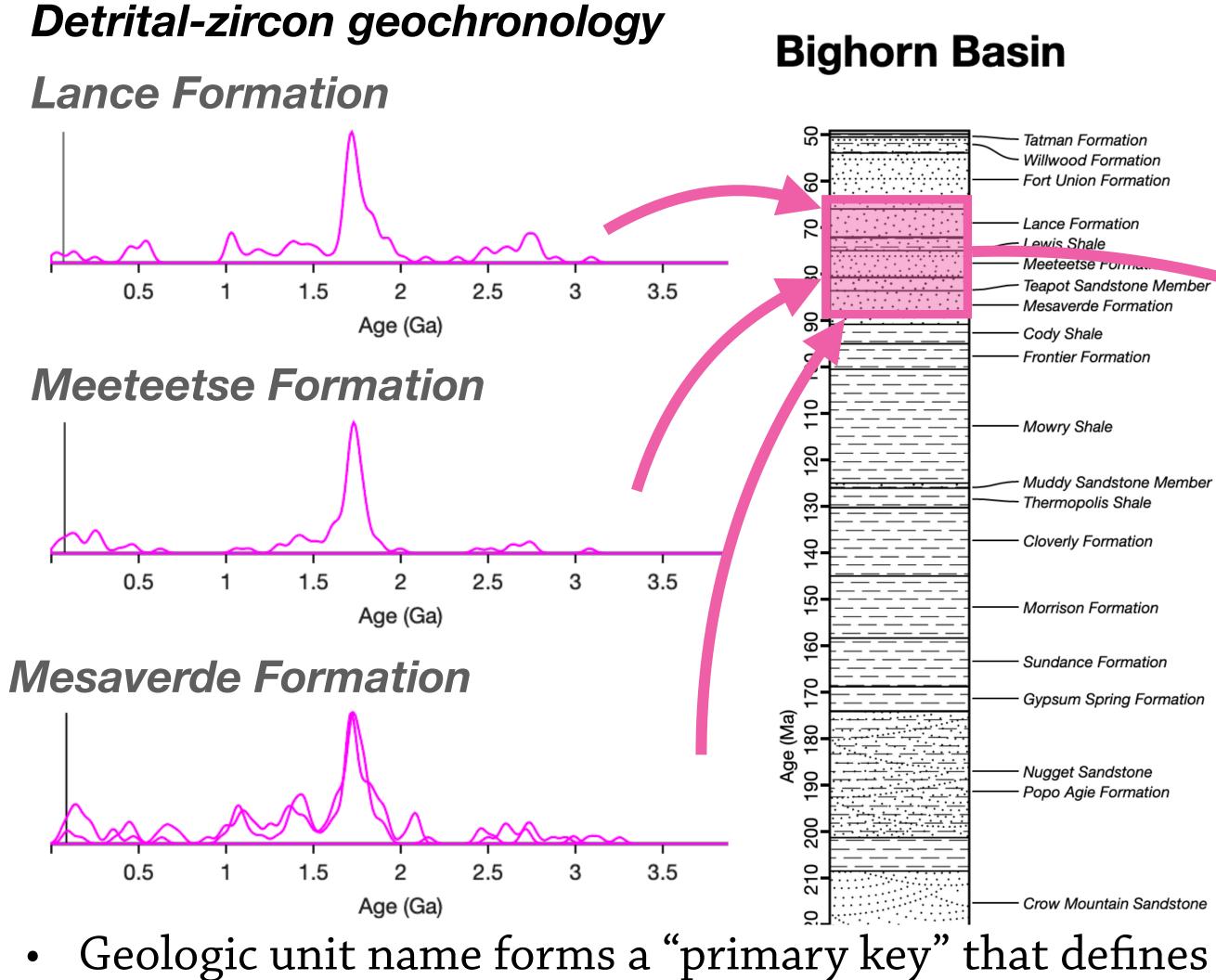
Red Peak Formation

Dinwoody Formation

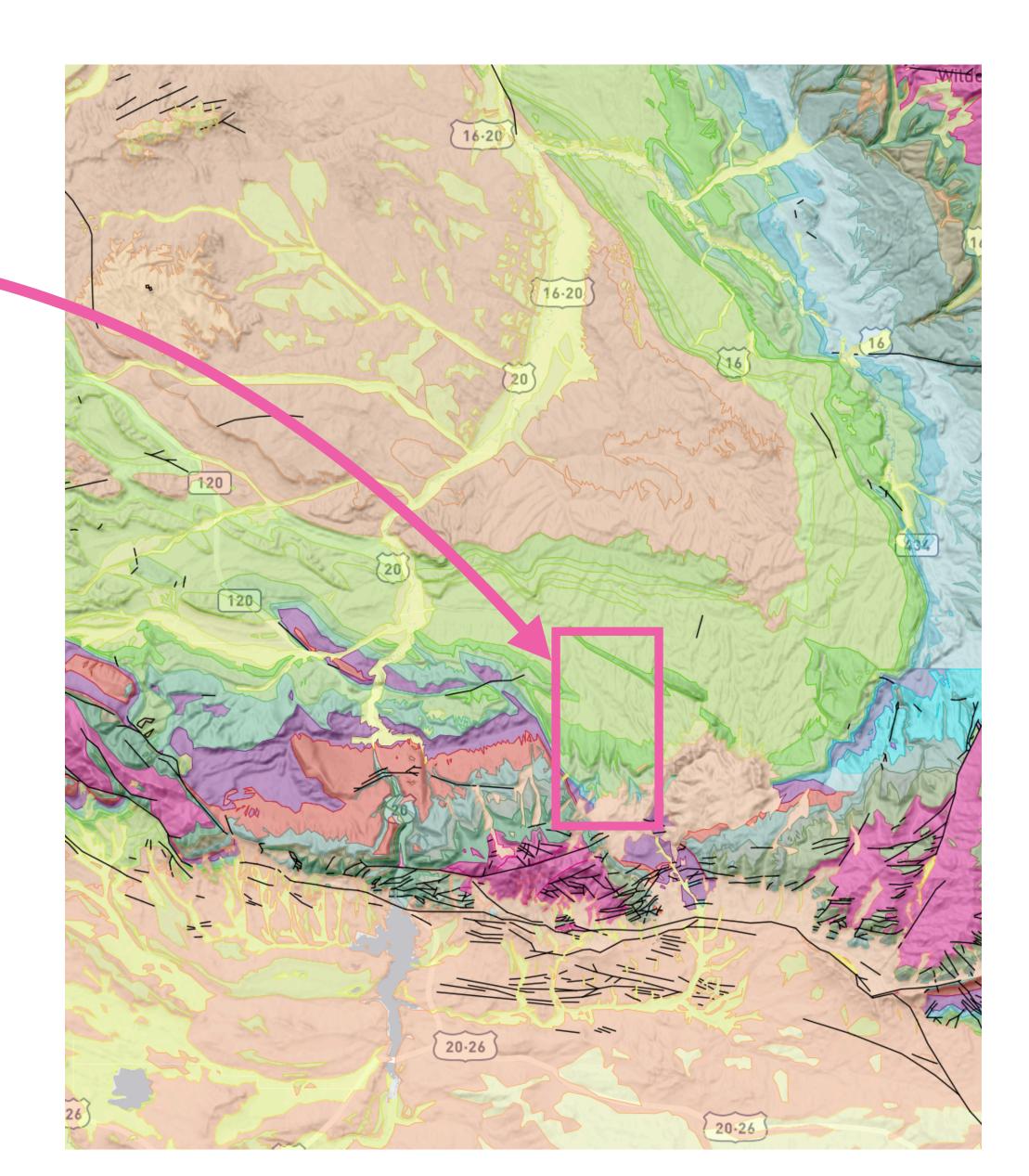


Phosphoria Formation

GETTING MORE GEOLOGICAL INFORMATION INTO THIS FRAMEWORK



- the relationship!
- Of course, labs often don't track this data 😕 \bullet



SOLUTION: METADATA TRACKING!

Need for good metadata is recognized in geoscience

USGS has a metadata mandate, supported by workflows, data curation staff, and tools



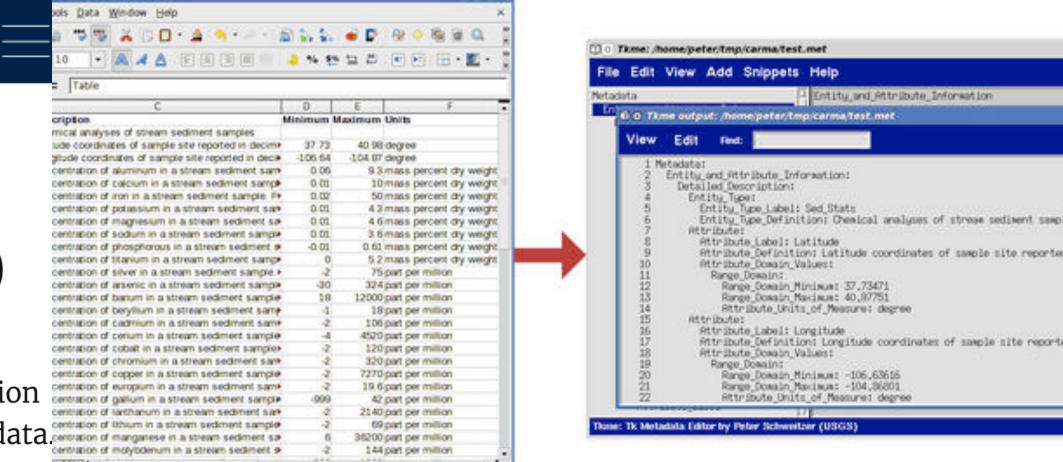
DATA MANAGEMENT

Describe (Metadata/Documentation)

By Data Management

Throughout the data lifecycle process, documentation must be updated to reflect actions taken upon the data This includes acquisition, processing, and analysis, but may touch upon any stage of the lifecycle. Updated and complete metadata are critical to maintaining data quality.

Exhortative explainer for agency staff



. . . .

Vocabulary management interface

0 0

- iii 1004

Samed

	Data Quality	Spatial Entity and Attribute Distribution Metada	ata R
Provide general Information ab	out the dataset.		*
Citation		FGDC Validation Errors	x
		The value for 'origin' cannot be empty	<u> </u>
Dataset Title	Where' and When' (Example: Point Lage)	Element 'pubdate': " is not a valid value of the union type 'pubdateType'.	
A good lille includes what,	Where', and When'. (Example: Point Locat	The folder of the compty	
		The value for 'abstract' cannot be empty The value for 'purpose' cannot be empty	=
Dataset Author/ Originator		Element 'begdate': " is not a valid value of the union type 'begdateType'.	
-	t the organization and/or person(s)	Element 'enddate': " is not a valid value of the union type 'enddateType'.	
	Add originator Remov		
		Element 'progress': [facet 'enumeration'] The value " is not an element of the set {'Complete', 'In work',	2
Originator		* The value for 'update' cannot be empty	
		The 'keywords' is missing the expected element(s) 'theme'	
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is this dataset part of a serie			
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Is it a release with an assign			
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Larger Work		The value for 'address' cannot be empty The value for 'city' cannot be empty The value for 'state' cannot be empty	

