Regional Resource Assessment for CO_2 Storage in New Mexico and Surrounding Areas: Identification, Characterization, and Evaluation of In-Situ Mineralization Site/Complex

Carbon Conversion

FOA2614: AOI 4

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U.S. Department of Energy

National Energy Technology Laboratory

2024 FECM / NETL Carbon Management Research Project Review Meeting

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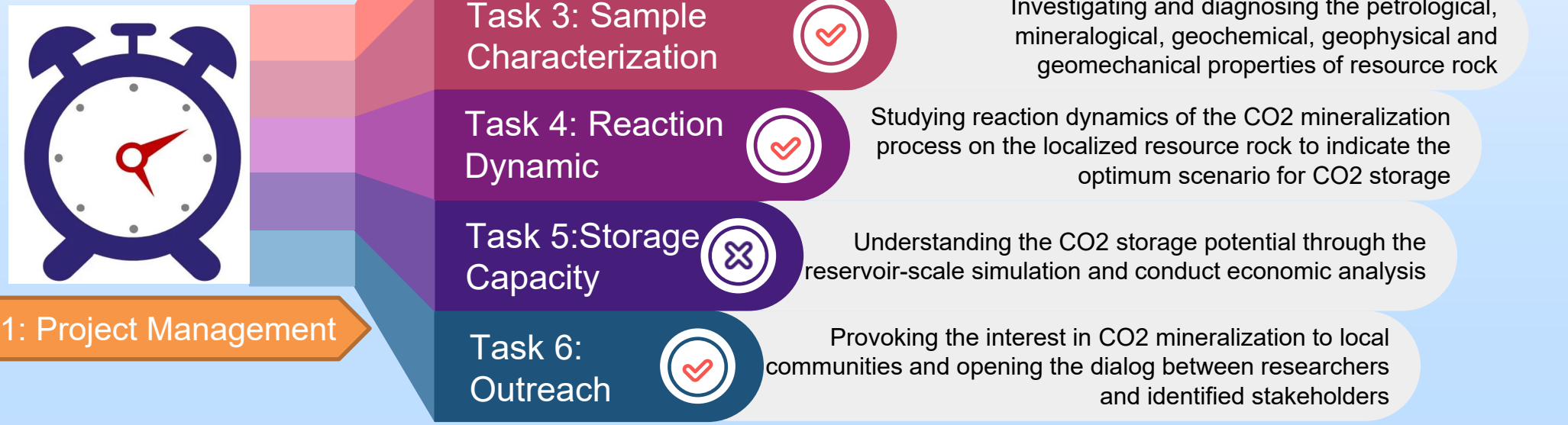
Project Objective and Goals

- Project Objective: Identify and access statewide resources for potential CO2 storage via mineralization processes, including basalt formations and related stratigraphic units, and mining wastes in the state of New Mexico, as well as identify and characterize potential targeted storage sites/complexes to provide insights on storage capacity.

