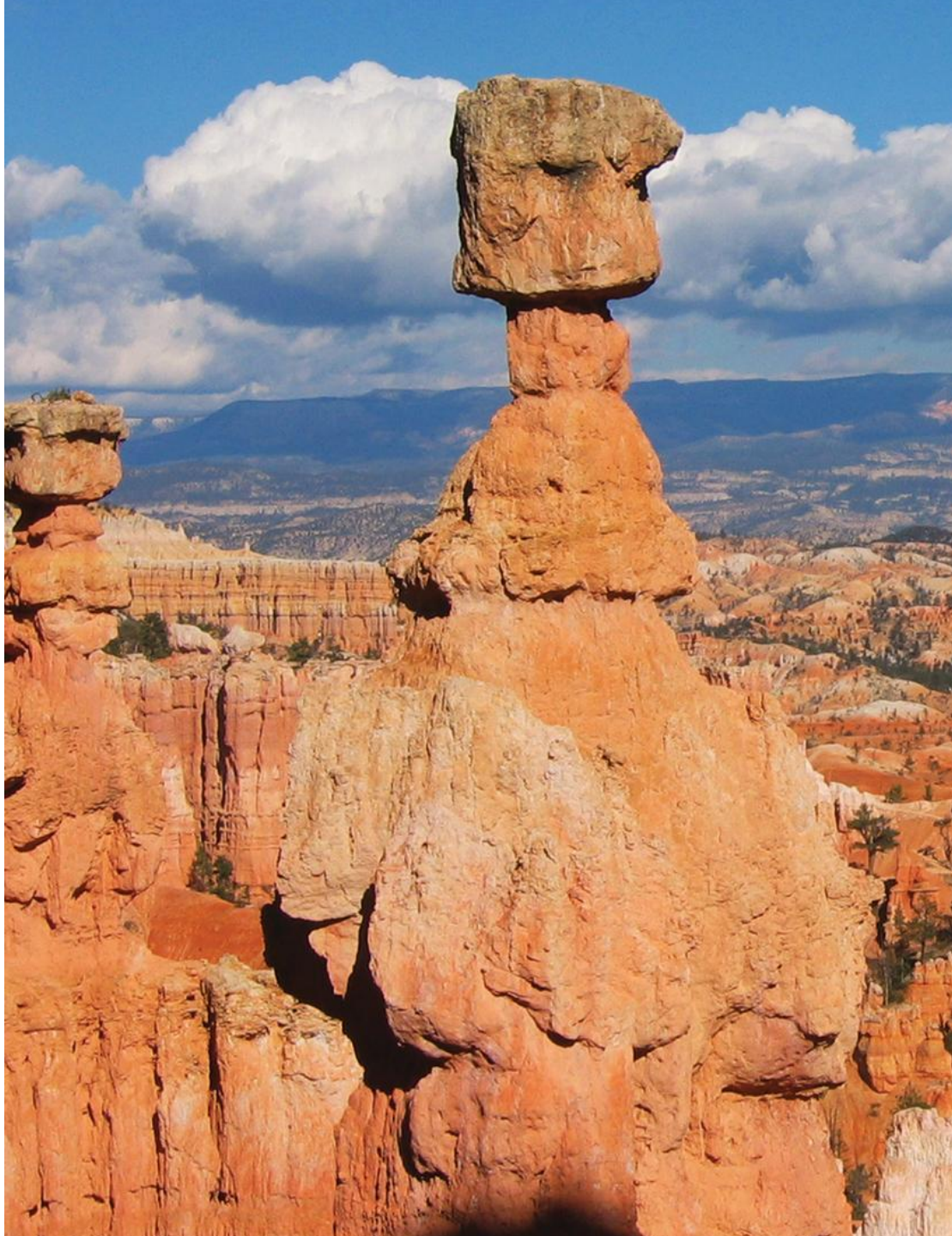
DOE Annual Meeting
August 5-6, 2024

Utah Geological Survey

Utah Statewide Carbon Storage Assessment:
Geological Data Gathering, Analysis, Sharing, and Engagement



Michael Vanden Berg, P.G. & Gabi St Pierre, Ph.D.

Utah Geological Survey

U.S. DEPARTMENT OF ENERGY

Fossil Energy and Carbon Management

This material is based upon work supported by the Department of Energy under Award Number DE-FE0032367

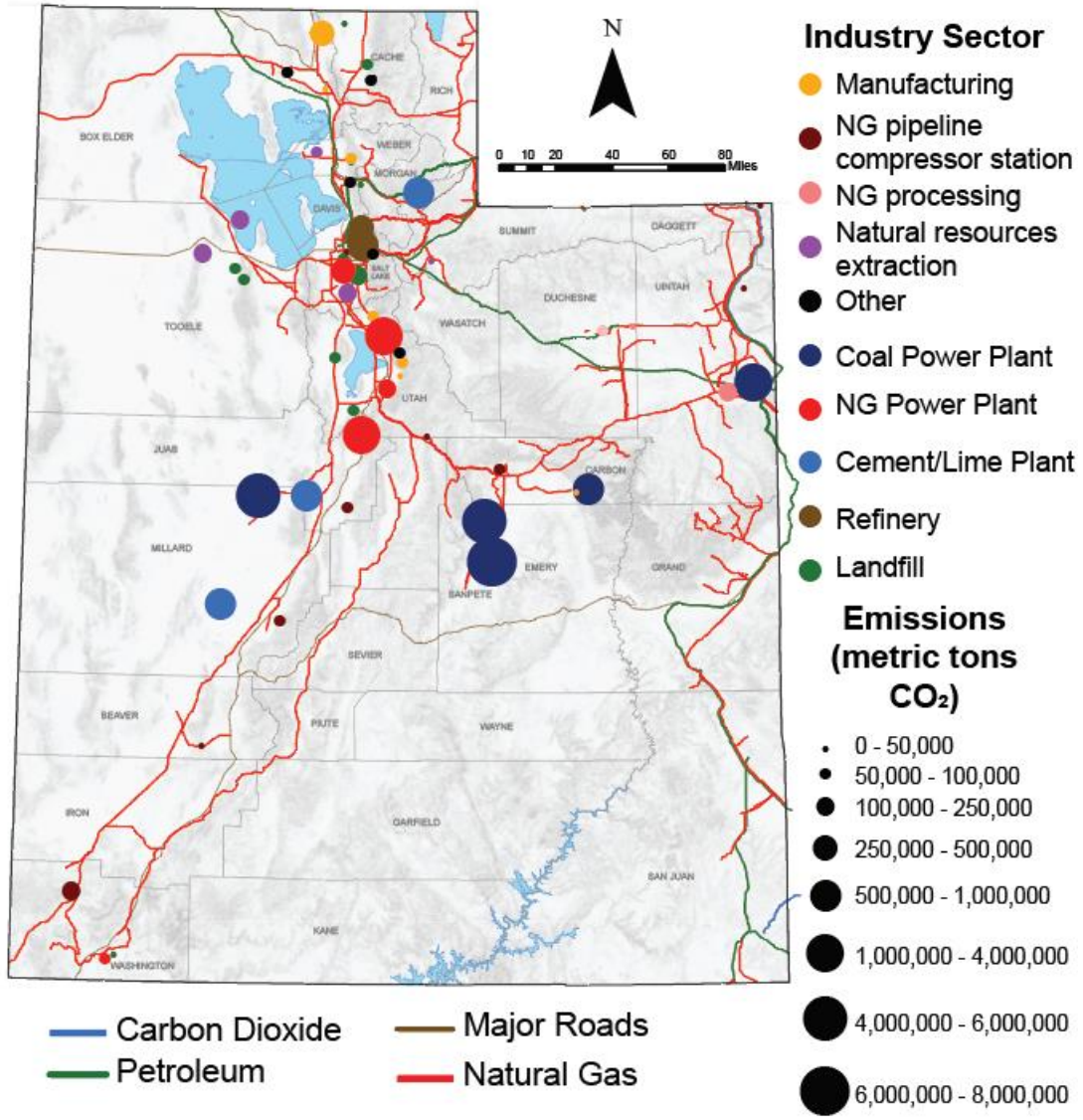
Project Overview:

- Aggregate, produce, analyze, and disseminate organized and accurate geological data for effective carbon storage (CS) in the state of Utah
- Create an interactive website application (“Web App”) that allows the visualization, storage, and systematic download of CS assessments
- Strongly consider societal and environmental impacts
- Include social justice frameworks in all tasks and interactions
- Set the stage for future business investment in Utah