Scary (and required) metadata wizard





Academic labs live in a world of Excel

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try	Mineral	Np	Dim Mass (µg)	rs (μm)	(nmol/g) 4He (nmol/g)	±	U (ppm)	±	Th (ppm)	±	Sm (ppm)	±	eU	4He (ncc)	±	Re (%)	U (ng)	±	Th (ng)	±	Sm (ng)	±	Th/U	(Ma) Raw Dat (Ma)
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	z	1	0.93	31.87	40.559	0.194	155.64	1.87	54.28	1.19	0.00	#DIV/0!	168.4	0.849	0.004	100.0	0.1454	0.002	0.0507	0.001	0.0000	0.000	0.349	44.52
_	z z	2	2.56 4.80	42.38 55.11	138.777 205.913	0.411 0.599	281.86 452.70	5.16 7.12	102.73 195.01	1.47 2.25	0.00	#DIV/0! #DIV/0!	306.0 498.5	7.967 22.152	0.024	100.0	0.7219 2.1728	0.013	0.2631	0.004	0.0000	0.000	0.364	83.53
	Z	2	4.12	49.31	899.300	2.531	5223.55	84.02	846.04	10.48	0.00	#DIV/0!	5422.4	82.973	0.234	100.0	21.5022	0.346	3.4827	0.043	0.0000	0.000	0.162	30.70
	z	2	3.97	50.28	103.972	0.305	305.57	6.53	157.54	3.88	0.00	#DIV/0!	342.6	9.262	0.027	100.0	1.2145	0.026	0.6261	0.015	0.0000	0.000	0.516	56.02
_	Z	2	2.80	44.99	219.658	0.627	491.14	8.68	441.54	8.65	0.00	#DIV/0!	594.9	13.796	0.039	100.0	1.3762	0.024	1.2373	0.024	0.0000	0.000	0.899	68.0
+	z z	2	4.47 2.24	44.66 33.49	136.464 75.761	0.401 0.233	384.74 190.59	6.23 2.96	202.19 204.57	5.45 5.51	0.00	#DIV/0! #DIV/0!	432.3 238.7	13.676 3.807	0.040	100.0	1.7203 0.4273	0.028	0.9040	0.024	0.0000	0.000	0.526	58.2
-	z	2	2.69	39.47	109.186	0.350	334.90	5.97	122.65	1.25	0.00	#DIV/0!	363.7	6.573	0.021	100.0	0.8995	0.016	0.3294	0.003	0.0000	0.000	0.366	55.4
	Z	2	6.57	54.07	275.177	0.780	644.88	8.74	210.52	2.38	0.00	#DIV/0!	694.3	40.509	0.115	100.0	4.2355	0.057	1.3827	0.016	0.0000	0.000	0.326	73.0
_	Z	2	5.38	64.13	85.671	0.250	215.25	4.45	109.17	1.52	0.00	#DIV/0!	240.9	10.339	0.030	100.0	1.1589	0.024	0.5878	0.008	0.0000	0.000	0.507	65.5
_	Z Z	2	5.26 50.44	52.62 134.99	33.436 6.811	0.125 0.028	73.13 12.69	1.30 0.24	36.78 8.27	0.62	0.00	#DIV/0! #DIV/0!	81.8 14.6	3.940 7.700	0.015	100.0	0.3844	0.007	0.1934	0.003	0.0000	0.000	0.503	75.36
	z	0	45.01	124.68	16.438	0.058	27.34	0.50	40.64	0.65	0.00	#DIV/0!	36.9	16.584	0.058	99.6	1.2307	0.023	1.8292	0.029	0.0000	0.000	1.486	82.00
	z	0	83.41	152.20	12.787	0.031	25.71	0.56	11.21	0.15	0.00	#DIV/0!	28.3	23.907	0.058	100.0	2.1445	0.046	0.9354	0.013	0.0000	0.000	0.436	83.09
_	Z	0	3.13 2.50	50.94 47.43	43.511 0.020	0.271 0.010	101.75 0.00	3.08 #DIV/0!	31.21 1.31	0.70	0.00	#DIV/0! #DIV/0!	109.1 0.3	3.051 0.001	0.019	100.0 75.3	0.3184	0.010	0.0977	0.002	0.0000	0.000	0.307 #DIV/0!	73.54
+	z z	1	1.35	37.94	0.020	0.010	0.00	#DIV/0!	5.01	0.03	0.00	#DIV/0!	1.2	0.001	0.001	27.5	0.0000	0.000	0.0068	0.000	0.0000	0.000	#DIV/0!	7.18
	Z	0	3.34	47.32	24.439	0.093	71.81	2.00	18.59	0.25	0.00	#DIV/0!	76.2	1.829	0.007	100.0	0.2398	0.007	0.0621	0.001	0.0000	0.000	0.259	59.2
	z	0	5.81	62.85	0.009	0.003	0.00	#DIV/0!	0.91	0.03	0.00	#DIV/0!	0.2	0.001	0.000	74.6	0.0000	0.000	0.0053	0.000	0.0000	0.000	#DIV/0!	7.39
_	z z	0	2.34 14.86	48.52 87.73	46.766 18.156	0.235 0.075	130.03 28.79	1.74 0.77	102.50 23.87	2.69 0.57	0.00	#DIV/0! #DIV/0!	154.1 34.4	2.457 6.047	0.012	100.0	0.3048	0.004	0.2403	0.006	0.0000	0.000	0.788	56.00
+	Z	2	14.38	74.24	216.536	1.055	337.90	3.79	187.07	2.57	0.00	#DIV/0!	381.9	69.788	0.340	100.0	4.8588	0.055	2.6900	0.000	0.0000	0.000	0.554	104.2
	z	2	14.09	70.48	143.113	0.679	200.18	2.00	114.60	1.02	0.00	#DIV/0!	227.1	45.206	0.215	100.0	2.8211	0.028	1.6150	0.014	0.0000	0.000	0.572	115.7
	z	2	9.65	64.80	178.421	0.728	274.80	4.78	152.76	2.11	0.00	#DIV/0!	310.7	38.579	0.157	99.8	2.6509	0.046	1.4736	0.020	0.0000	0.000	0.556	105.5
	z z	2	9.07 13.67	64.27 73.23	238.133 219.312	0.783 0.578	444.08 381.45	5.44	178.36 160.74	2.49 2.05	0.00	#DIV/0! #DIV/0!	486.0 419.2	48.424 67.186	0.159 0.177	100.0	4.0289 5.2136	0.049	1.6182 2.1970	0.023	0.0000	0.000	0.402	90.19
	z	2	3.66	47.11	0.054	0.003	1.08	0.14	0.00	#DIV/0!	0.00	#DIV/0!	1.1	0.004	0.000	53.2	0.0040	0.000	0.0000	0.000	0.0000	0.000	0.000	9.27
	z	2	4.17	49.82	844.329	4.532	1638.61	44.87	580.49	12.17	0.00	#DIV/0!	1775.0	78.983	0.424	99.7	6.8389	0.187	2.4228	0.051	0.0000	0.000	0.354	87.5
_	Z	2	400.95	212.48	2.629	0.003	0.0416	0.0030	0.5512	0.0115	0.0000	#DIV/0! #DIV/0!	0.1711	23.627	0.026	21.0	0.0167	0.001	0.2210	0.005	0.0000	0.000	13.260	2542.
+	Z Z	0	261.86 59.70	222.52 143.44	2.749 5.279	0.000	0.1212	0.0052	0.0448	0.0018	0.0000	#DIV/0!	0.1317 14.6	16.134 7.064	0.002	2.9 100.0	0.0317	0.001	0.0117	0.000	0.0000	0.000	0.370	2952.
	z	1	1.21	37.32	0.030	0.022	0.00	#DIV/0!	0.00	#DIV/0!	0.00	#DIV/0!	0.0	0.001	0.001	88.9	0.0000	0.000	0.0000	0.000	0.0000	0.000	#DIV/0!	#DIV/
	z	2	8.58	66.01	96.771	0.515	665.51	7.52	371.85	10.09	0.00	#DIV/0!	752.9	18.619	0.099	99.9	5.7127	0.065	3.1919	0.087	0.0000	0.000	0.559	23.79
_	Z 7	2	4.80	50.88	66.388 36.573	0.259 0.184	449.99 249.26	9.75 3.95	281.34	3.24	0.00	#DIV/0! #DIV/0!	516.1 283.7	7.138	0.028	100.0	2.1586 3.4980	0.047	1.3496 2.0576	0.016	0.0000	0.000	0.625	23.8
	z z	2	14.03 9.88	75.23 67.18	41.483	0.184	249.26	4.16	146.62 168.63	1.94	0.00	#DIV/0!	330.9	9.187	0.058	100.0	2.8777	0.055	1.6663	0.027	0.0000	0.000	0.588	23.8
	z	2	11.67	71.88	17.455	0.058	125.12	2.01	78.10	0.97	0.00	#DIV/0!	143.5	4.566	0.015	100.0	1.4604	0.023	0.9115	0.011	0.0000	0.000	0.624	22.52
T	7	2	4.57	51.13	58.987	0.176	439.28	8.90	237.58	4.94	0.00	#DIV/01	495.1	6.042	0.018	100.0	2.0076	0.041	1.0858	0.023	0.0000	0.000	0.541	22.06
	ICP	PMS Data	Spike Bla	anks	Nb Blanks	s M	ultigrain Wo	orksheet	Calculat	tions Page	Alpha	a Ejection C	Compiler	Alph	a Ejectior	n Calcs	Alpha	Ejection	Constant	S (Complete S	Summar	y Table	+