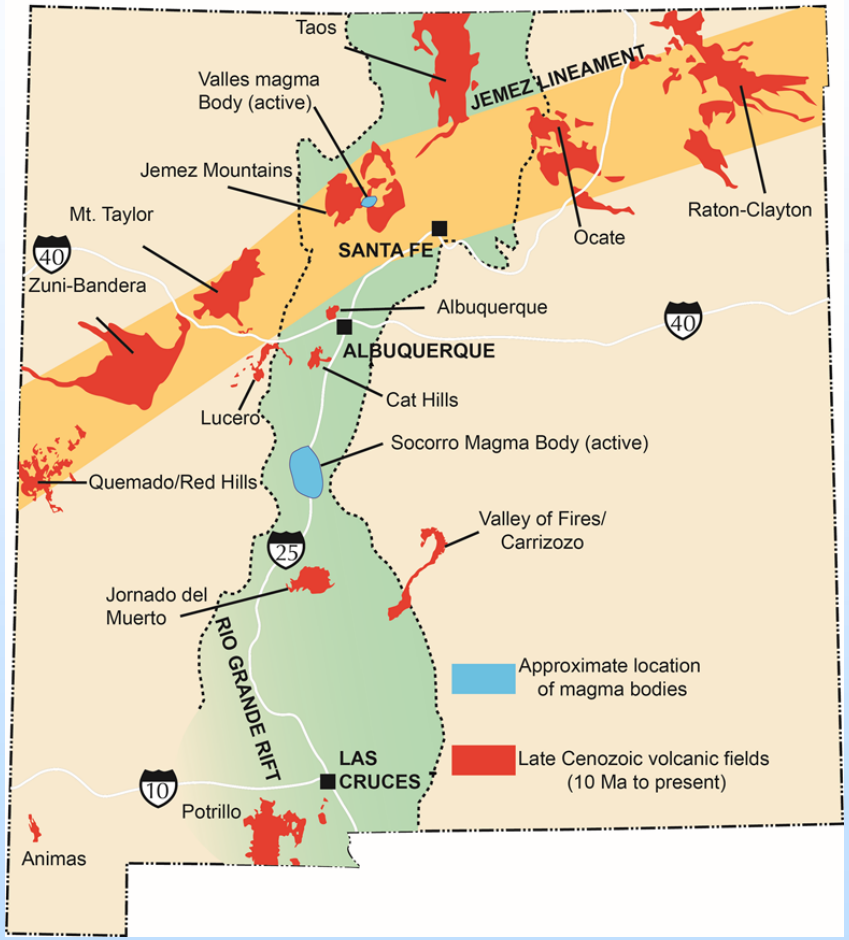
- Project Performance Dates: 09/04/2023 – 09/03/2025

- Tasks:

