

DIGITAL MAPPING TECHNIQUES 2017

The following was presented at DMT'17
(May 21-24, 2017 - Minnesota Geological
Survey, Minneapolis, MN)

The contents of this document are provisional

See Presentations and Proceedings
from the DMT Meetings (1997-2017)

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

Visit Wyoming's Geology!

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INTERACTIVE MAPS AT THE WYOMING STATE GEOLOGICAL SURVEY

Interactive online maps are becoming more prominent at the Wyoming State Geological Survey, being that they are more accessible to the public, faster to create and update, and offer the spatial information their predecessor paper maps could not.

In 2016, WSGS launched the interactive **Oil & Gas Map** of Wyoming, highlighting a new 223-element model that when run, delineates which wells go into which oil and gas fields. This enhancement allows updates of this map on a yearly basis, or more often if necessary, when it used to take many years to organize and update this map.

Other interactive maps available through the WSGS website include the **Wyoming Groundwater Atlas** launched in March 2017, the **Geochronology map**, which went online in June 2017, the **Bedrock and Surficial Geologic Map Index**, that has been available for several years in different forms, and coming in 2018, the **Mines and Minerals Map of Wyoming**.

One more map currently available for the 2017 tourist season is an ESRI Story Map, **Visit Wyoming's Geology**. This map highlights eight main geologic sites, with numerous surrounding geologic sites, museums, and hidden gems. Many sites lie within the path of the total solar eclipse, shown on the map, which will occur in August 2017. Personal experience with this map allows me to talk about testing of ESRI's story map templates, which ones worked for what we needed, which ones didn't, what worked within the Map Series template we chose, and where problems arose with it. Some were solved by us, some by ESRI, and some unsolved issues we simply worked around.

Teams were organized to craft each map; each team had a map steward that was assigned the ArcGIS Online license, and that person created and is responsible for updates of that map. Map usage is tracked through ArcGIS Online.

REFERENCES

Stafford, J.E., Taboga, K.G., and Toner, R.T., 2017, Groundwater atlas of Wyoming: Wyoming State Geological Survey, at <http://wsgs.maps.arcgis.com/apps/webappviewer/index.html?id=09ebeedba94048a0b1ec4dcfc71eb9b5>

Toner, R.N., Lynds, R.M., and Stafford, J.E., 2016, Interactive oil and gas map of Wyoming (updated April 2017): Wyoming State Geological Survey, at <http://wsgs.maps.arcgis.com/apps/webappviewer/index.html?id=3f7ab99343c34bd3ac5ae6ac8c04d95a/>

WSGS, 2016, Bedrock and surficial geologic map index: Wyoming State Geological Survey, at <http://www.wsgs.wyo.gov/wyoming-geology/mapping>

WSGS, 2017, Visit Wyoming's geology!—A story map: Wyoming State Geological Survey, at <http://www.wsgs.wyo.gov/public-info/tour-geology>

Visit Wyoming's Geology!



SUZANNE LUHR
GIS Map Editor

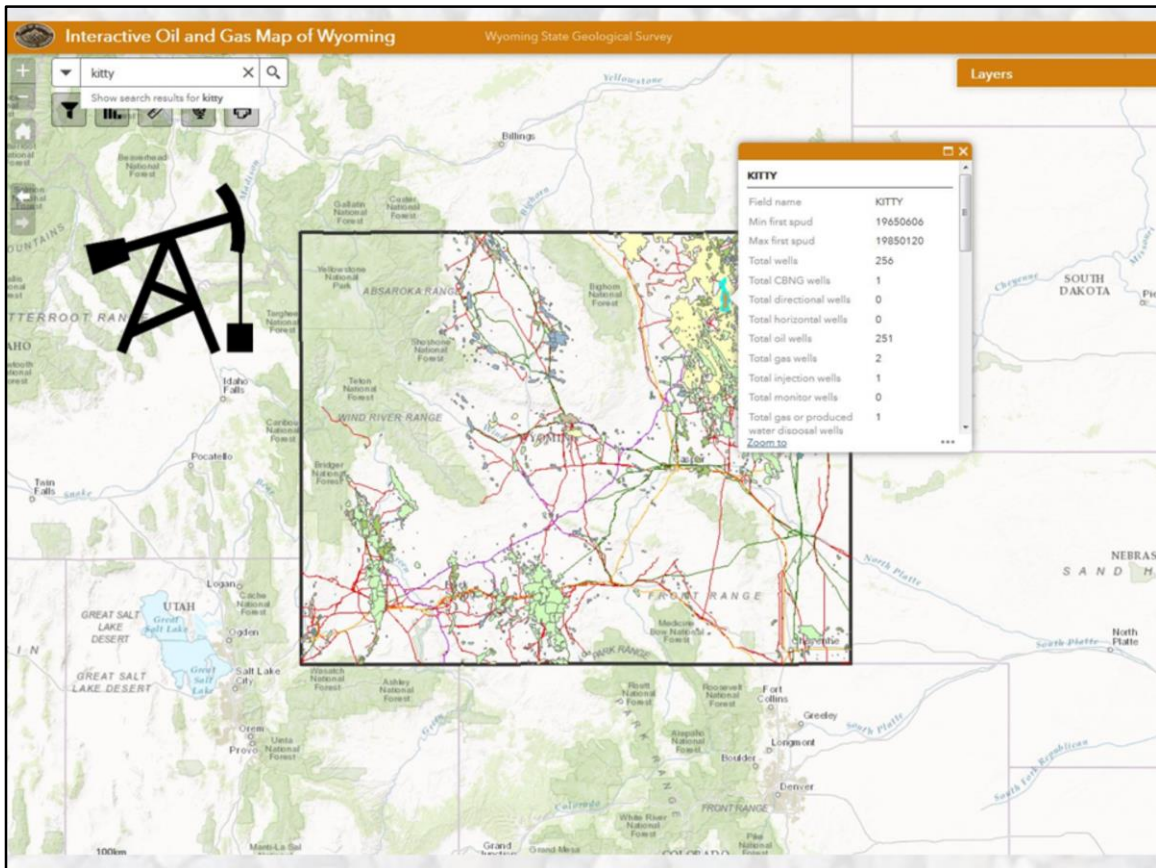
WYOMING STATE GEOLOGICAL SURVEY

That's what I'm talking about!

Online maps available at WSGS

- ↗ Oil and gas map
- ↗ Groundwater atlas
- ↗ Published maps index
- ↗ Geochronology map (coming soon)
- ↗ Mines and minerals map (coming soon)
- ↗ NREX* (Natural Resource and Energy Explorer)
- ↗ **GeoTourism story map** (what worked, what didn't)