1000s of files spanning 10+ years of operation

Each lab has different file formats, data standards, etc.





Academic labs live in a world of Excel

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I J K L M N O P Q R S T U V W X Y Z AA AB AC AD Mineral Np Dim Mass(μ) rs (μ m) $\frac{4He}{mol/g}$ ± U(ppm) ± Th (ppm) ± Sm (ppm) ± eU 4He (ncc) ± Re (%) U(ng) ± Th (ng) ± Sm (ppm) ± Sm (ppm) ± eU 4He (ncc) ± Re (%) U(ng) ± Th (ng) ± Sm (ppm) ± Sm (ppm) ± Eu Mineral Mineral Np Dim Mass(μ $M_{mol/g}$ ± U(ppm) ± Th (ppm) ± Sm (ppm) ± eU 4He (ncc) ± Re (%) U(ng) ± Th (ng) ± Sm (ng) ± Mineral E Mineral Mineral Mineral Mineral Mineral Sm (pm) ± Sm (pm) ± Sm (pm) ± Sm (pm) ± E Sm (pm) ± E Sm (p	ng) ± Th/U Raw (N	AC AD			For				→.0 For	.00	• % •	· • \$	rge & Center	E 🔛 Me	→				•••• •		В	e 🞺	ste
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$\frac{1}{10000000000000000000000000000000000$	ng) ± 117/0 (N		AB	AA	Z	Y	Х	W	V	U	Т	S	R	Q	Р	0	Ν	Μ	L	К	J	I	
$\frac{1}{(nmol/g)} = 0 \frac{1}{(nmol/g)} = 0 \frac{1}{(pmol/g)} = 0 \frac{1}{(p$		Sm (ng) ±	± S	Th (ng)	±	U (ng)	Re (%)	±	4He (ncc)	eU	±	Sm (ppm)	±	Th (ppm)	±	U (ppm)	±		rs (μm)	Dim Mass (µg)	Np	Miner	
Image: Second state Image: Second state<	ng) ± Th/U Raw (N	Sm (ng) ±	± §	Th (ng)	±	U (ng)	Re (%)	±	4He (ncc)	eU	±	Sm (ppm)	±	Th (ppm)	±	U (ppm)	±		rs (μm)	Dim Mass (µg)	Np	Miner	I
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1000s of files spanning 10+ years of operation

Each lab has different file formats, data standards, etc.









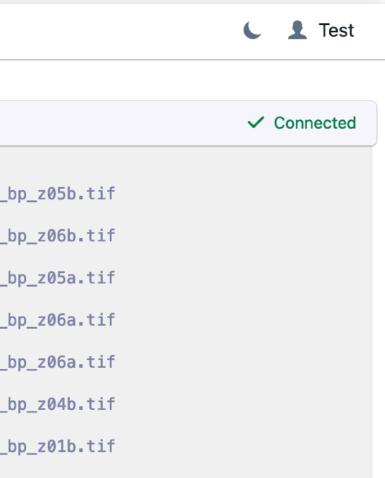
Sparrow

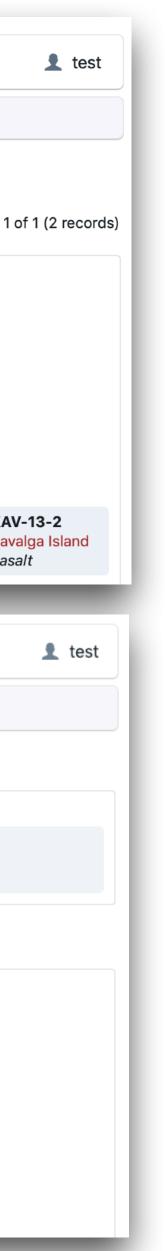
Web-based **metadata management platform** for a geochemical lab's data archive

- Set embargo for projects and samples
- Manage project- and sample-level metadata
- Search and link publications
- Access analytical data
- Import, export, and track original data files