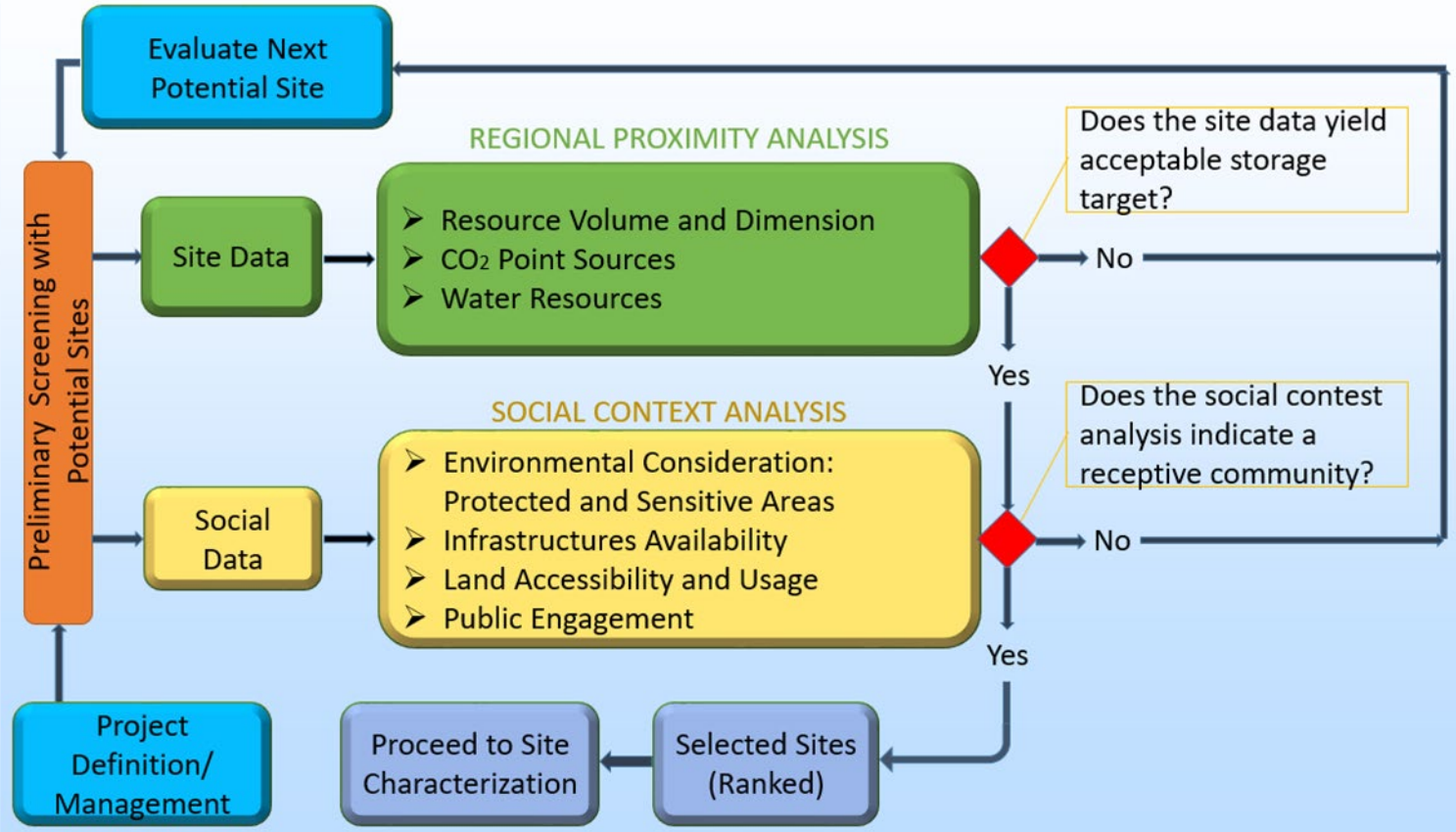


Technical Update

Site Selection-Surface/Near-surface Basalt



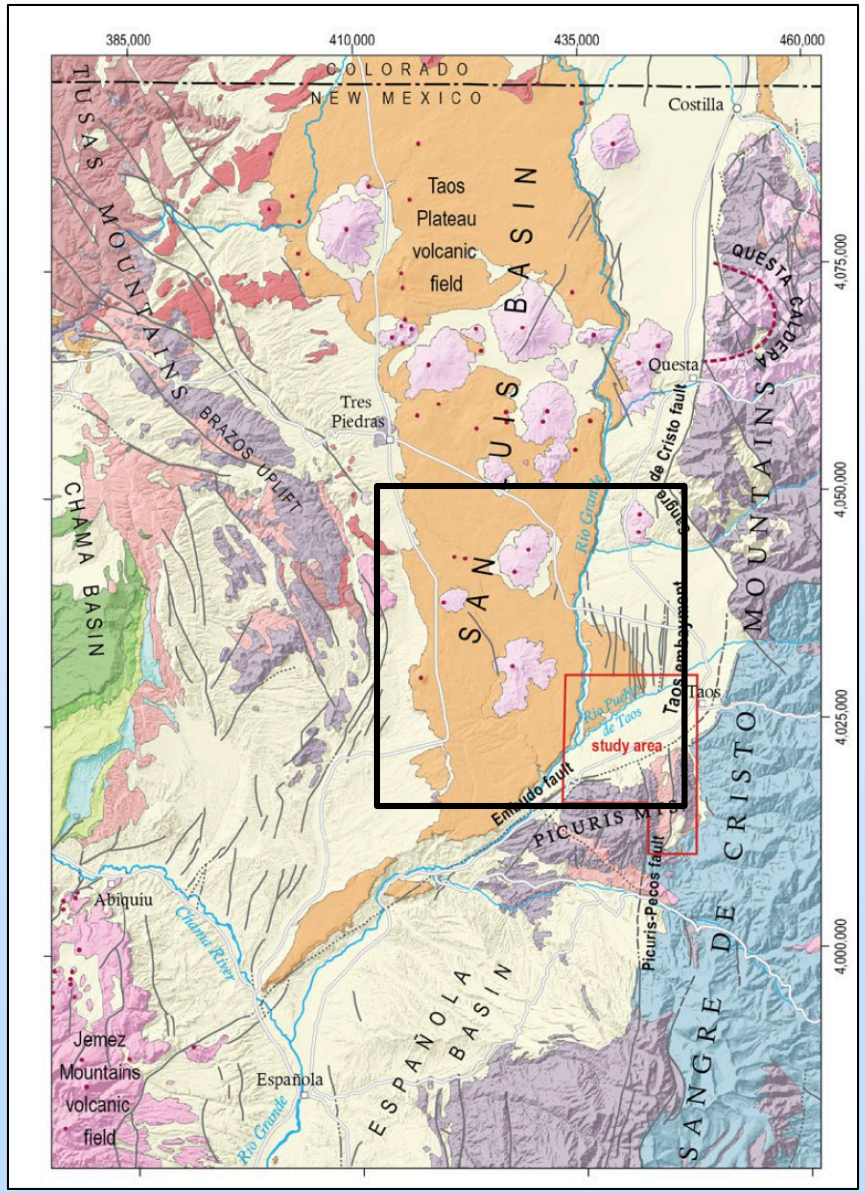
Geographical distribution of the basaltic rock in New Mexico