Project Overview

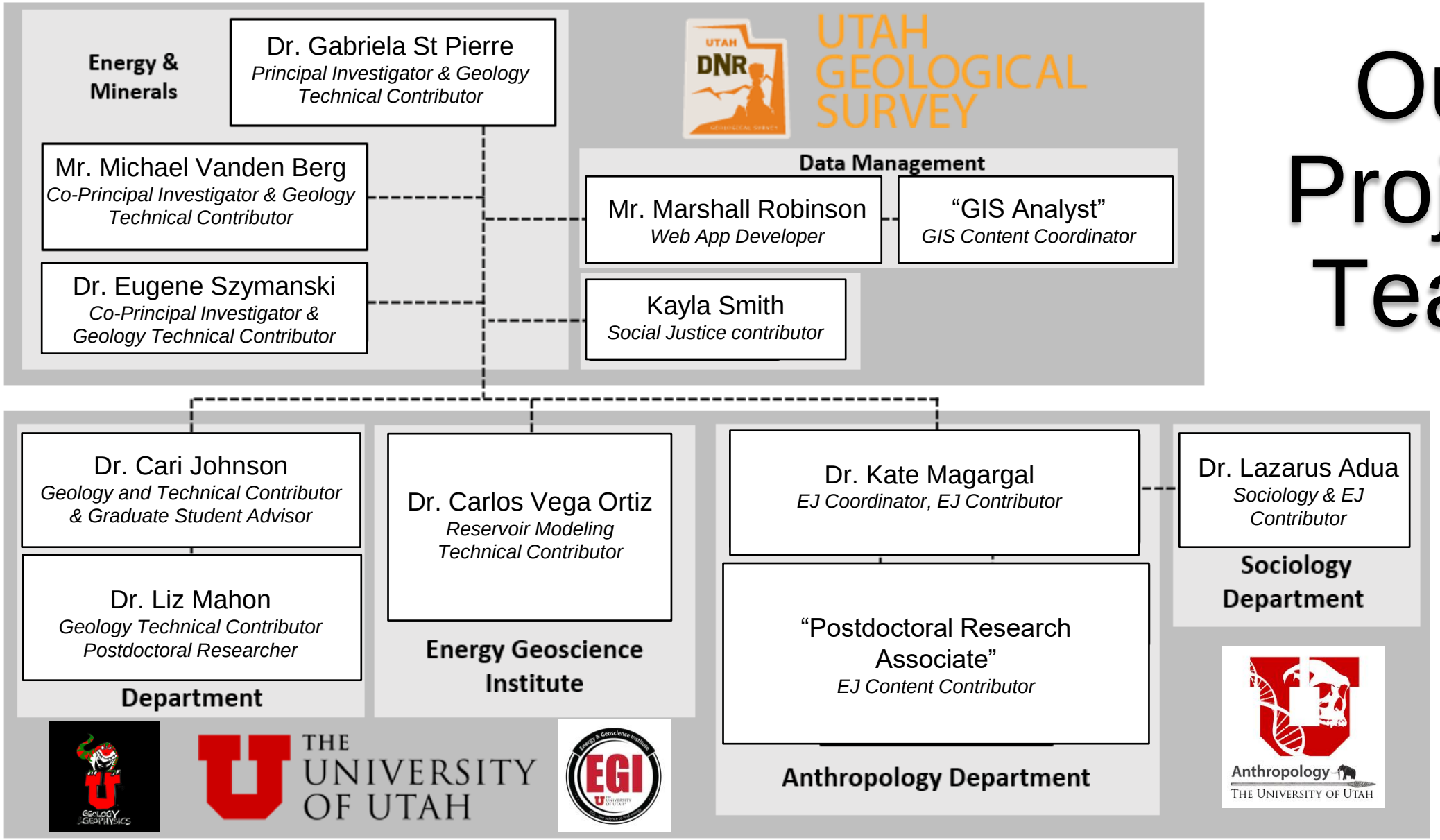
- There are limited CO_2 sources in Utah
  - Coal fired power plants, natural gas power plants
- Most sources are concentrated near population centers
  - E.g., Wasatch Front
- Likely a need for storage away from primary CO_2 sources
  - Direct Air Capture (DAC)
  - Carbon transport via pipelines

"sinks in search of sources"



2022 EPA flight data; https://ghgdata.epa.gov/ghgp/

Our Project Team



Project Plan

1. Project Management and Planning

2. Community Benefits Plan

3. Data Model Definition and Web Application Development

4. Data Gathering

5. Assessment of Carbon Storage Potential by Geologic Region

6. Assessment of Carbon Storage Potential: Key Reservoir/Seal Pairs

7. New Data Collection to Reduce Data Gaps

2. Community Benefits Plan

- The overarching intention of our CBP is to build relationships that can serve as the foundation for future planning.
- **The primary benefit to the community is to be prioritized in decision structures that value community-held knowledge and lived experiences of community members.**

CBP analyses will take a two-pronged approach:

1. Statewide Scale: assess an average or control condition among the population of Utah
2. Community scale: assess specific environmental justice dynamics (including identifying geospatial overlap with disadvantaged communities, or DACs) of potentially affected communities based on geoscience findings

*Data from the Climate and Economic Justice Screening Tool https://screeningtool.geoplatform.gov/en/#4.89/39.04/-116.27

DAC: Meets >1 burden threshold and the socio-economic threshold

DAC: Meets 1 burden threshold and the socio-economic threshold

Non DAC

2. Community Benefits Plan

Secondary and primary, qualitative and quantitative data will be gathered as part of the CBP plan. These data will be analyzed and synthesized into indexes intended to characterize the vulnerability of communities to climate change and energy justice.

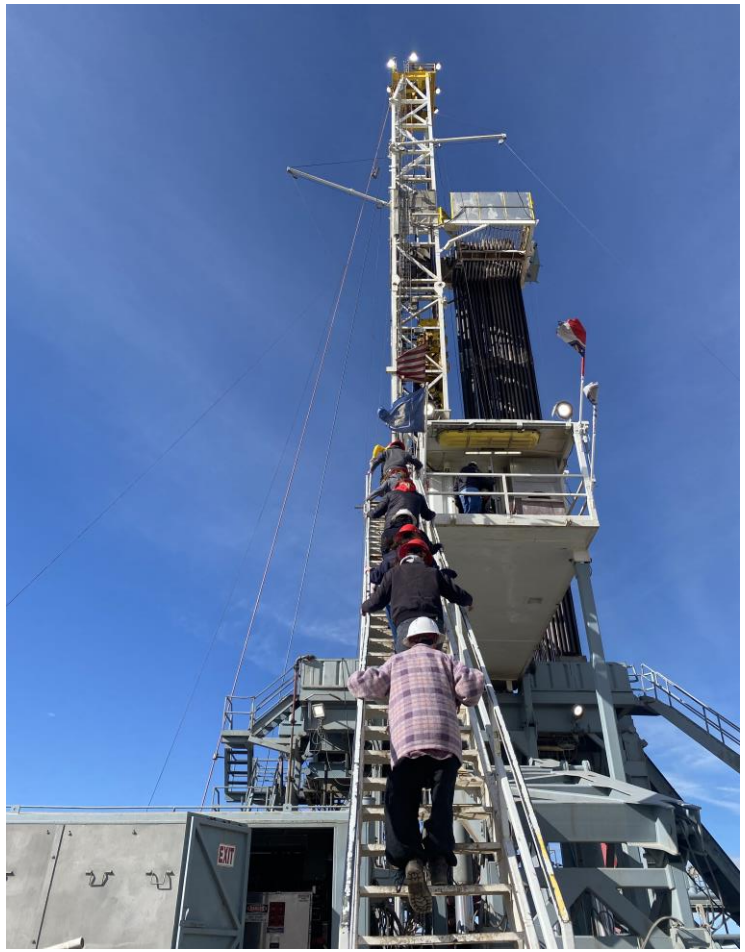
	Secondary	Primary
Quantitative	Census Data	Frequencies of attitude categories, response counts from household surveys
Qualitative	Characterizations of existing CM communities in US, identified DACs	Quotes and insights from interviews, public comment during forums

Outcomes: Maps of focal communities, information supporting community participation in CM future that includes index assessments.