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Projects				
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Eocene to Pleistocene	e magmatic evolution	of the Delarof Islands, Ale	eutian Arc	
Publications Eocene to Pleistocene	e magmatic evolution	of the Delarof Islands, Ale	eutian Arc – doi: 10).1002/2015GC0
Researchers				
No researchers				
Samples				
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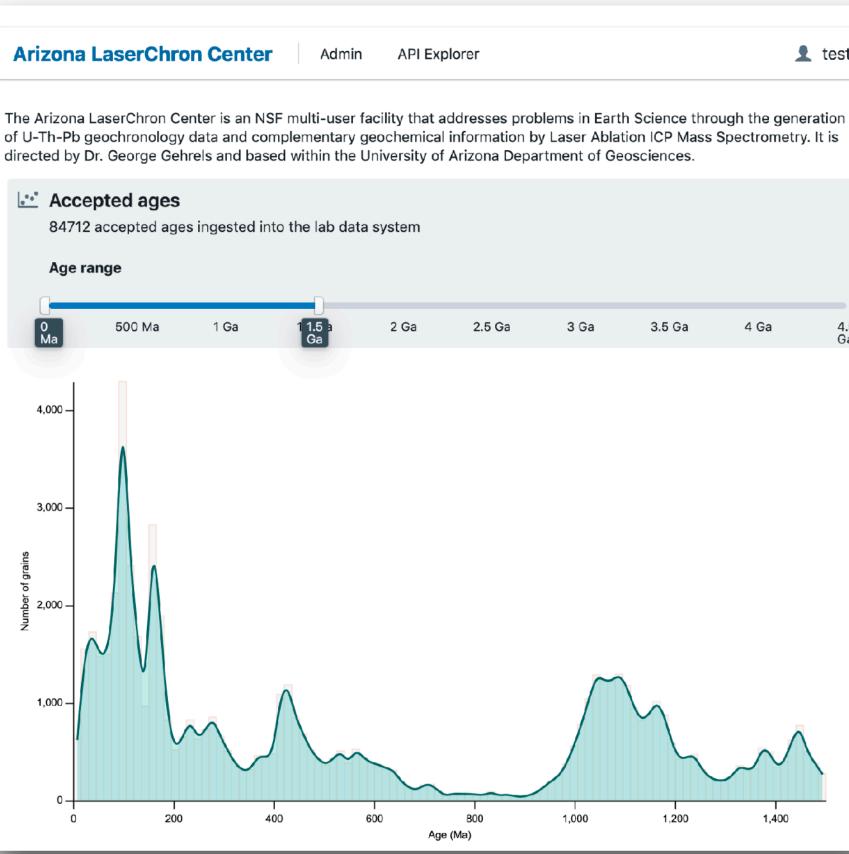




Sparrow's role in labs A public data portal

- Summary statistics
- Publications links
- Maps of samples
- Sample-specific information

- Helps fulfill open-data and reporting requirements
- **Extensible** for methodspecific needs





		👤 test

2.5 Ga	3 Ga	3.5 Ga	4 Ga	4.5 Ga

Boise State IGL

Admin API Explorer

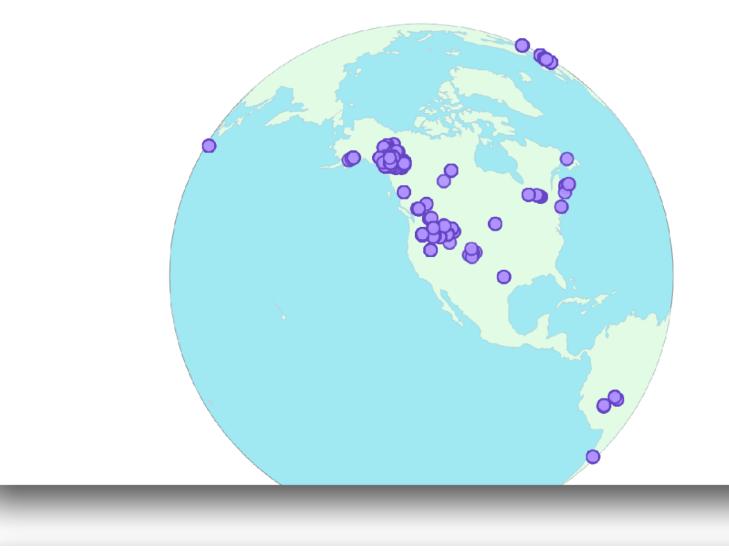
About the lab

The Boise State University Isotope Geology Laboratory (IGL) is a state-of-the-art facility for the analysis of radiogenic isotopes in Earth materials, with a focus on in situ and high-precision geochronology (U-Pb zircon) and tracer isotope geochemistry. These tools can be applied to a variety of problems in igneous and metamorphic petrology, structural geology and tectonics, paleobiological evolution and paleoclimate change in deep time. See our main website for further details

Geochronology data system

The IGL is a node in the EARTHTIME Network for the Calibration of Earth History. It is also a partner in the NSF EarthCube Geochronology Infrastructure project. This Sparrow lab information management system is a product of that collaboration.

1707 measurements have been linked to their geologic metadata



WiscAr API Explorer Admin

About the lab

WiscAr is the Argon geochronology laboratory at the University of Wisconsin — Madison. This implementation of Sparrow holds the lab's data archive and makes it accessible via an API and this web interface.





Sparrow's database

A single measured value

H2O content:	5.34 ±0.534(1s) %
De:	21.6 ±0.900(1s) Gy
OD:	24.0 %
luminescence age:	5.36 ±0.342(1s) ka
total dose rate:	4.03 ±0.195(1s) Gy/ka

An instance of space- or time-resolved data collection



Datum

Metadata tables Geological context, publication status, embargo...