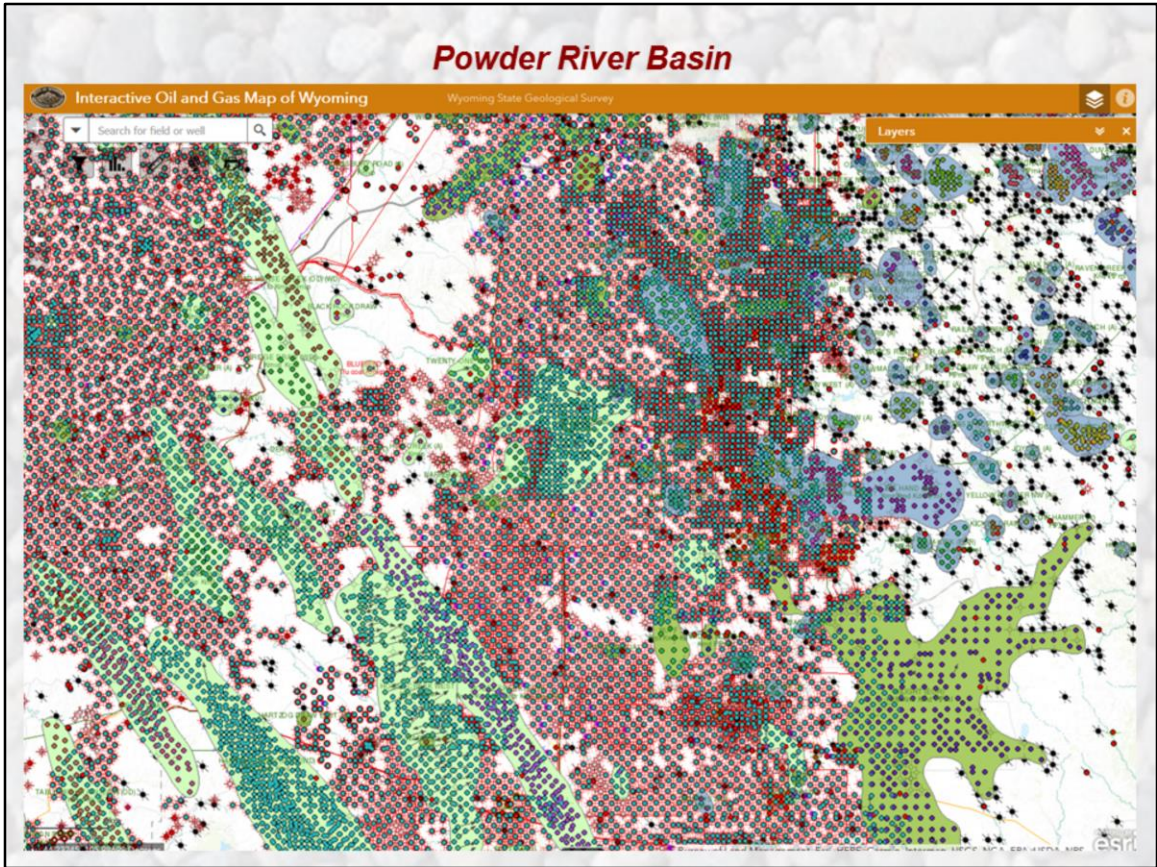
Here's a list of the various online maps at WSGS. I'll talk a bit about each one, ending with the fun one, our GeoTourism story map.



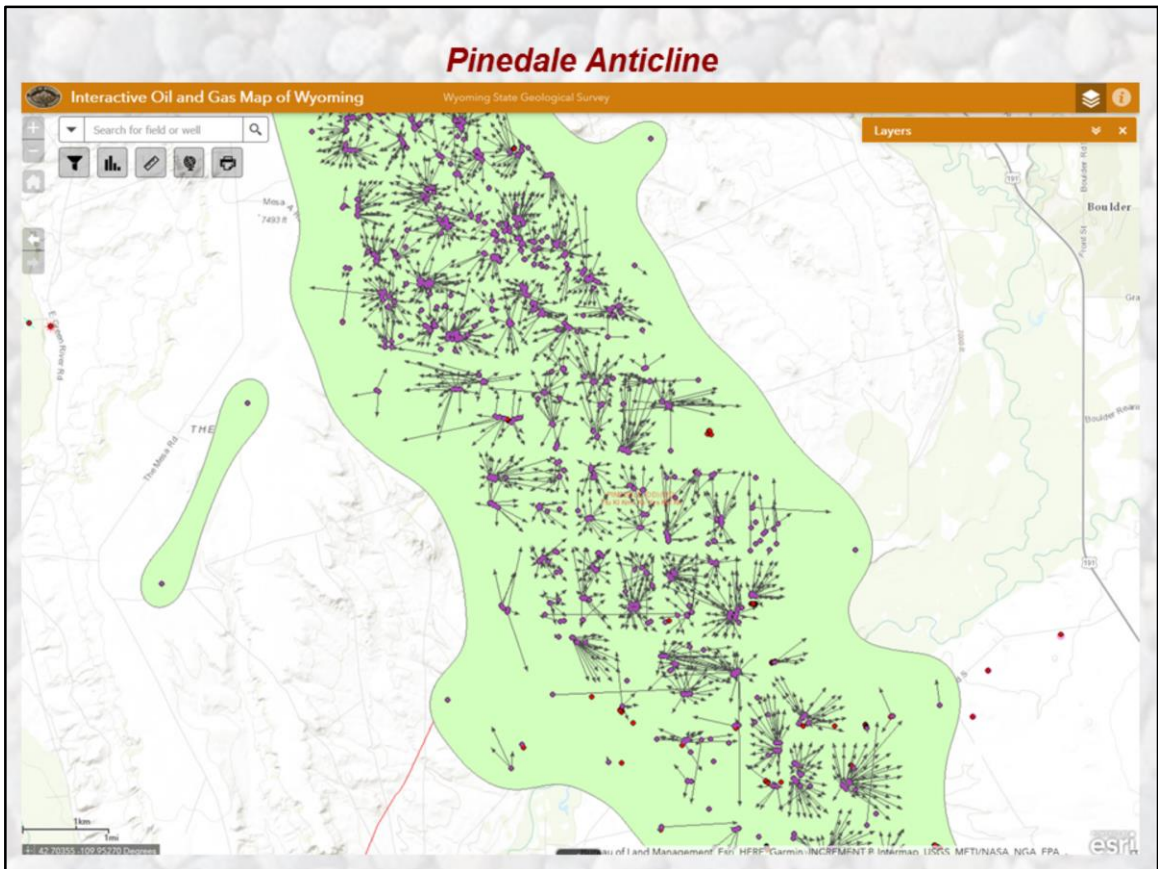
Maps completed:

In 2016 our oil and gas geologist and her team created the online **Oil and Gas Map**, to complement the traditional paper map. This map depicts about 122,000 wells, oil and gas fields, reservoirs, pipelines, and other infrastructure.

Our Natural Resources Analyst set up a 223-element model to streamline updates of this map on a yearly basis; or more often if necessary. The advantage of the model is that updates are relatively quick, and are consistent. It's not left to the whim of an individual to decide what wells go in what fields, as in the past.



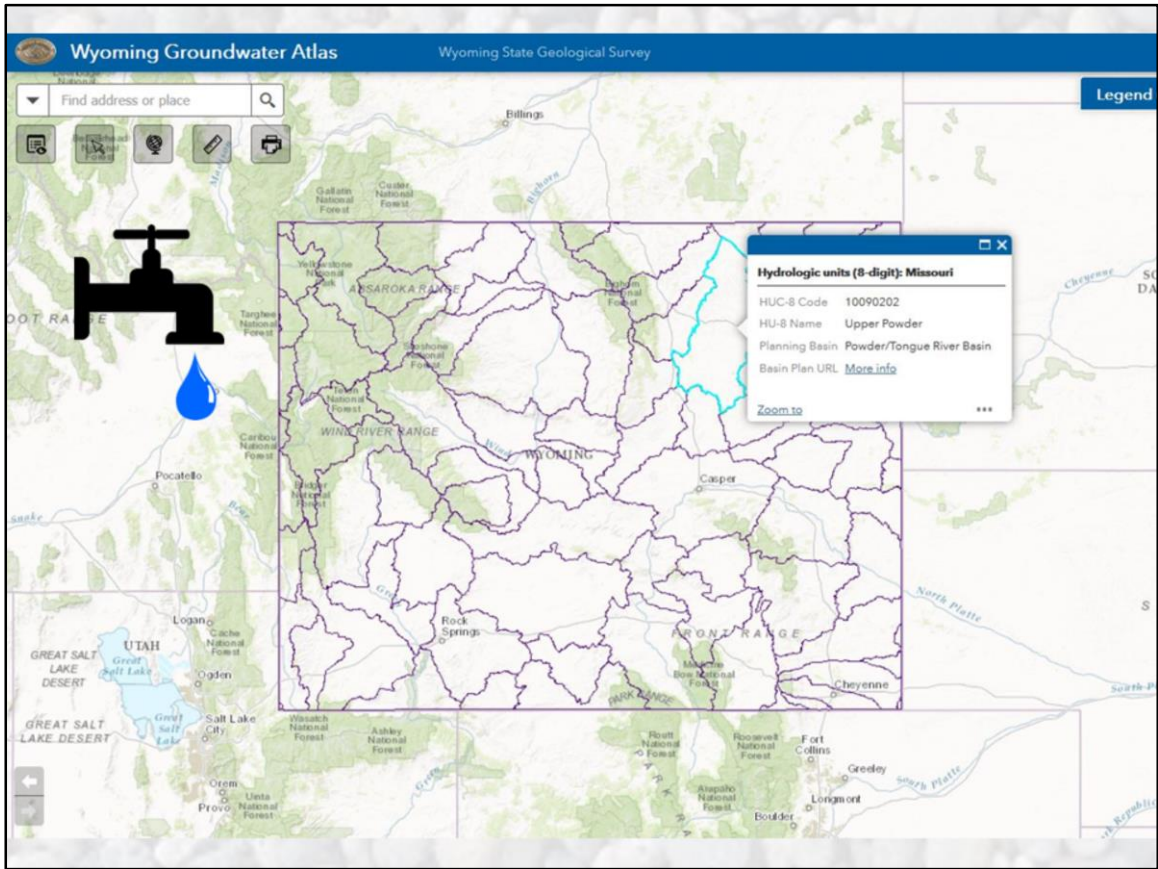
The Powder River Basin in Wyoming is an example of why this model is such a welcome addition.