2. Community Benefits Plan

Groups targeted for relationship-building are defined as:

1. Leaders from tribal and municipal governments
2. Representatives of non-profit organizations and corporations with a vested interest in energy projects, including CS
3. Community members at large and private land holders



UINTAH BASIN ENERGY SUMMIT

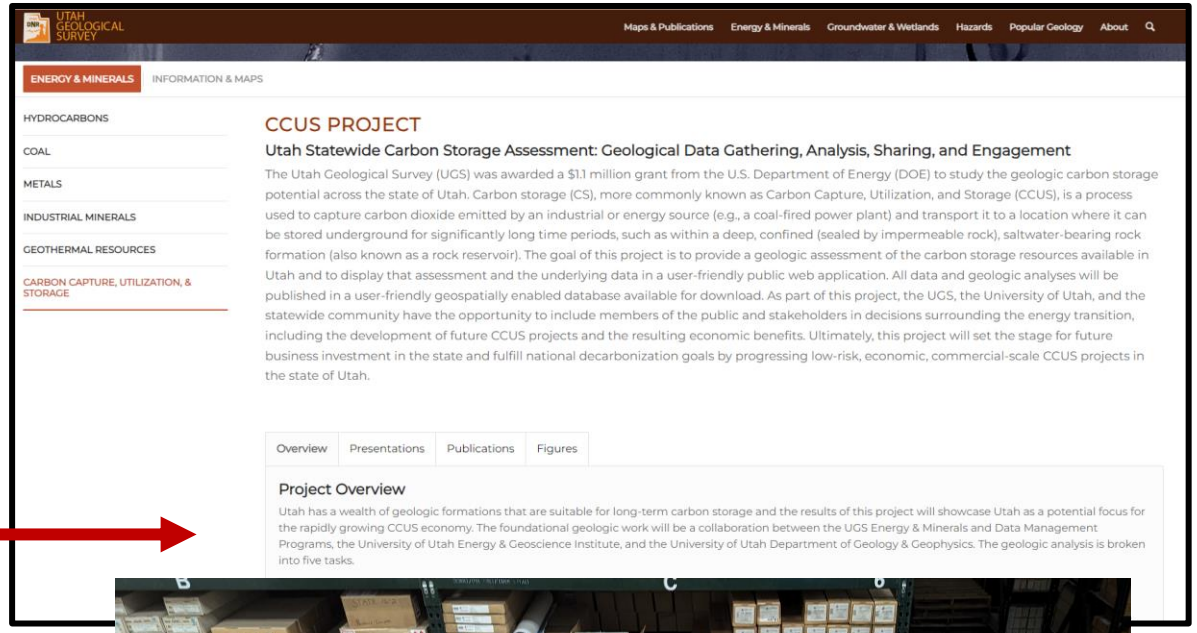
Uinta Basin Energy Summit happens each year in Vernal, UT

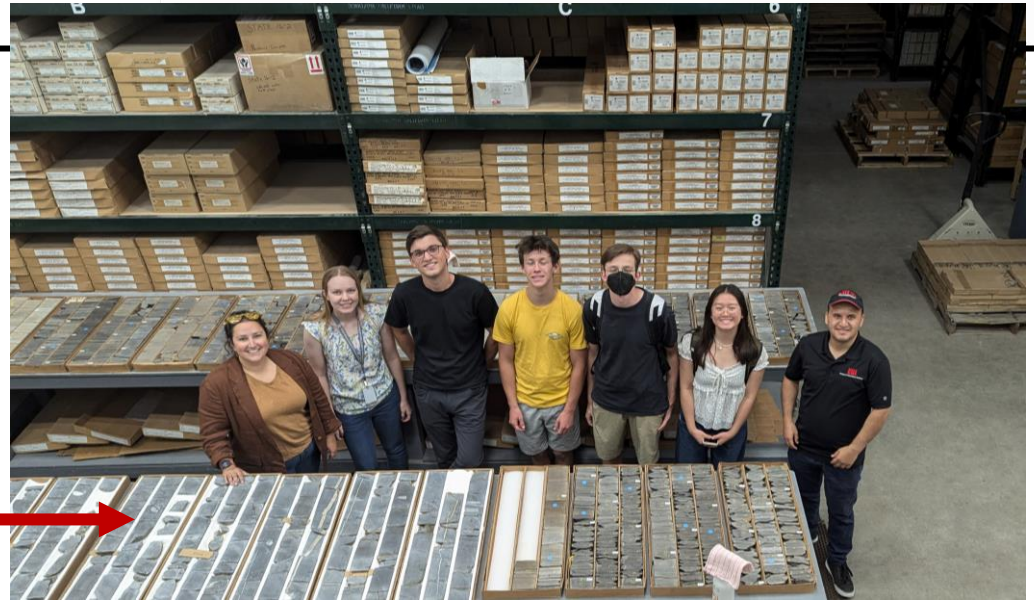
University of Utah students visit a drill rig in the Uinta Basin, a region we expect will be identified for public outreach.

*Diversity, Equity, Inclusion, and Accessibility Plan**

Specific efforts as applied to this research include:

- *Information accessibility*:
  - *Translating our press release into Spanish*
  - *Survey Notes article on our project for September issue*
  - *Creating project webpage on UGS Energy and Minerals website*
- *Indigenous inclusion*: land acknowledgements, indigenous place-names
- *Team accountability*: everyone needs to attend a relevant educational event
- *Mentorship:* intentionally target early-career folks for training and involve them in the publication process

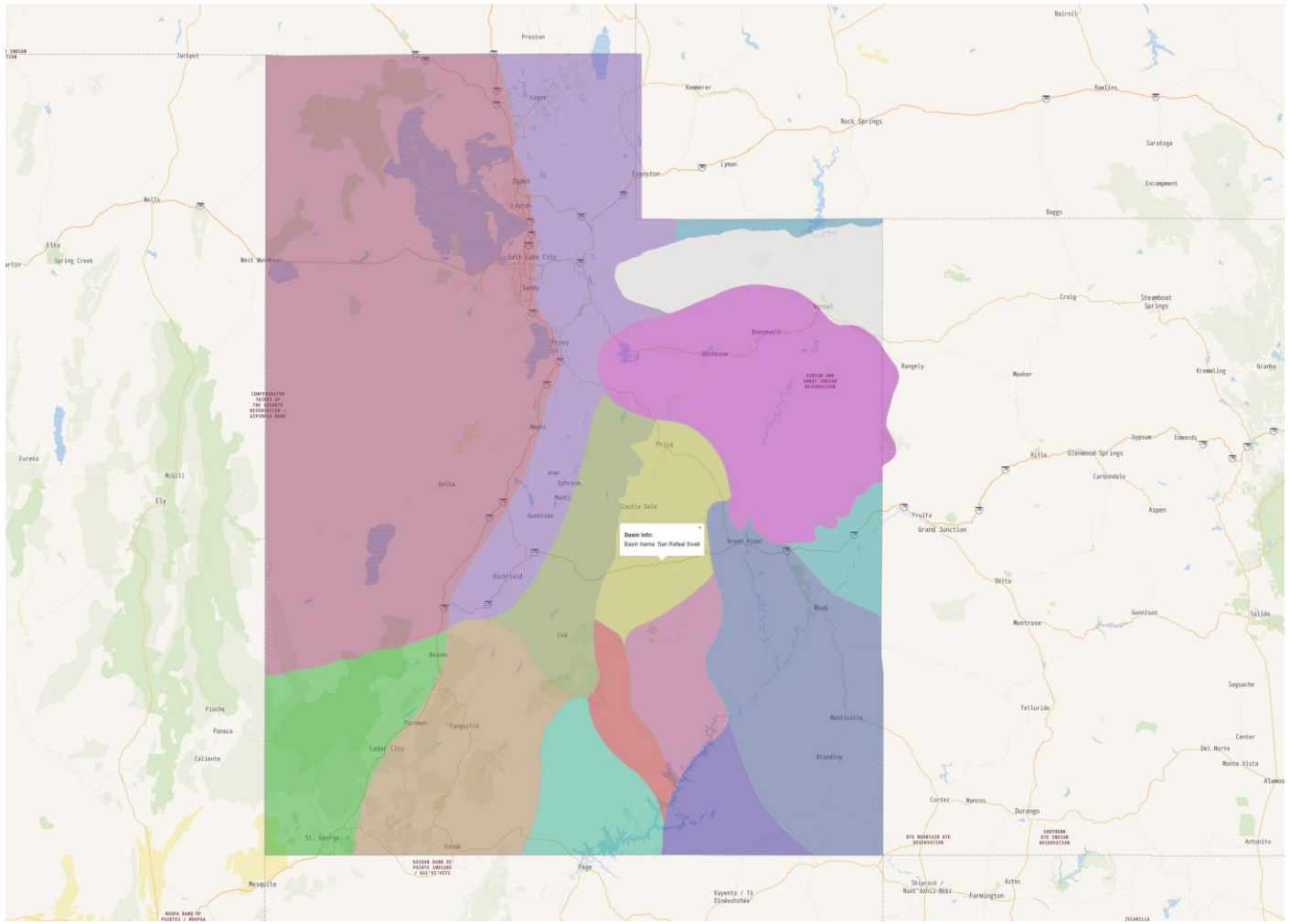




**This plan is required to meet federal DOE grant obligations*

Task 3: Data Model Definition and Web App Development

- Geospatial Database Development
- Web Application Development
  - Collected most of the basic data that will be shared in the web application, and have it published in PostGIS
    - Wells, cores, cuttings, geo-regions, infrastructure, etc
  - Created a very basic testing application that displays the data on an interactive map