Site Suitability: Decision criteria are relevant to the specifics of CCUS via mineralization projects, such as: geologic formation volume, presence of divalent cation, proximity to sensitive areas, land access, CO2 sources, surrounding water resources, infrastructure availability and public engagement, etc.

Technical Update

Taos Plateau Volcanic Field - Introduction



>6.0 Ma to 1.0 Ma

~2,500 km^2

~250 km^3

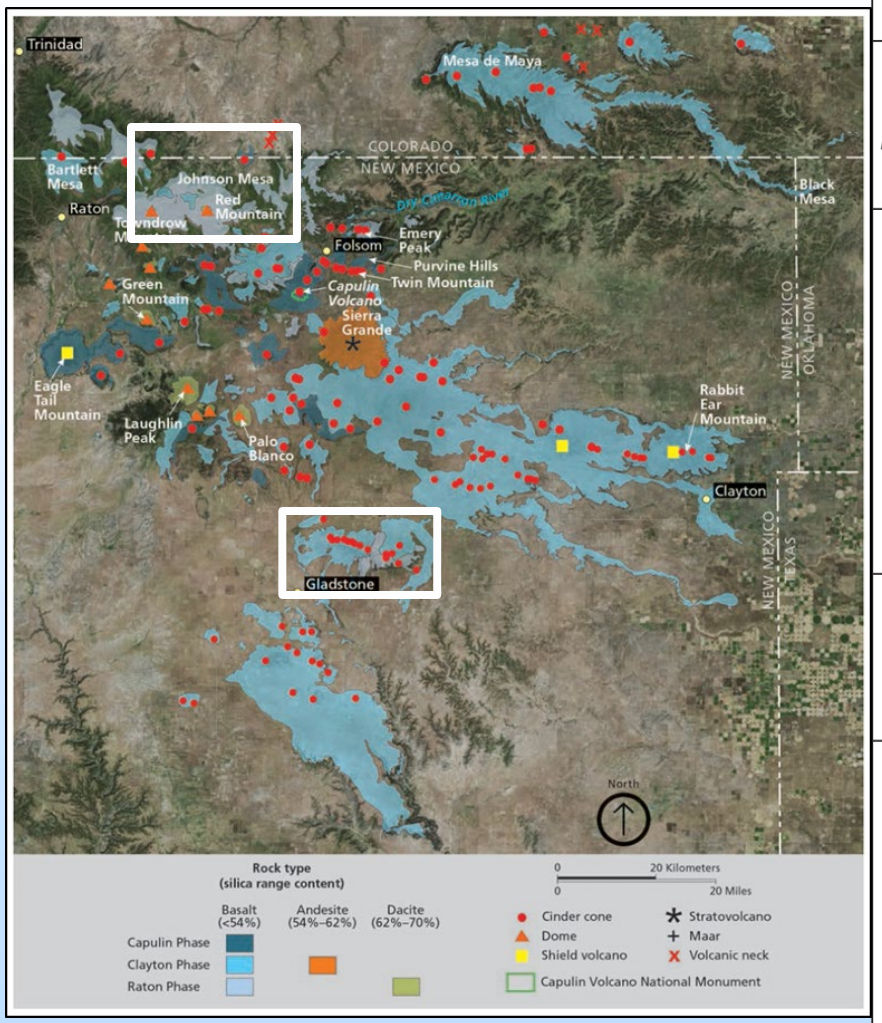
35-50 exposed volcanoes(more buried)