Grouped measurements in a single instrument run

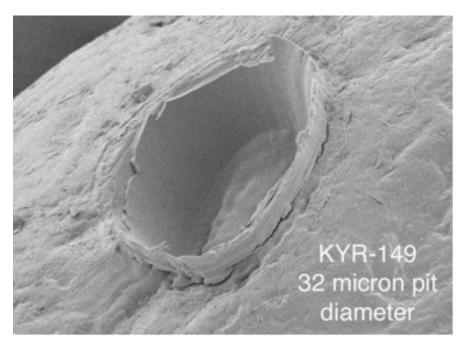


Sparrow's database

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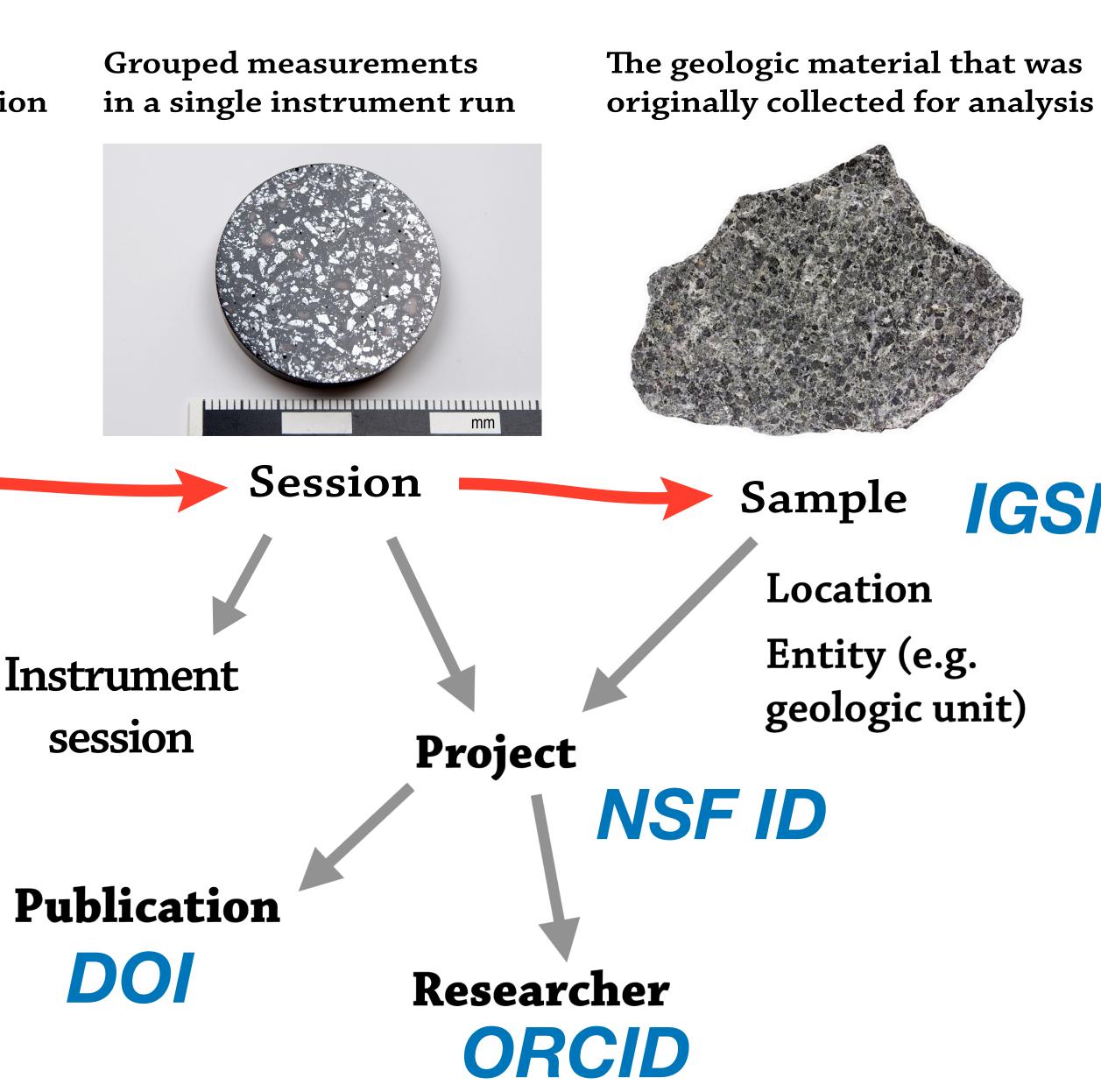
An instance of space- or time-resolved data collection



Datum Analysis

Metadata tables Geological context, publication status, embargo...

A platform for data curation

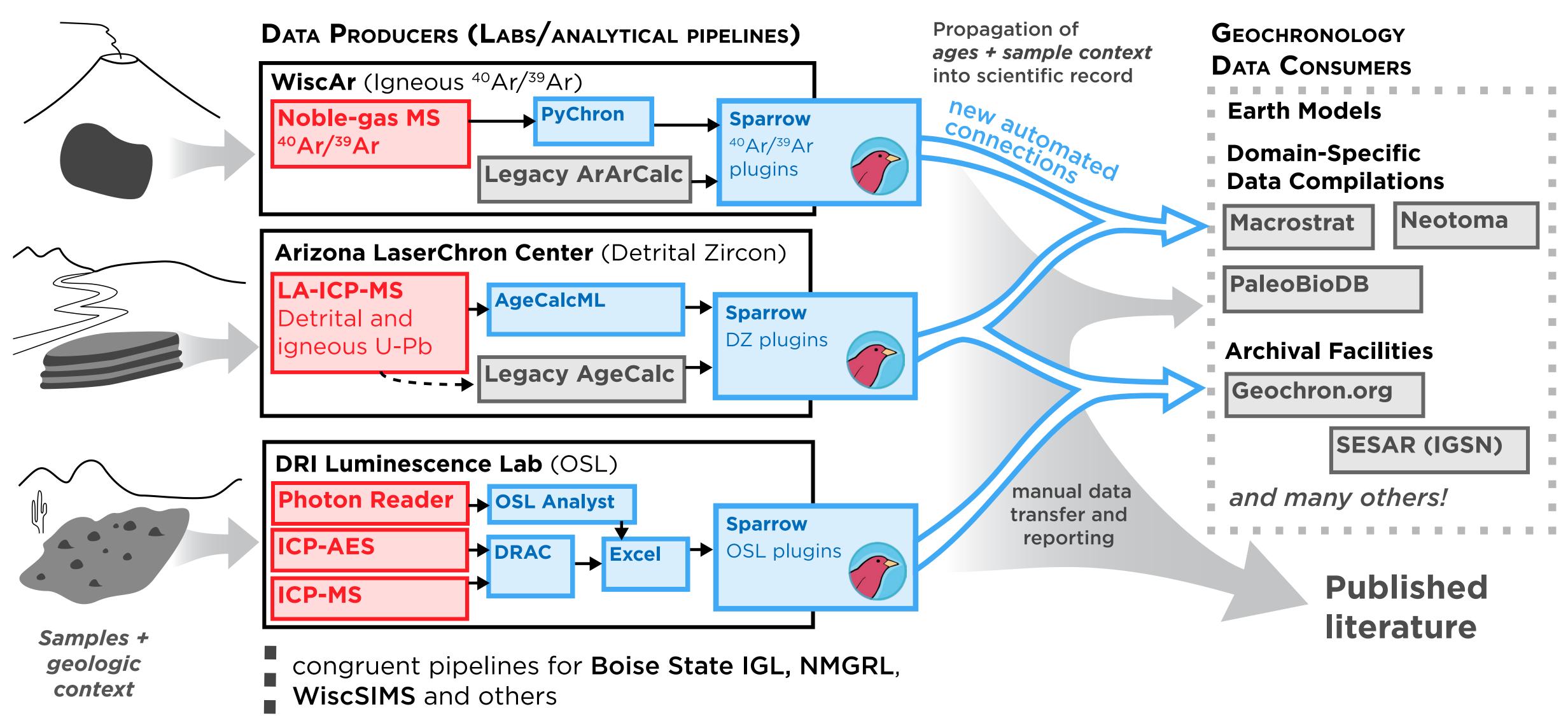






Vision: connecting lab data systems to the community

...in a way where labs also benefit on their own terms

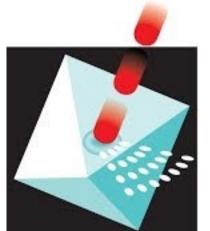




SO HOW'S THAT GOING?