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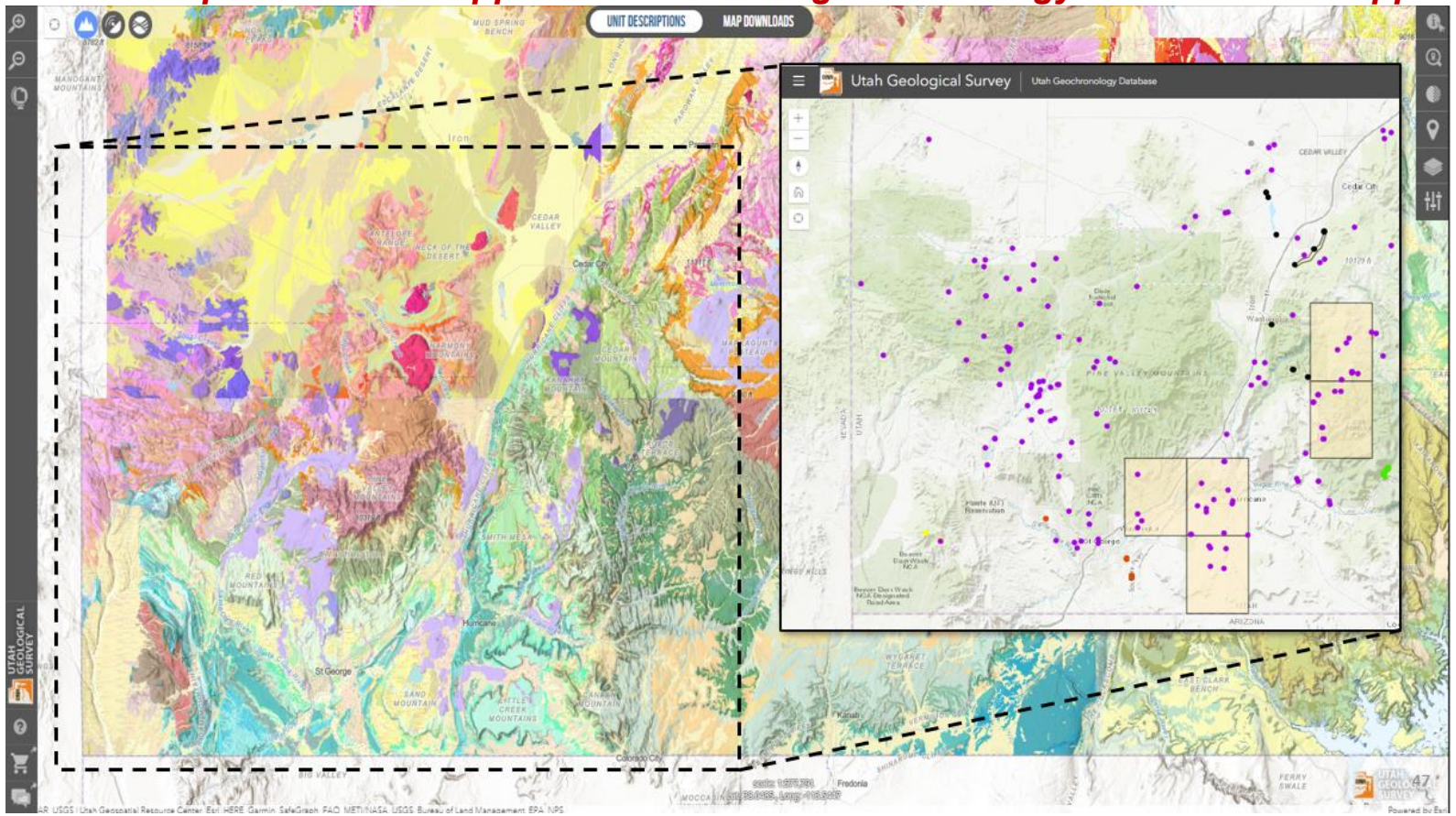
Example 'final' web application from the geochronology resources web app

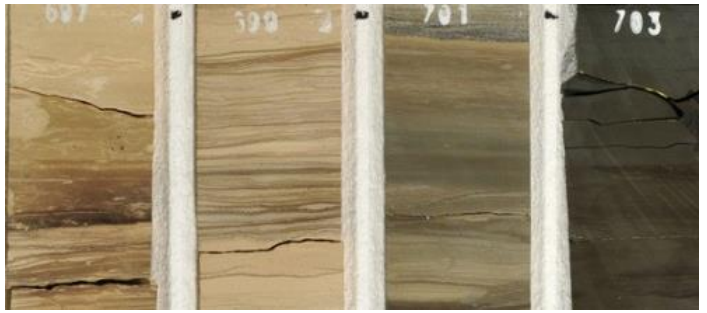


https://geology.utah.gov/apps/intgeomap/?view=scene&scale=1813311&zoom=8.35&lat=39.48501&lng=-111.56892&layers=footprints%2C500k%2C100k%2C24k&tilt=1&heading=358&elev=613560&exag=2.5&base=ustopo

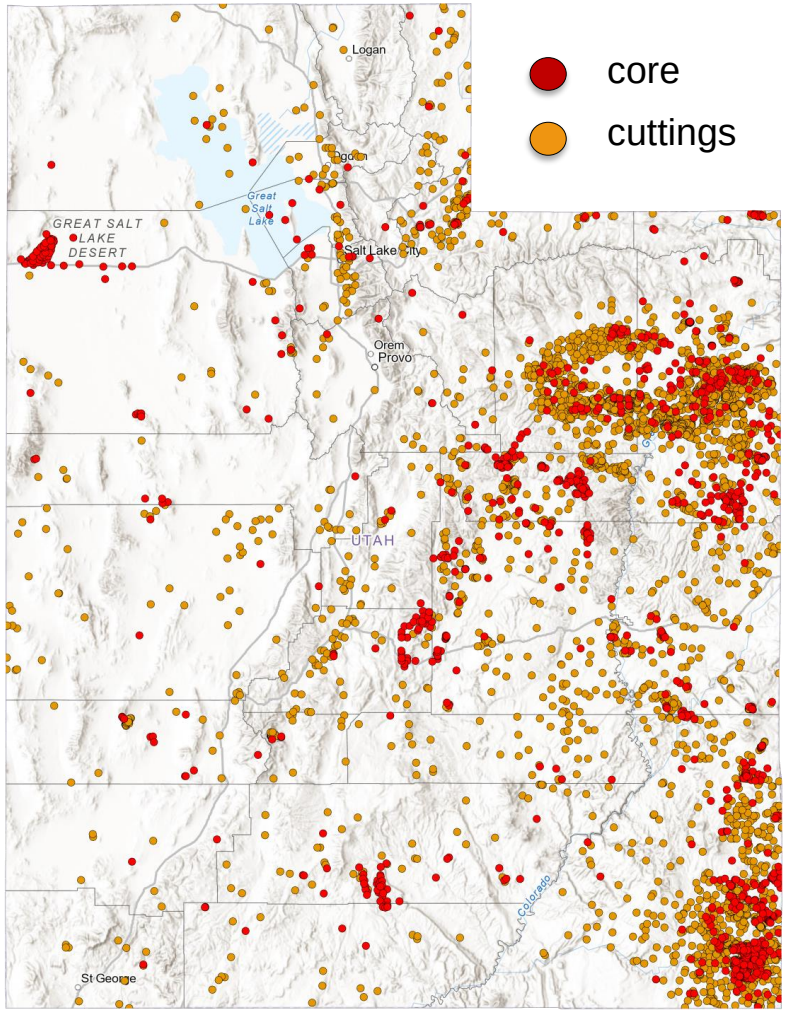
Task 4: Data Gathering

- Integration of Existing Carbon Storage Data
  - Well logs, petrophysical data (e.g., porosity, permeability)
  - Cores, cuttings
  - Outcrop data (e.g., measured stratigraphic columns)
- Identification of Data Gaps and Limitations