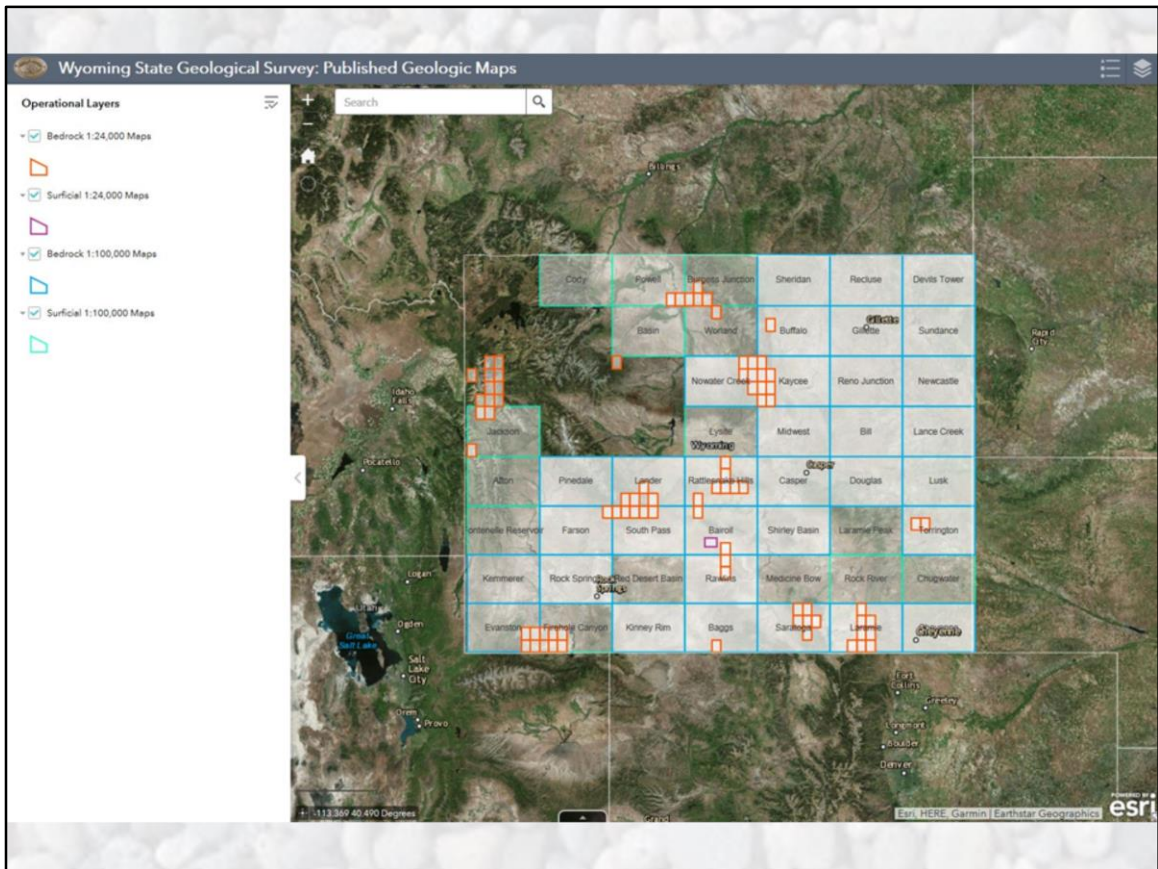
On the western side of the state, in the Pinedale anticline they're drilling 30-40 directional wells from each well pad!

Both the online and paper versions of the oil and gas map have won several awards in the last year. The model behind the online map was also featured in the winter 2017 issue of ArcNews.

This is one of our more popular maps.



This year in March, our hydrology section created a **Groundwater Atlas** application. It offers surface hydrology, hydrologic units, water wells, water rights, aquifers, groundwater quality data. It's important information in a dry state. This is information that people are always coming looking for, so they got busy and put it all together for easy access. It will be updated as needed. This application has had about 1500 views since its launch.



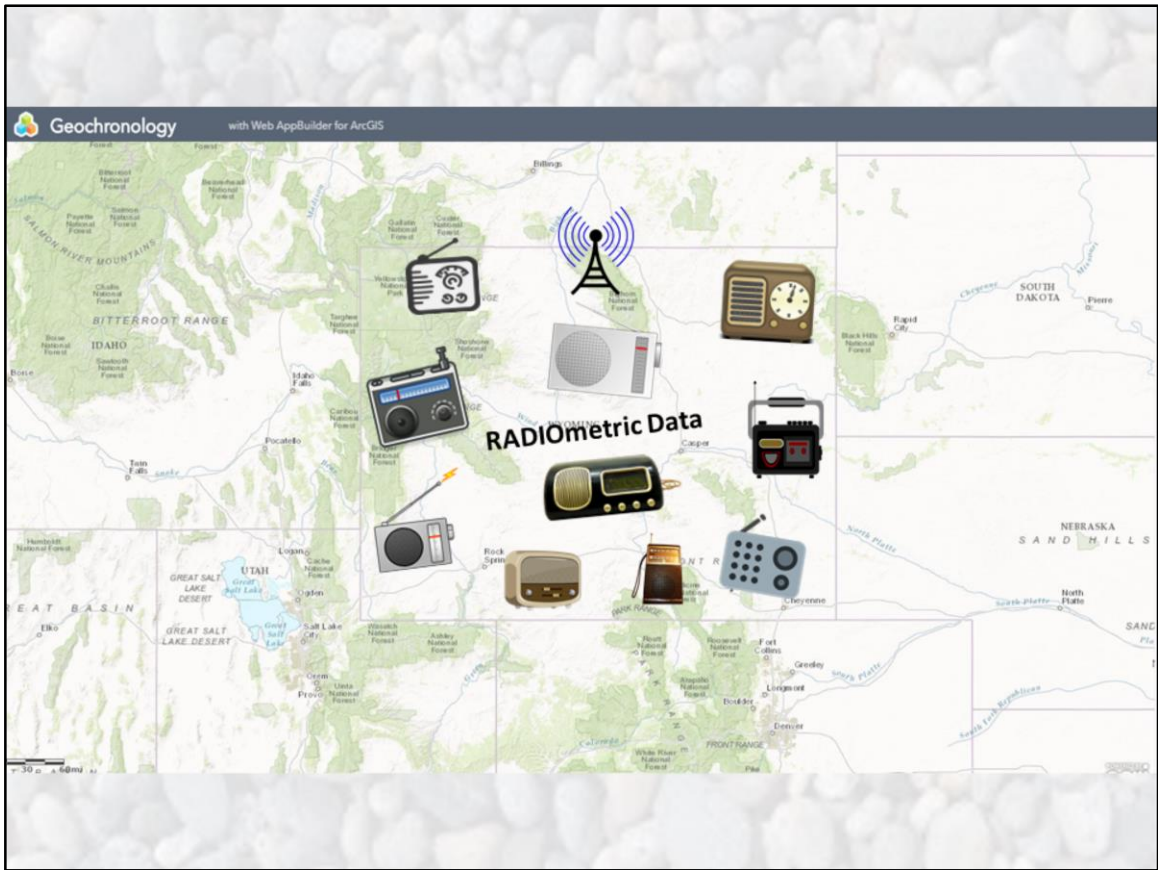
The **Published Maps Index** is a basic application, but useful. It shows our bedrock, surficial, 100k, 24k published geologic maps, and links to pdfs. We have the shapefiles on our website. You can see we've got a ways to go to complete the statewide bedrock mapping at 1:100,000. A lot more geologic mapping has been done by the USGS of course, and is available through NGMDB.