~10 in-progress laboratory implementations across domains of geochronology and geochemistry

- Uranium–Lead
- Argon–Argon
- Cosmogenic nuclides
- (U+Th)/He thermochronology
- Optically-stimulated luminescence
- In-situ stable isotope geochemistry (SIMS)
- Electron Microprobe
- Carbon radioisotopes/AMS (*planned*)









RI7ONA Department of Geosciences

University of Arizona









UW Cosmogenic Nuclide Lab

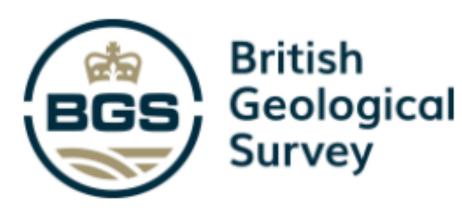








NAU Paleoclimate **Dynamics** Lab



SO HOW'S THAT GOING? But really, how is it going? (five years in)

~10 in-progress laboratory implementations across domains of geochronology and geochemistry

- Uranium–Lead
- Argon–Argon
- Cosmogenic nuclides
- (U+Th)/He thermochronology
- Optically-stimulated luminescence
- In-situ stable isotope geochemistry (SIMS)
- Electron Microprobe
- Carbon radioisotopes/AMS (*planned*)

One *operational* pipeline



ISOTOPE







RI7ONA **Department of Geosciences**

University of Arizona





UW Cosmogenic Nuclide Lab



Wisc



NAU Paleoclimate **Dynamics Lab**



esearch aboratory





British Geological Survey





SO HOW'S THAT GOING?

~10 in-progress laboratory implementations across domains of geochronology and geochemistry

- Ura
- Arg Cost
- (U+
- Opt
- In-s
- ElecCarl

- Academic labs lack expertise to implement/ manage metadata tracking.
- *It is just not their core task and is treated accordingly.* Even with purpose-built software, the "last-mile"
- problem is difficult to solve.

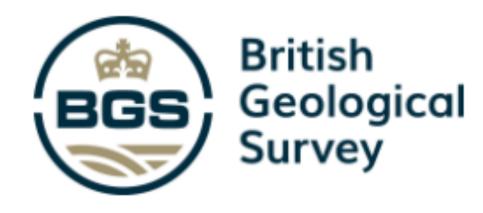
One operational pipeline







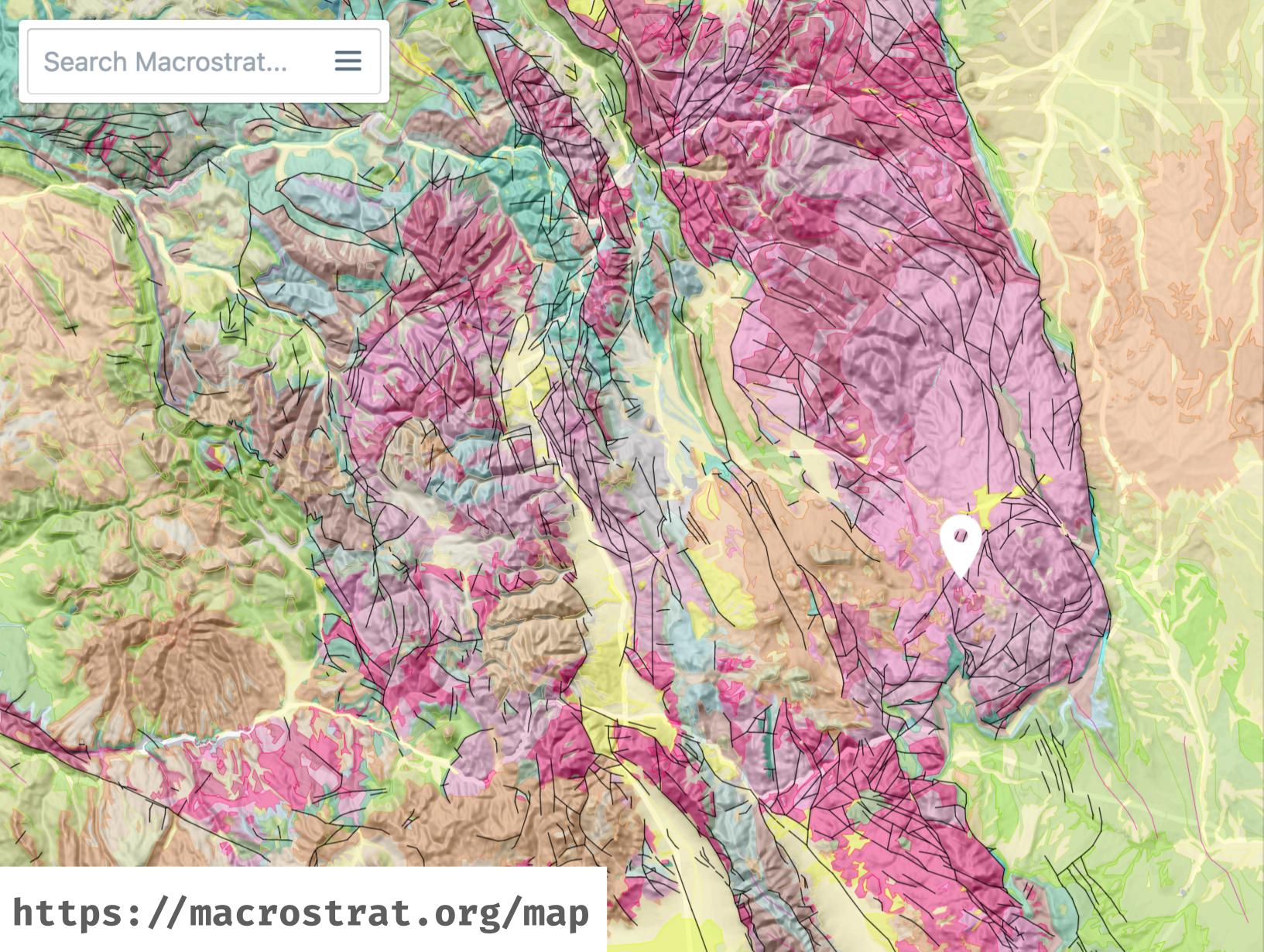
Desert Research Institute







Final note: Automation to the rescue?