Utah Core Research Center (UCRC)



Core and Cuttings Available at UCRC



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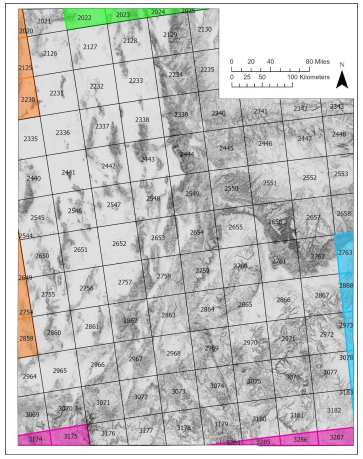


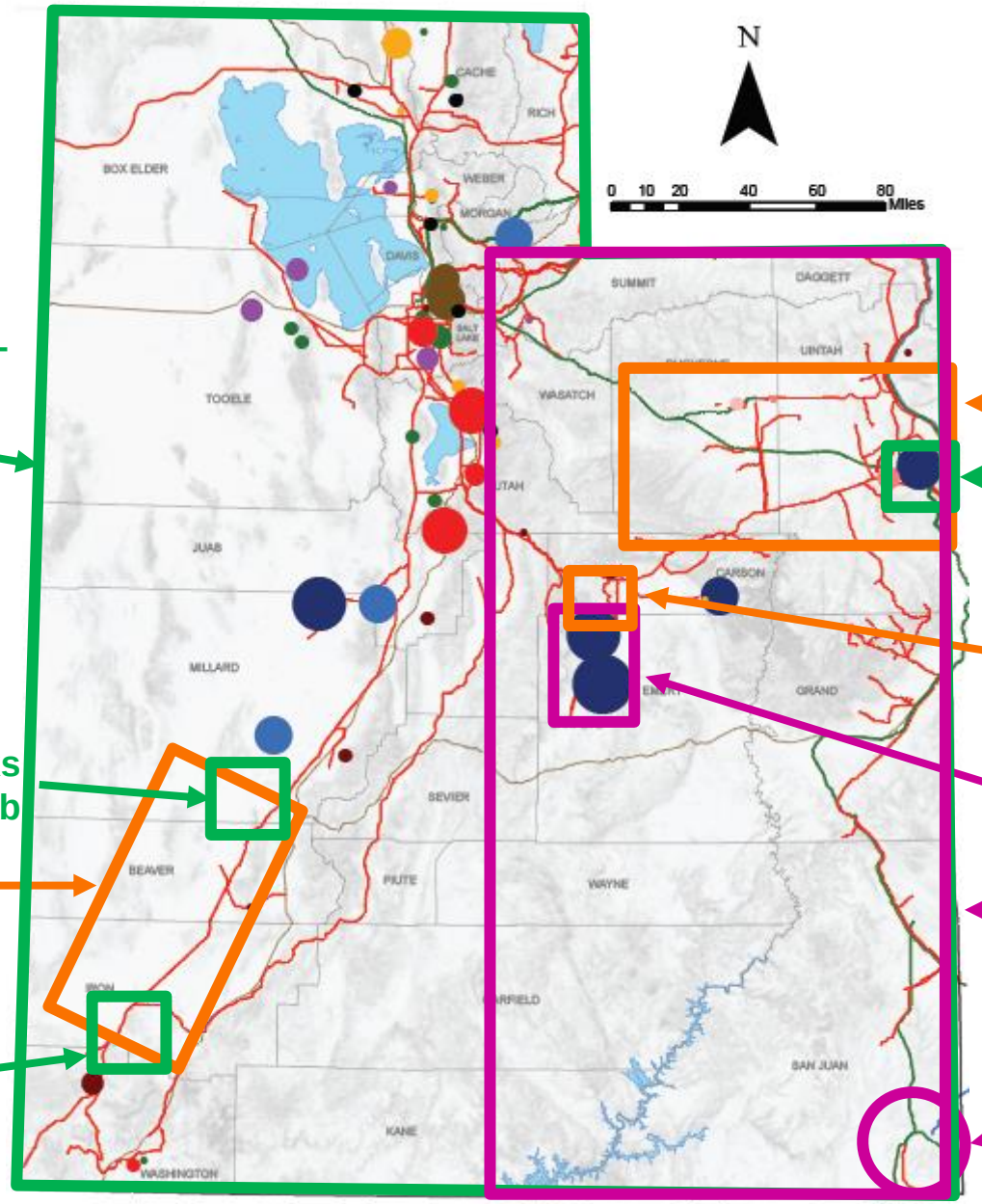
CUSP West Partnership

CUSP West SCO_2T Database (Whole State)

Red Rocks DAC Hub

Proposal: Great Basin CarbonSAFE Phase 2

Iron Mountain CUSP focus project



Currently Funded Projects

New Proposals In Progress

Previous Work

Proposal: RITAP FOA: Uinta-Piceance Region

Uinta Basin CarbonSAFE Phase 2

Proposal: San Rafael Swell CarbonSAFE Phase 2

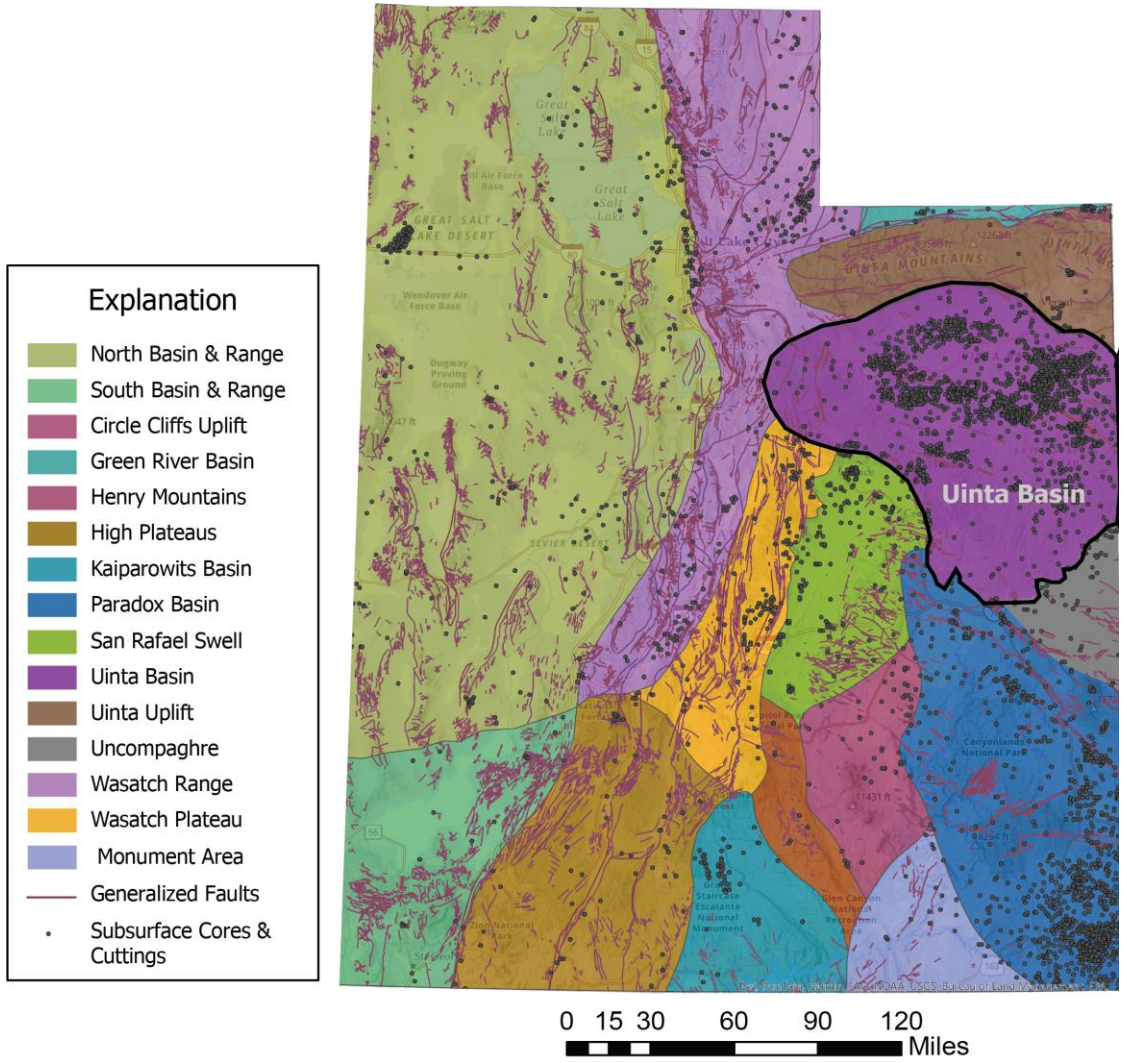
San Rafael Swell CarbonSAFE Phase 1

Southwest Partnership (SWP): Colorado Plateau (NATCARB)