That's what I'm talking about!

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Maps in the making...



We have a **Geochronology app** coming out in June. It's a compilation of internal and external radiometric data for the state. I don't have an official map to show, so I made something up.

Hey, we're not all geologists!



Our Minerals geologist is working on a **Mines and Minerals** online map. I do not have a shot of this map either, so I'm just showing some of Wyoming's rocks and minerals. This map will have mineral sample locations, chemical analyses, active and inactive mine locations, and everything from precious minerals, metals, and rare earth elements, to industrial minerals and construction aggregates, like sand and gravel. It will be a useful tool for mineral investigations. ETA on this map is summer 2018.

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NREX is not our application. It was mandated by the governor a couple of years ago, to get publicly available statewide data of all kinds into a usable app, and was created by WyGIS, the Wyoming Geographic Information Science Center. It's kind of Wyoming's data clearinghouse. Our 500k geology and oil & gas fields are in this app. It's a useful application, but does however require a login to use.



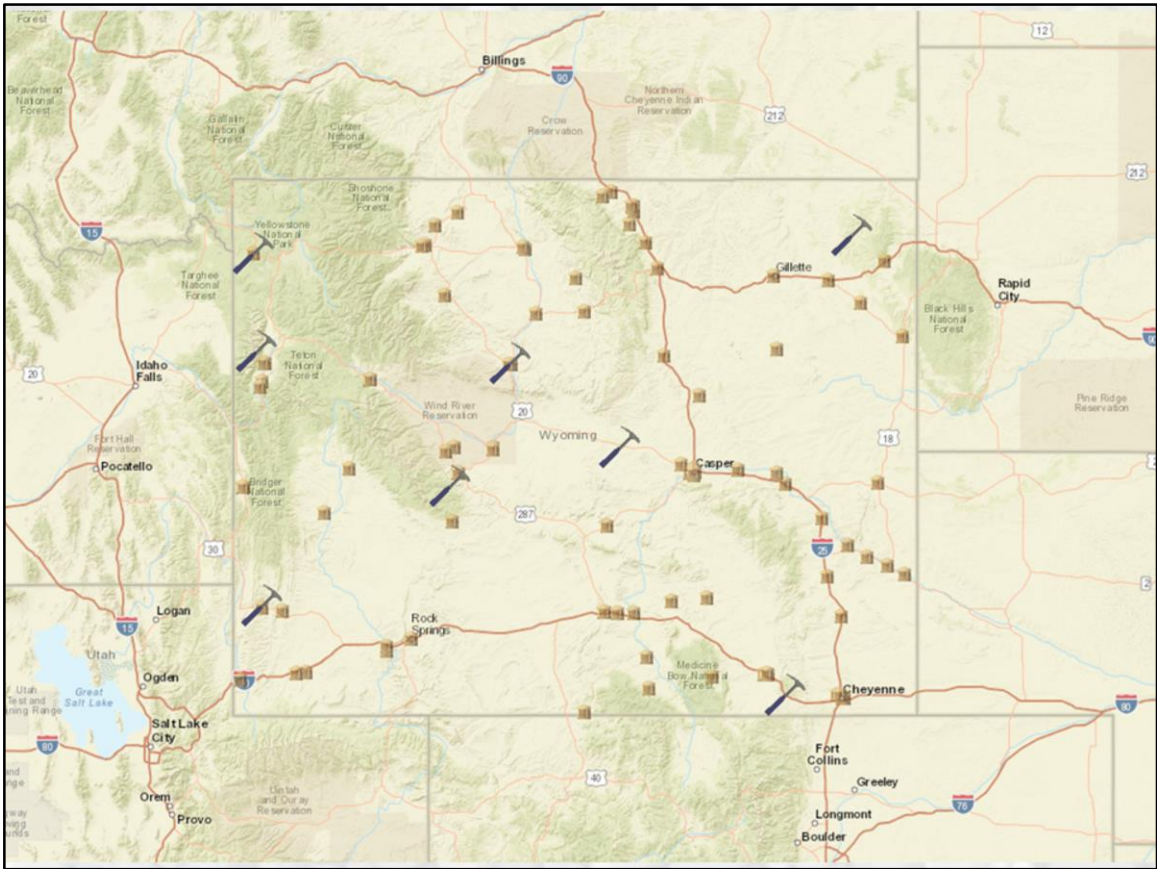
Now on to our **GeoTourism Story Map**! Let's take a drive.

Last fall we put together a small team consisting of a couple of geologists, the two of us in GIS, our PR person, and our supervisor, as the voice of reason. We then started working on how best to get Wyoming's geology out to the public.

"The voice of reason" wanted to keep it simple, so out-of-the-box story maps were chosen, and we started scheming.