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Primary literature

Robinson, Charles Sherwood, Geology and ore deposits of the Whitepine area, Tomichi mining district, Gunnison County, Colorado.

Nash, J. Thomas, Supergene uranium deposits in brecciated zones of Laramide upthrusts; concepts and applications. V

Young, E. J., Felsic-mafic ratios and silica saturation ratios; their rationale and use as petrographic and petrologic indicators. V

Hills, F. A., Dickinson, K. A., Silver Plume Granite; possible source of uranium in sandstone uranium deposits, Tallahassee Creek and High Park areas, Fremont and Teller counties, Colorado. 🗸

Finch, Warren Irvin, Stratigraphic distribution of uranium clusters in the Rocky Mountain and Intermontane Basins Uranium Province.

Braddock, William A., Cole, James C., Preliminary geologic map of the Greeley 1 degree by 2 degrees Quadrangle, Colorado and Wyoming.

Snyder, George L., Preliminary geologic map of the central Laramie Mountains, Albany and Platte counties, Wyoming. 🗸

McCallum, M. E., Burch, A. L., Uranium and thorium in Precambrian crystalline rocks of the Medicine Bow Mountains, north-central Colorado. 🗸

Stuckloss I.S. Hodgo C.E. Wonner D.B. Nkeme I.T. Isotonic studies



Final note: Automation to the rescue?

Search Macrostrat...

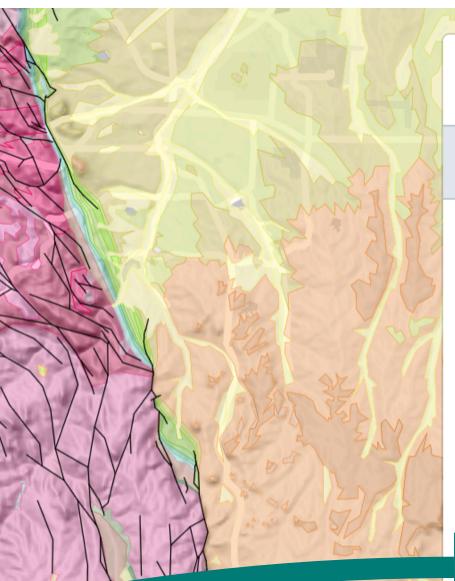
UNITED STATES DEPARTMENT OF THE INTERIOR GEOLOGICAL SURVEY

Silver Plume Granite--Possible Source of Uranium in Sandstone Uranium Deposits, Tallahassee Creek and High Park Areas, Fremont and Teller Counties, Colorado

By

Francis Allan Hills and Kendell A. Dickinson

https://macrostrat.org/map





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Young, E. J., Felsic-mafic ratios and silica saturation ratios; their rationale and use as petrographic and petrologic indicators. V

Hills, F. A., Dickinson, K. A., Silver Plume Granite; possible source of uranium in sandstone uranium deposits, Tallahassee Creek and High Park areas, Fremont and Teller counties, Colorado. 🗸

Finch, Warren Irvin, Stratigraphic distribution of uranium clusters in the Rocky Mountain and Intermontane Basins Uranium Province. $\mathbf{\nabla}$

Braddock, William A., Cole, James C., Preliminary geologic map of the Greeley 1 degree by 2 degrees Quadrangle, Colorado and Wyoming.

Snyder, George L., Preliminary geologic map of the central Laramie Mountains, Albany and Platte counties, Wyoming.

McCallum, M. E., Burch, A. L., Uranium and thorium in Precambrian crystalline rocks of the Medicine Bow Mountains, north-central Colorado. 🗸

Stuckloss I.S. Hodgo C.E. Wonnor D.B. Nkomo I.T. Isotonic studios





Final note: Automation to the rescue?

Macrostrat is linked to the **xDD** (formerly, GeoDeepDive) machine reading library, data infrastructure, and API



- Detecting and surfacing references to geologic units in the scientific literature
- These aren't real metadata-level links, but they are pretty useful

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Primary literature

via xDD 🔨

Robinson, Charles Sherwood, Geology and ore deposits of the Whitepine area, To

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Nash, J. Thomas, S Laramide upthrus

Young, E. J rational and use

Hills, F. A., Dickinso uranium in sandst Park areas, Fremo

Finch, Warren Irvin the Rocky Mounta \sim

Braddock, William Greeley 1 degree b \sim

Snyder, George L., I

Hills, F. A., Dickinson, K. A., Silver Plume Granite; possible source of uranium in sandstone uranium deposits, Tallahassee Creek and High Park areas, Fremont and Teller counties, Colorado.

...Anomalously high concentrations of thorium and of the light rare earth elements lanthanum and cerium suggest that the actinides and light lanthanides were enriched to an abnormal degree by the magmatic processes that formed the Proterozoic Y **Silver Plume Granite** in areas adjoining Tallahassee Creek and High Park

...Although a significant contribution of uranium from Tertiary volcanic rocks can not be ruled out and is even probable (Dickinson and Hills, 1982), it appears probable that some of the uranium in deposits of the Tallahassee Creek area was derived from Silver Plume Granite

...Although uranium presently does not appear to be significantly enriched in sampled outcrops of **Silver Plume Granite**, a large part of the original uranium content of Silver Plume may have been removed by oxidizing ground waters, leaving behind mainly the uranium bound in resistate minerals such as zircon and monazite

...Creek area was **Silver Plume Granite**, and Tertiary volcanic rocks also probably supplied significant amounts of uranium (Dickinson and Hills, 1982), the inferred fertility of the **Silver Plume Granite**, its abundance in areas adjoining Tallahassee Creek, and the demonstrated former existence of an appropriate paleohydrologic system for transporting lead from the Silver Plume and depositing it in the Tallahassee Creek area make highly probable that the **Silver Plume Granite** supplied part of the uranium now found in the Tallahassee Creek deposits

Mountains, Albany and Platte counties, Wyoming.