SWP Aneth CO_2 EOR

Task 5: Assessment of Carbon Storage Potential by Geologic Region

- Objective: Create a high-level summary so non-experts can understand the CS potential of each region
- Current tasks:
  - *Review of Existing Carbon Storage and Geologic Data by Georegion*
  - *Adding Relevant Data into the Web Application*
  - *Modeling initial carbon storage resource estimate and cost*
- End Deliverable: Regional Assessment Report



Cost and CO_2 Storage Resource Assessment: SCO_2T^{PRO}

- SCO_2T^{PRO} is a new software package that uses machine learning to simulate CO_2 storage in saline aquifers
- Key Geologic parameters:
  - Formation
  - Thickness
  - Depth
  - Permeability
  - Porosity
  - Pressure
  - Temperature/temperature gradient
- Key Engineering/Cost parameters:
  - Max injection rate
  - Number of injection wells
  - Injection well diameter
  - Old oil and gas wells
  - Injection period and rate

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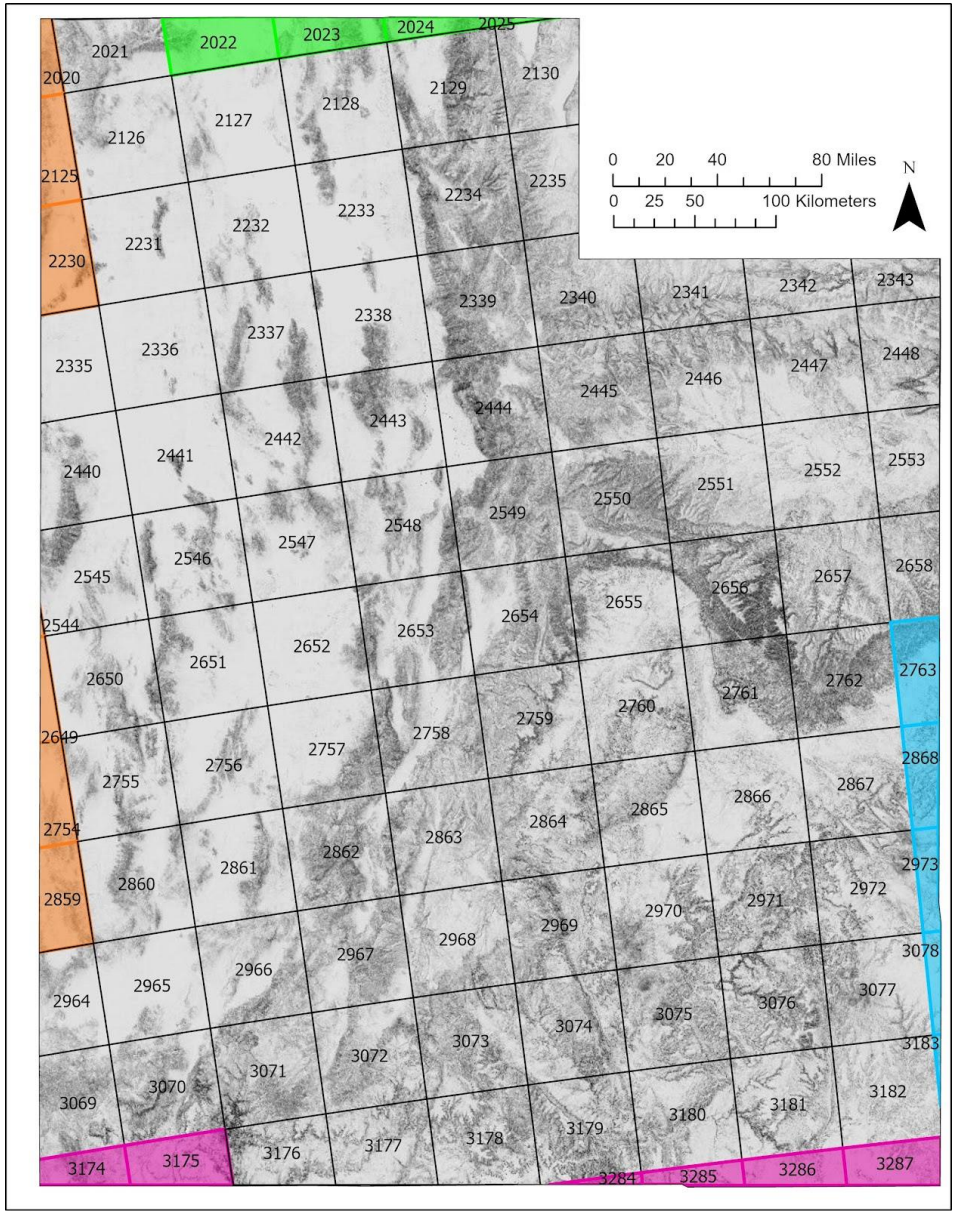


Cost and CO_2 Storage Resource Assessment: SCO_2T^{PRO}

Geo_Region	Reservoir Name	Depth (ft)	Depth Source	Net Thickness (ft)	Net Thickness Source	Permeability (mD)	Permeability Source	Porosity (%)	Porosity Source	Area
High Plateuas	Dakota Sandstone	6,500	Panguitch #1 Well; API 430	200.0	Hintze and Kowallis	0.08	Avg from PP datab	13	Avg from PP datab	109.0
High Plateuas	Kaibab Limestone	10280	Panguitch #1 Well; API 430	170.0	Hintze and Kowallis	281	From AAPG Oil and	12.000	From Fed Apple 2	82.0
High Plateuas	Navajo Sandstone	8,960	Dixie Unit 2; API 430173010	1600.0	Hintze and Kowallis	80	Sprinkel et al 2007	8.00	Iron Mnt project	186.0
High Plateuas	None	None	None	None	None	None	None	None	None	0.0
High Plateuas	Kaibab Limestone	11,500	Panguitch-1 Well	100.0	estimate	281	From AAPG Oil and	17	From AAPG Oil and	582.2
High Plateuas	Navajo Sandstone	6,000	Well Report	1500.0	Hintze and Kowallis	80	Sprinkel et al 2007	12.00	Sprinkel et al 2007	582.2
High Plateuas	Kaibab Limestone	7,000	Johns Valley Unit 2	170.0	120-230 ft thick (Fro	281	From AAPG Oil and	17	From AAPG Oil and	2500.0
High Plateuas	Navajo Sandstone	4200	only in NE and NW corners;	1600	Estimated from Hintz	80	Sprinkel et al 2007	12.00	Sprinkel et al 2007	610
High Plateuas	White Rim Sandstone	7,200	Wells - depths go from 420	170.0	Estimated from Hintz	1.58	*Avg from Weber i	15	Copied from From B	954.3
High Plateuas	none	none	none	none	none	none	none	none	none	0.0
High Plateuas	none	none	none	none	none	none	none	none	none	0.0