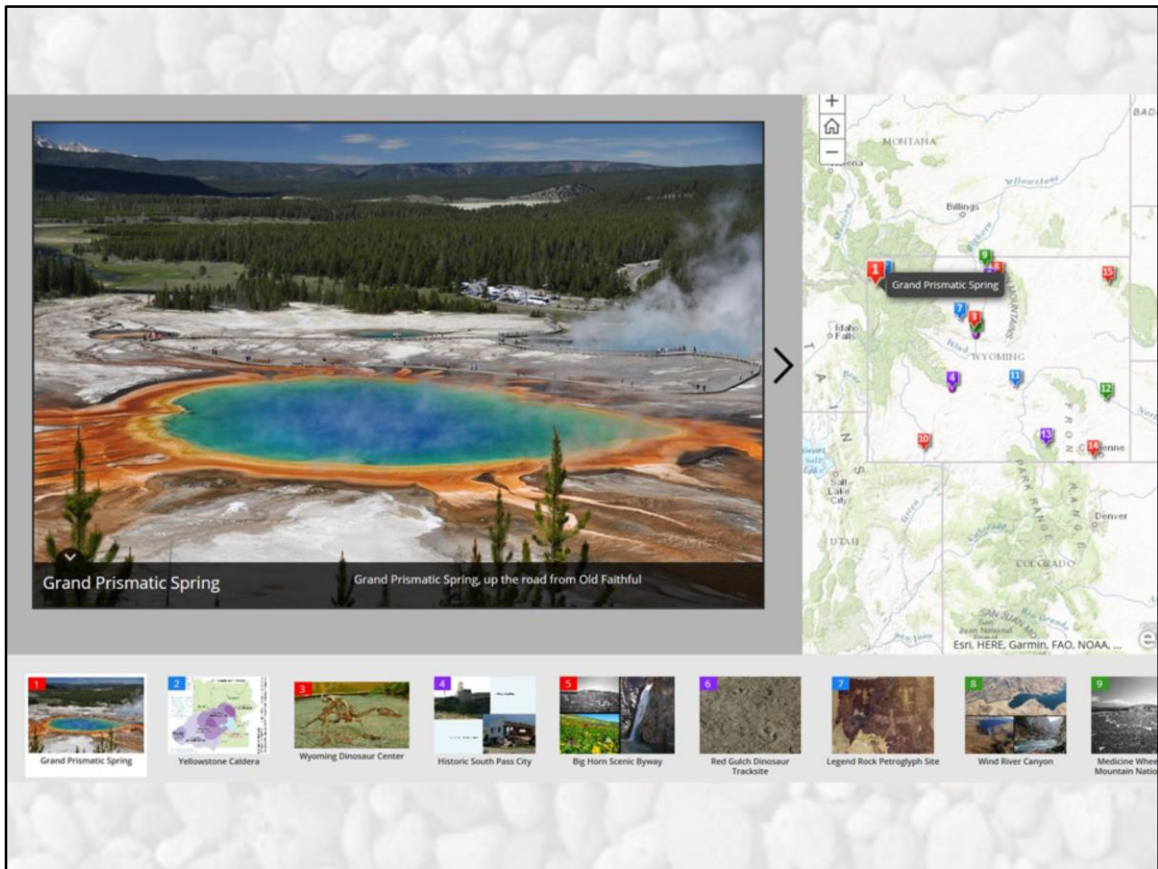


We all threw our ideas for geologic sites into a hat and after much debate we narrowed them down to eight final sites. These sites met certain criteria: accessibility, popularity (or in some cases just nice geology), and a good spread throughout the state.



We decided to add museums, and narrowed the list down to those with any geologic interest.

Then we started experimenting with Story Map templates.



We tried the Map Tour template. We put together a collection of sites to test it out. It was catchy, but not quite what we needed. We wanted more flexibility in the map symbology, and more options for descriptions.

Ejecta Volume (in cubic miles)

1st caldera 600
2nd caldera 67
3rd caldera 240

Underwater Timeline

- *Epeiric Seas, including Sundance Sea and Western Interior Seaway 542-66 Ma
- *Bull Lake Glaciation 157-151 ka
- *Pinedale Glaciation 20-16 ka

Yellowstone National Park

Labels on map: Mt. Washburn, Gibbon Falls, Sour Creek resurgent dome, Lake Butte, Mallard Lake resurgent dome, Yellowstone Caldera.

Yellowstone Caldera

1st caldera 2.1 million years old

3rd caldera 640,000 years old

Yes, Yellowstone is a volcano. The Yellowstone Caldera was created by the most recent massive eruption approximately 640,000 years ago. Subsequent lava flows filled in much of the caldera. The Upper Geyser Basin which includes Old Faithful is surrounded by relatively recent rhyolitic lava flows. The volcano is still very active, as evidenced by the park's many hydrothermal features and earthquakes—1,000 to 3,000 per year—also revealing activity below ground. The University of Utah Seismograph Station tracks this activity closely.

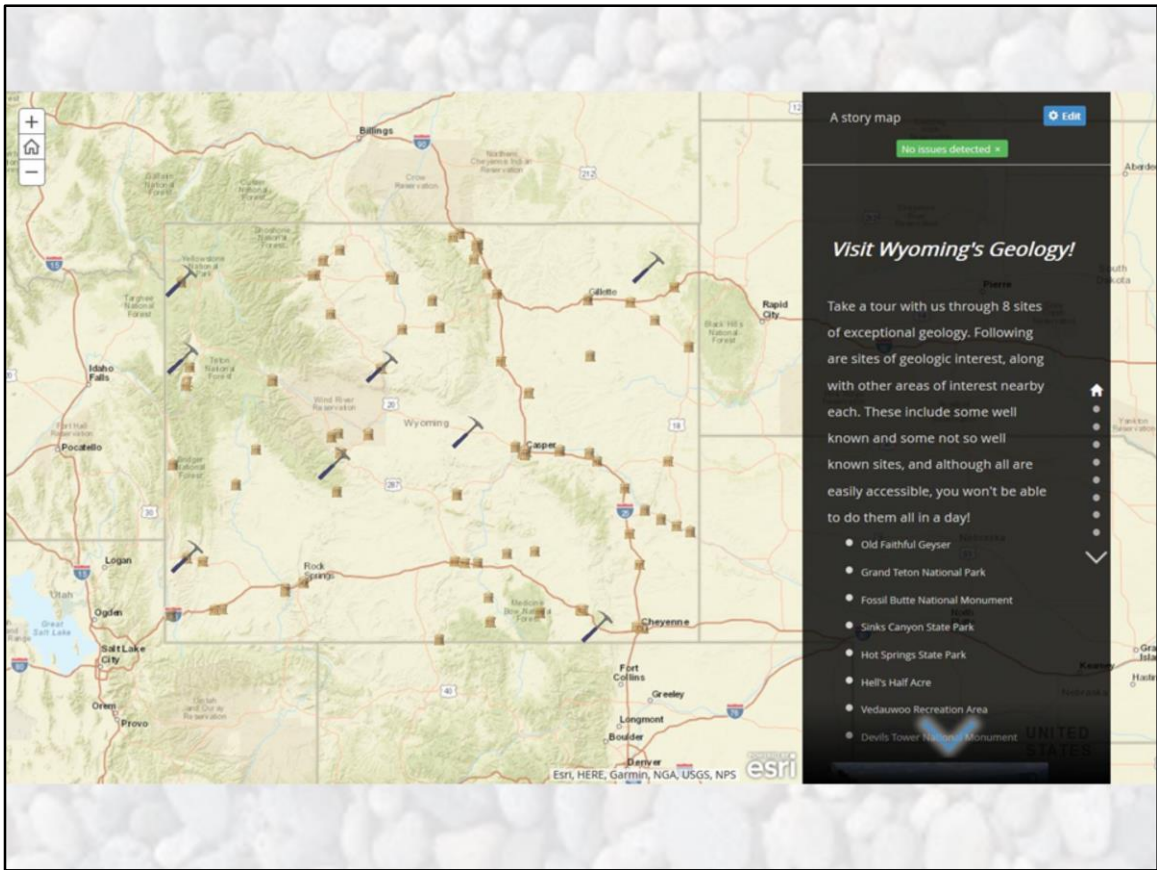
ADAPTED WITH PERMISSION FROM WINDOWS INTO THE CALDERA BY ROBERT SMITH AND LEE J. SIEGEL, 2000.

Map of the region showing Wyoming, Colorado, Utah, and Montana with various landmarks and cities.

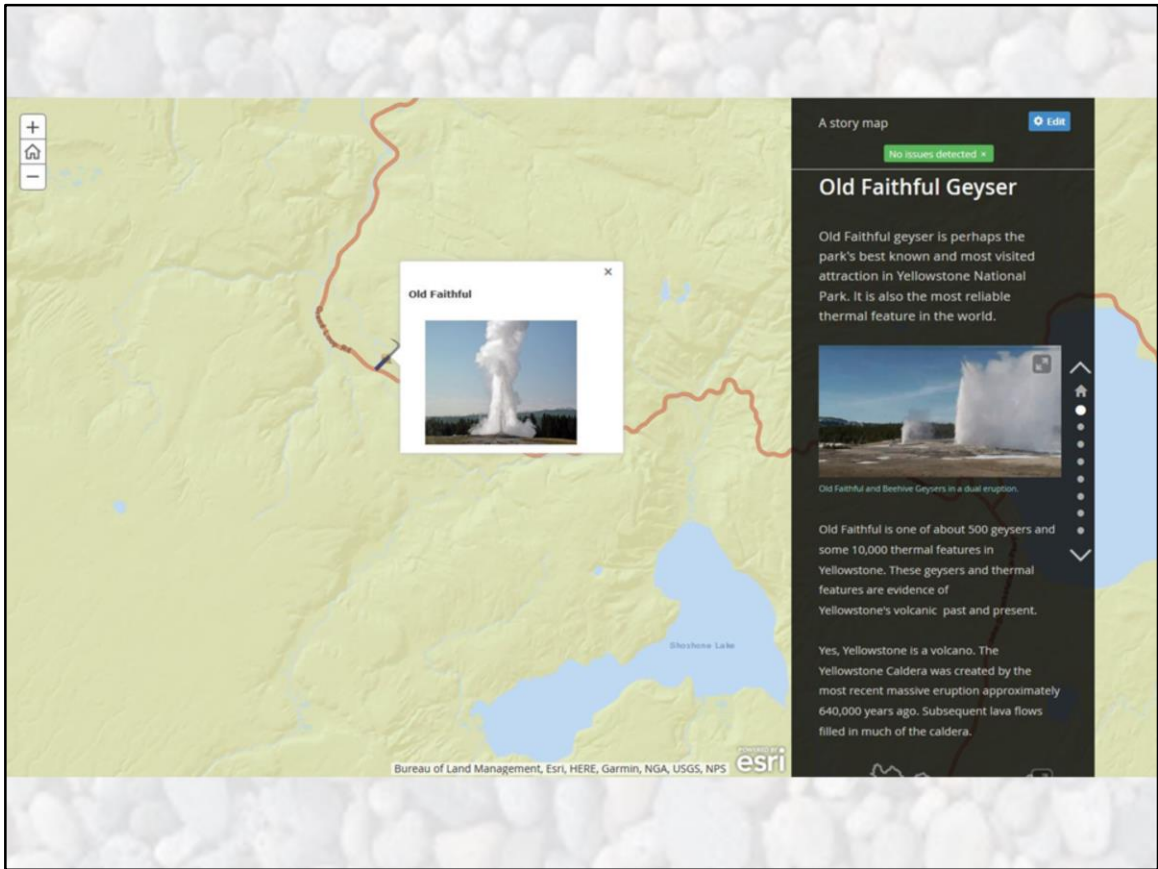
Legend for thumbnail images:

- Grand Prismatic Spring
- Yellowstone Caldera
- Wyoming Dinosaur Center
- Historic South Pass City
- Big Horn Scenic Byway
- Red Gulch Dinosaur Tracksite
- Legend Rock Petroglyph Site
- Wind River Canyon
- Medicine Wheel Mountain Nation

We couldn't get too wordy or our photo would disappear!

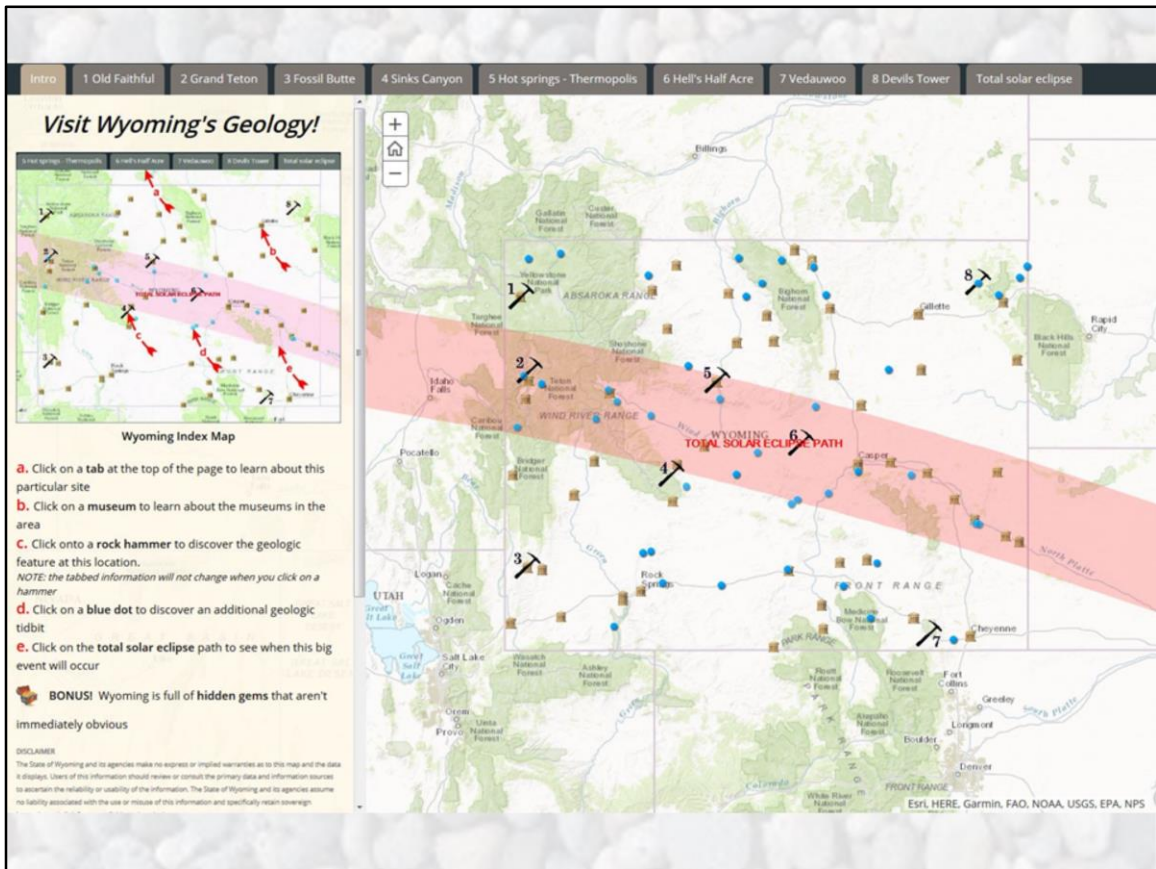


We tried the Map Journal template. I liked it, but it got voted down as it was too wordy. The “voice of reason” argued that people these days have the attention span of a two-year-old, would read a line or two, and shut it down and move on.



So this was *too much* description. We were suffering from the Goldilocks Effect. Too little in Map Tour, too much in Map Journal!

We tried Cascade. And Shortlist. They didn't fit our needs.



Then we found our way to the Map Series template. This was the one!

And as it turns out, ESRI's "Ask a Pro" suggested that we use Map Series. I just didn't discover this early on. But then, I wouldn't have had all the fun and gained all the experience of testing out the other story map templates. Which was a good thing!

Map Series gave us our map, front and center, with the flexibility of symbology that we wanted.

Home About Energy Hazards Minerals Water Wyoming Geology Publications Public Information

Back to Map Old Faithful Grand Teton Fossil Butte Sinks Canyon Thermopole Hot Springs Hell's Half Acre Vedauwo Devils Tower

Discover the Geology of Grand Teton

The jagged peaks and glacier-carved topography of the Teton Range in northwestern Wyoming are an image often associated with the state. The tallest serrated point in this 40-mile stretch of mountains is Grand Teton, which, at 13,722 feet above sea level, makes it the highest point in Grand Teton National Park and the second highest in Wyoming.

While most mountain ranges in the Rocky Mountains are 50 million years old or older, the Teton Range is around 5 million years old and still actively shifting along a fault. As impressively high as they appear from the Jackson Hole valley, the rocks of the Teton Range have been uplifted a great deal more than what we now see. The Flathead sandstone, a 500-million-year-old deposit, can be found at the top of Mount Moran, almost 6,000 feet above the valley floor, while the same rocks are found more than 24,000 feet below the surface of the valley. That is a total vertical offset of more than 30,000 feet, and the mountains are still rising today.

Although the range is one of the youngest in the Rocky Mountains, it exposes some of the oldest rocks in North America. Most of the range is composed of gneiss (metamorphic rock) that formed when layers of seafloor sediments and volcanic flows were buried and deformed due to tectonic activity about 2.8 billion years ago. Around 2.5 billion years ago, magma intruded into the gneiss, cooled, and crystallized into granite, which makes up some of the highest peaks, including Grand Teton.

More information about Grand Teton and the Teton Range can be found on the [National Park Service](#) website.