Carbon Solutions LLC

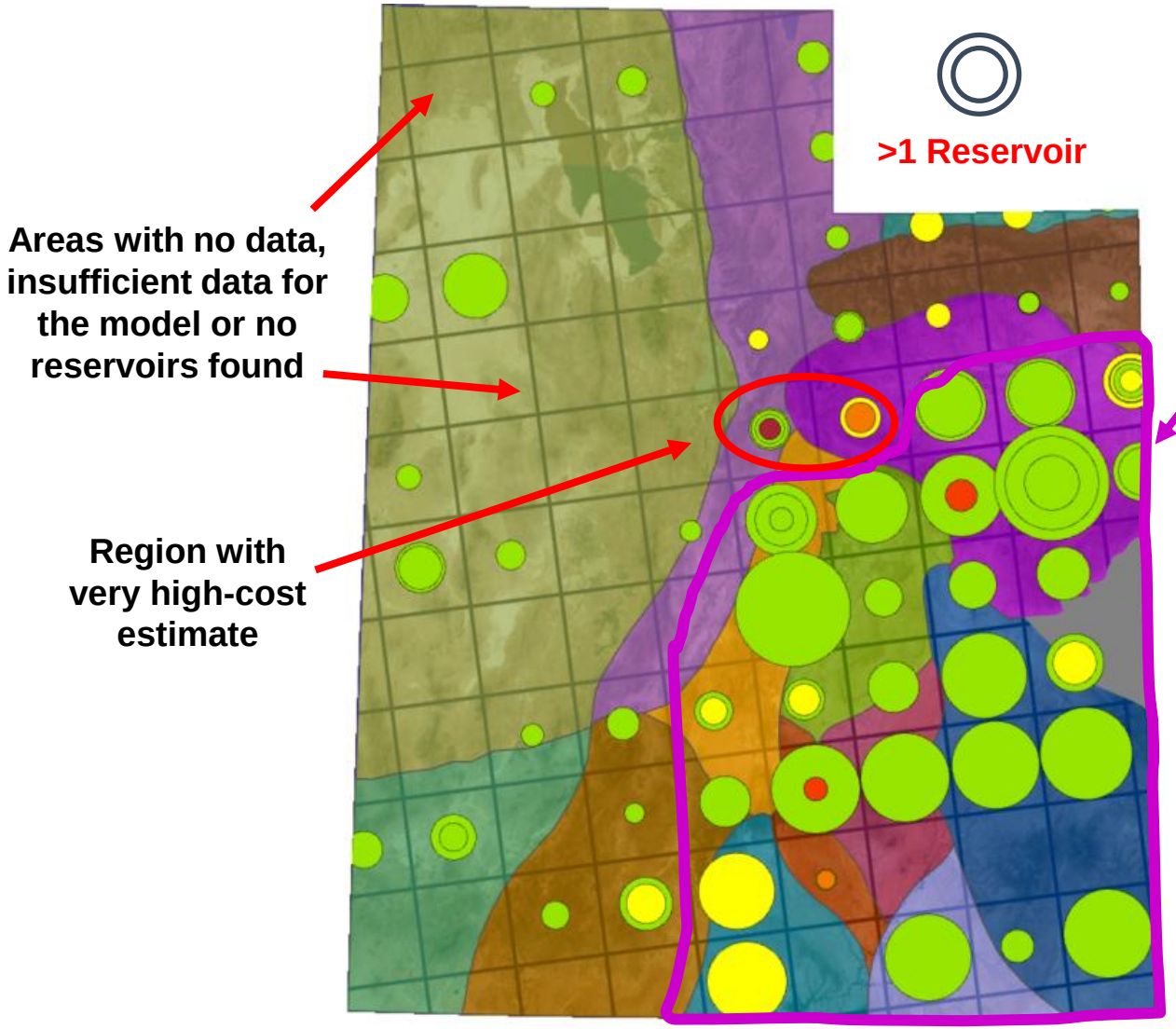
Cost and CO_2 Storage Resource Assessment: Results

Storage Cost (dollar/Mt CO_2)

- <12
- 13-22
- 23-35
- 36-53
- 54-100

CO_2 Storage Resource Potential (Mt CO_2)

- 120
- 1760
- 3400
- 5000



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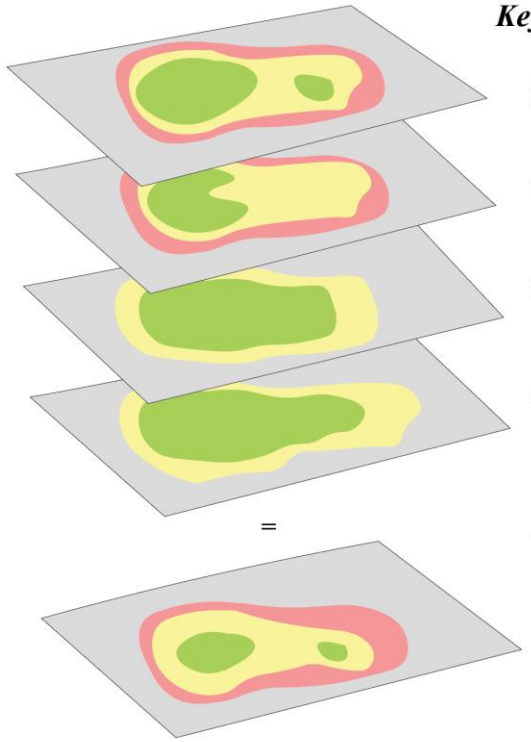
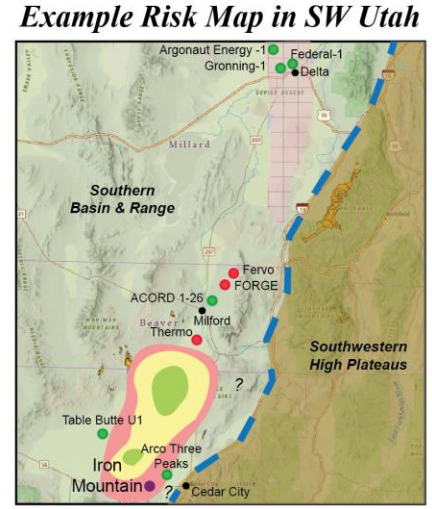
Task 6: Assessment of Carbon Storage Potential: Key Reservoir/Seal Pairs

1. Reservoir & Seal layer mapping
2. CS Prospect Risking and Favorability Ranking
3. Carbon Storage Resource Polygons
4. Highlight regions with few, or no existing geologic data
5. Publish in the Web Application (Production Release)