Additional resources:

- [Creation of the Teton Landscape](#)
- [Tectonic History of Teton Region](#)
- [Geologic Map of the Grand Teton National Park](#)

► References

...clicking on **More...** takes them to a web page for each of the eight sites with more detailed information and links. These pages reside on our website.

And the fun part? Visitors can cruise across the state from site to site in the little red jeep, in the dynamic graphic above.

Visit Wyoming's Geology!

Wyoming Index Map

- Click on a **tab** at the top of the page to learn about this particular site
- Click on a **museum** to learn about the museums in the area
- Click on a **hammer** to discover the geologic feature at this location.

NOTE: the tabbed information will not change when you click on a hammer

- Click on a **blue dot** to discover an additional geologic tidbit
- Click on the **total solar eclipse path** to see when this big event will occur

BONUS! Wyoming is full of hidden gems that aren't immediately obvious

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Meeteetse Museums
Meeteetse

What you'll find:

- Black-footed ferret exhibit
- Charles Beiden photography
- Ghost town of Kirwin history

[Website...](#)

We've added the museums with customized popups that include short bulleted descriptions and links to their websites.

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Red Wall
Triassic-age Chugwater Formation cliffs grace this scenic backway (gravel, high-clearance vehicles recommended)
[Red Wall Scenic Backway \(p.38\)](#)

WYOMING TOTAL SOLAR ECLIPSE PATH


We've included additional geologic sites in the blue dots, with a little information on each, and websites.

Intro 1 Old Faithful 2 Grand Teton 3 Fossil Butte 4 Sinks Canyon 5 Hot springs - Thermopols 6 Hell's Half Acre 7 Vedauwoo 8 Devils Tower Total solar eclipse

A total solar eclipse is a "happy accident of nature".

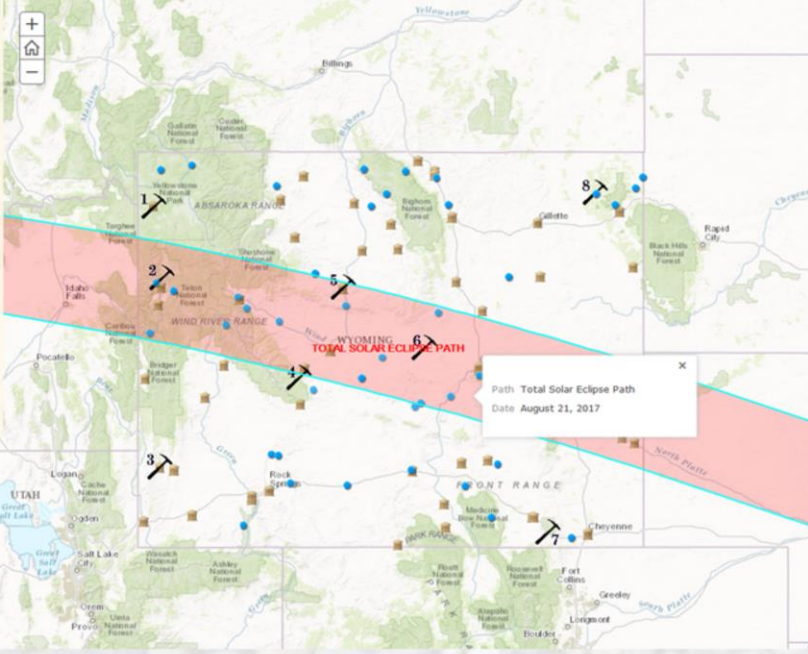
On August 21, 2017 the sun and moon will play hide-and-seek for several hours across Wyoming. This is the first total solar eclipse in the state since June 8, 1918. The one before that was on July 3, 1878, which was notable because Thomas Edison came to Wyoming to witness the big event. The next one won't cross our state again until May 3, 2106. (Michael Pierce, oral commun., 2017)

Wyoming is lucky enough to have this one run straight through its center, so this is the place to be!



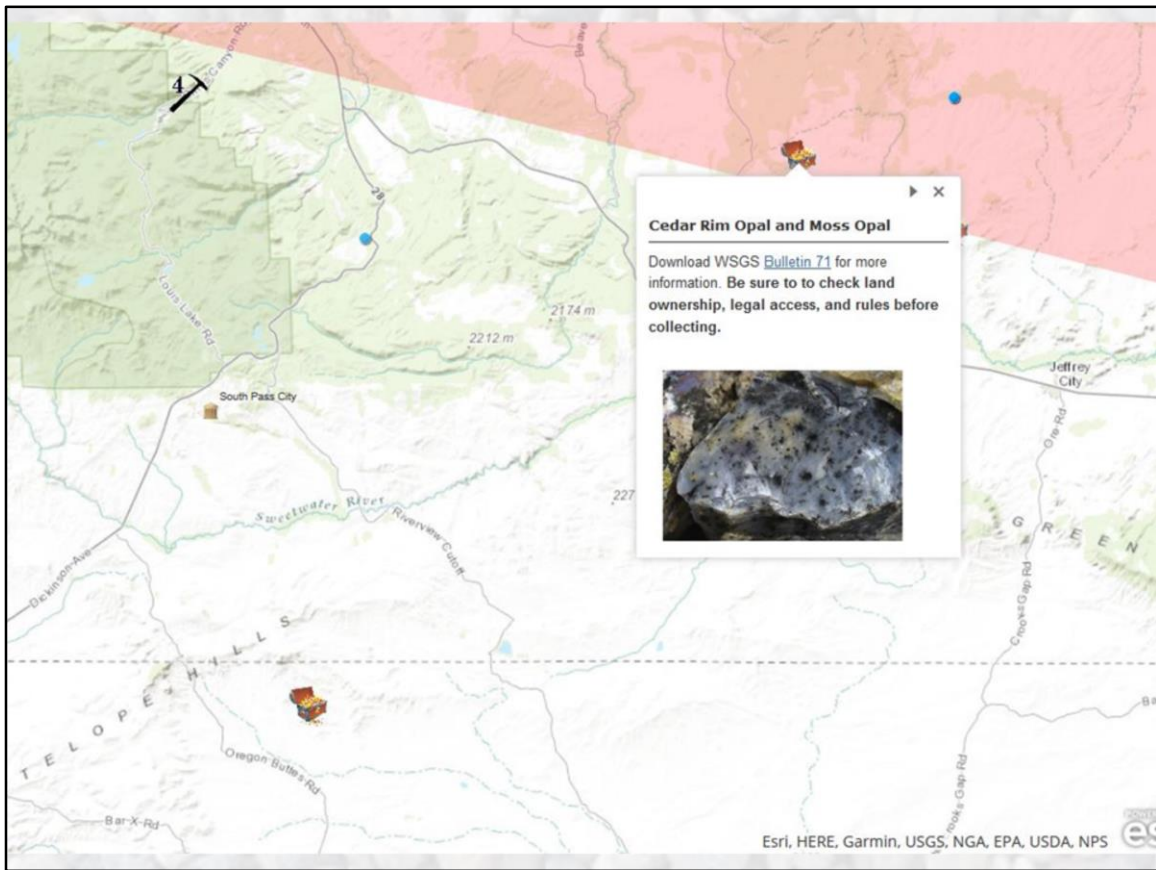
Path of the eclipse (timeanddate.com)

[More...](#)