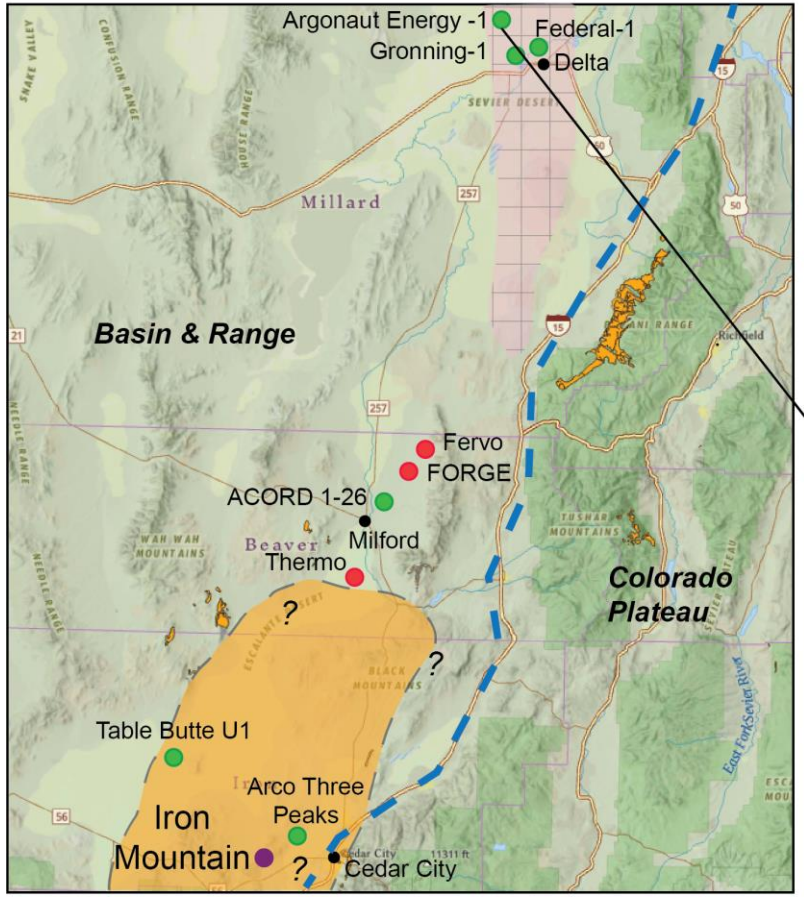
Example Final Risk Map

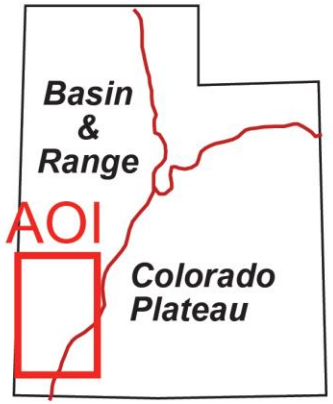


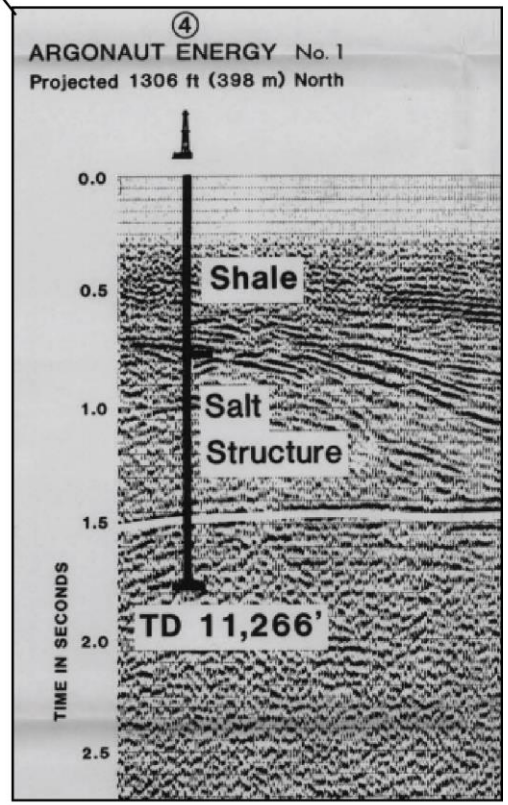
https://www.gis-pax.com/play-mapping/traffic-light-maps-vs-split-risking-maps/

Example

- Possible reservoirs:
  - Basalts
  - Beneath salt domes
  - Navajo, White Rim, Cedar Mesa Sandstones
  - Kaibab, Leadville/Redwall Limestone etc.
- Polygon attributes could include:
  - reservoir thickness
  - subsurface depth
  - dominant fracture sets
  - paleo-depositional environment
  - stratigraphic architecture
  - rock property information such as porosity, permeability, framework mineralogy, and geochemistry

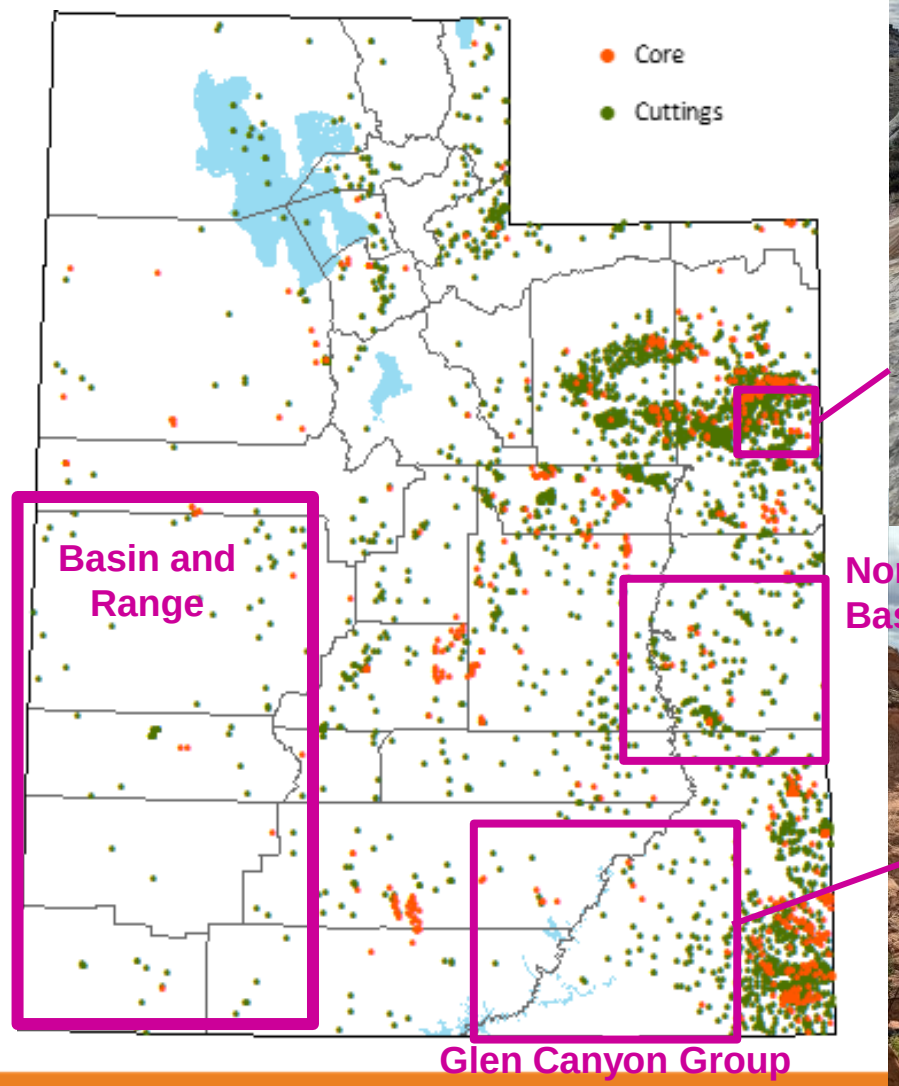


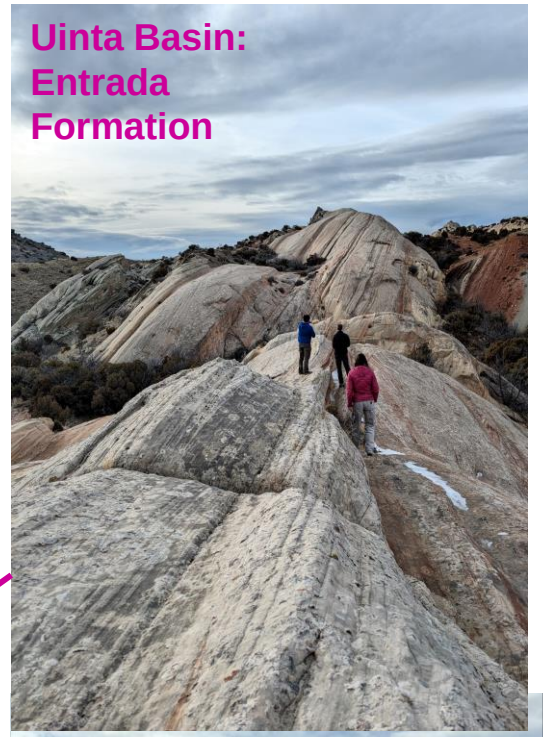


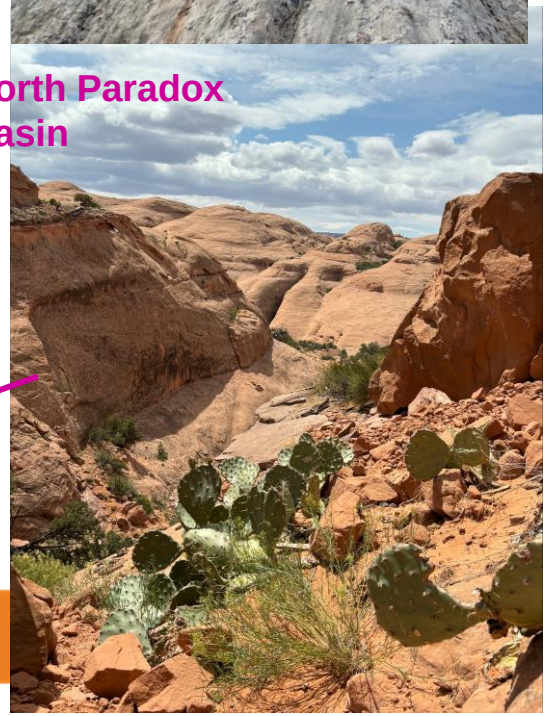


Task 7: Reducing Data Gaps

- Data Gap Reduction through New Data Collection
  - University of Utah GG: Currently investigating the Navajo Sandstone across UT and other potential Glen Canyon Group reservoirs
- Petrophysical and Fluid Property Assessment
  - EGI is investigating the northern Paradox Basin
- Reservoir Modeling for Regional CO_2 Volume Estimates
- Add New Geologic Data into Web Application (Production Release)







Next Steps:

- Continue updating webapp and database with new data
- Send state-wide survey to the public to evaluate their opinions on CCUS and energy transitions in Utah
- Survey Notes Article, September 2024
- Begin carbon storage analysis by geo-region
- Continue identifying areas with data gaps that need to be filled

Thank you.

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UGS Project Team

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