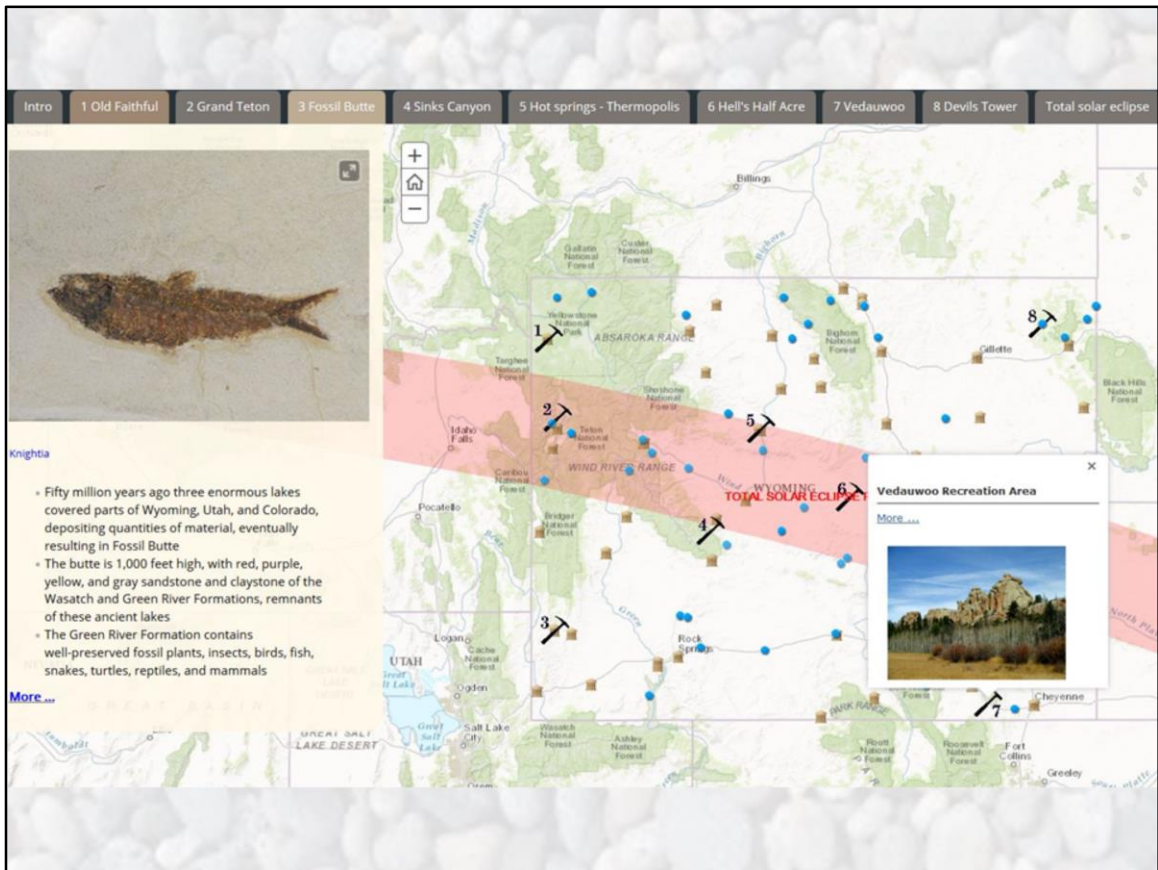


Path Total Solar Eclipse Path
Date August 21, 2017

Then there's the Big Event! Wyoming is smack dab in the path of the Total Solar Eclipse in August. First time in Wyoming since 1918, and it won't happen again until 2106. It's estimated Wyoming's population will likely double for that week! (No kidding!) So we've added a selection of geologic sites within the path so people have something to do before and after the 2-minute event.



Then we have added a BONUS feature we call Hidden Gems, which are rockhounding areas or just nice geologic sites for those that would like to explore a little further. They aren't immediately obvious, so like hidden treasure, people have to search for them.



Problems we had with Map Series?

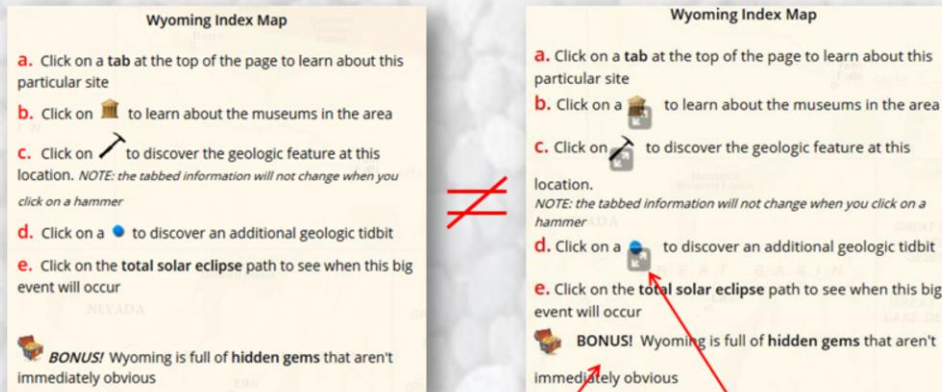
Probably the biggest hurdle is the disconnect between the symbol on the map, and the tab! It doesn't go both ways. Click on a tab above, and the description panel pops up on the map, but click on the rock hammer symbol on the map, and it does NOT bring up the corresponding information panel. I wrote ESRI about this, and they said they will 'incorporate my comments into future app development'.

UNRESOLVED ISSUES

- Disconnect between map symbol and description panel
- Line spacing
- Image issues

from Editing

to Final



Line Spacing Issues

Symbols Issues


A couple of heartburn issues were line spacing and symbols in the description panel.

Line spacing was erratic, it might look fine in edit mode, but moving to final, the spacing would often change.

And the symbol images in the key on the Intro panel were unpredictable; some added blow-up arrows where I requested none. And it was inconsistent, as some had them and some did not. So after struggling with this at great length, I left them off altogether.

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Visit Wyoming's Geology!

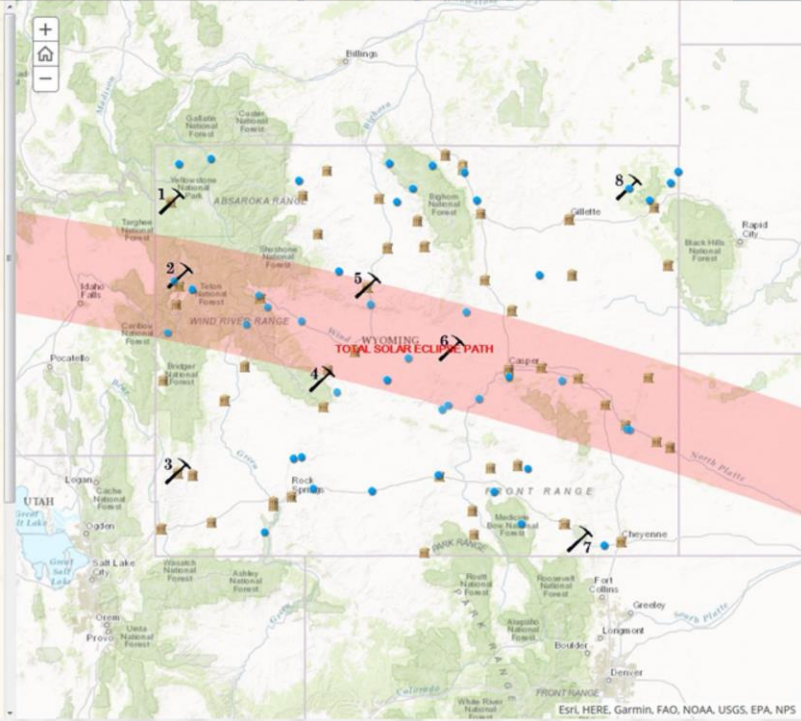


Wyoming Index Map

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ESRI, HERE, Garmin, FAO, NOAA, USGS, EPA, NPS

Considering the wish list we had for the out-of-the-box quick-and-easy story maps, we probably could have downloaded and customized an app more quickly. But we like the look and feel of the story map, and I think we came up with a winning app in the end.

So, if you're not doing anything August 21, come out to Wyoming for 2 minutes of ecliptic excitement! Or better yet, to enjoy Wyoming's world-class geology.



Thank you!

Links

Visit Wyoming's Geology!

<http://wsgs.maps.arcgis.com/apps/MapSeries/index.html?appid=d89f3810924b4c35884d58481b7ac01a>

Wyoming State Geological Survey

<http://www.wsgs.wyo.gov/>



Albino pronghorn antelope near Laramie, Wyoming