Compositionally diverse

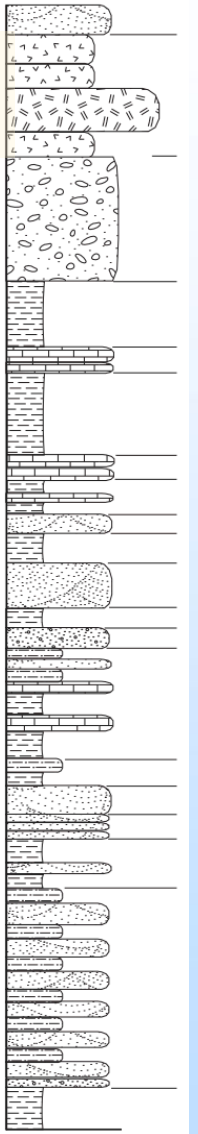
Late Cenozoic field in NM

Technical Update

Raton-Clayton Stratigraphy



Geologic Age	Stratigraphic Unit	General Rock Type(s)	Avg. Thickness
Quaternary		Eolian sand sheets, dune and alluvial deposits.	~0-30 m
	Raton-Clayton-Capulin volcanics	Dark gray to black basalts, cinder cones and fissure vents ranging in age from ~ 36 ka - ~ 9 Ma. Incl. Sierra Grande: med. gray andesite, ~2.6-3.8 Ma.	
Miocene-Pliocene	Ogallala Fm.	Reddish-brown to tan coarse-grained sand with local lenses of pebble to cobble conglomerate. Heavily bioturbated. Locally capped by well-developed calcrete.	0 - 200 m
Cretaceous	Smoky Hill Marl (Niobrara Fm.)	Dark gray silty to sandy shale with thin beds of limestone and marl.	305 m
	Ft. Hays Ls.	Pale gray medium bedded limestone	15 m
	Carlile Shale	Dark gray shale with thin limestone beds in upper section.	61 m
	Greenhorn Ls.	Gray shale and pale gray medium-bedded micrite beds.	9 m
	Graneros Shale	Medium gray shale with thin fossiliferous limestone beds.	38 m
	Dakota Group: Romeroville Ss.	Yellowish-gray medium-grained, locally pebbly sandstone.	0-8 m
	Dakota Group: Pajarito Shale	Medium gray shale.	10-20 m
	Dakota Group: Mesa Rica Ss.	Brownish-yellow persistent medium grained, cross-bedded sandstone.	33 m
	Glencairn Fm.	Gray to dark gray shale, siltstone and sandstone.	22 m
	Lytle Ss.	Light gray conglomeratic cross-bedded sandstone.	10-20 m
Jurassic	Morrison Fm.	Gray-green and red mudstone with locally thick medium to coarse-grained sandstone and thin micrite beds.	52-168 m
	Bell Ranch Fm.	Dark brown mudstone with nodules of alabaster.	0-8 m
	Exeter Sandst.	White to pale pink cross-bedded sandstone.	0-24 m
Late Triassic	Dockum Group: Sheep Pen Ss.	Light-brown, thin-bedded sandstone.	0-33 m
	Dockum Group: Sloan Canyon Fm.	Red and pale gray-green mudstone with lenses of medium-grained sandstone.	0-46 m
	Dockum Group: Travesser Fm.	Reddish-brown siltstone and sandstone with local intraformational conglomerate lenses.	75-168 m
	Dockum Group: Baldy Hill Fm.	Purple, red and green mottled mudstone with lenses of coarse-grained sandstone. Base not exposed.	> 30 m



Lithology Key: Basalt, Andesite, Limestone, Conglomerate/ conglom. sandstone, Sandstone, Siltstone, Mudstone/shale

Eruptions between ca. 9 Ma and 37 ka

~140 vents (mostly cinder cones)

7,000-10,000 km2

~100-200 km3

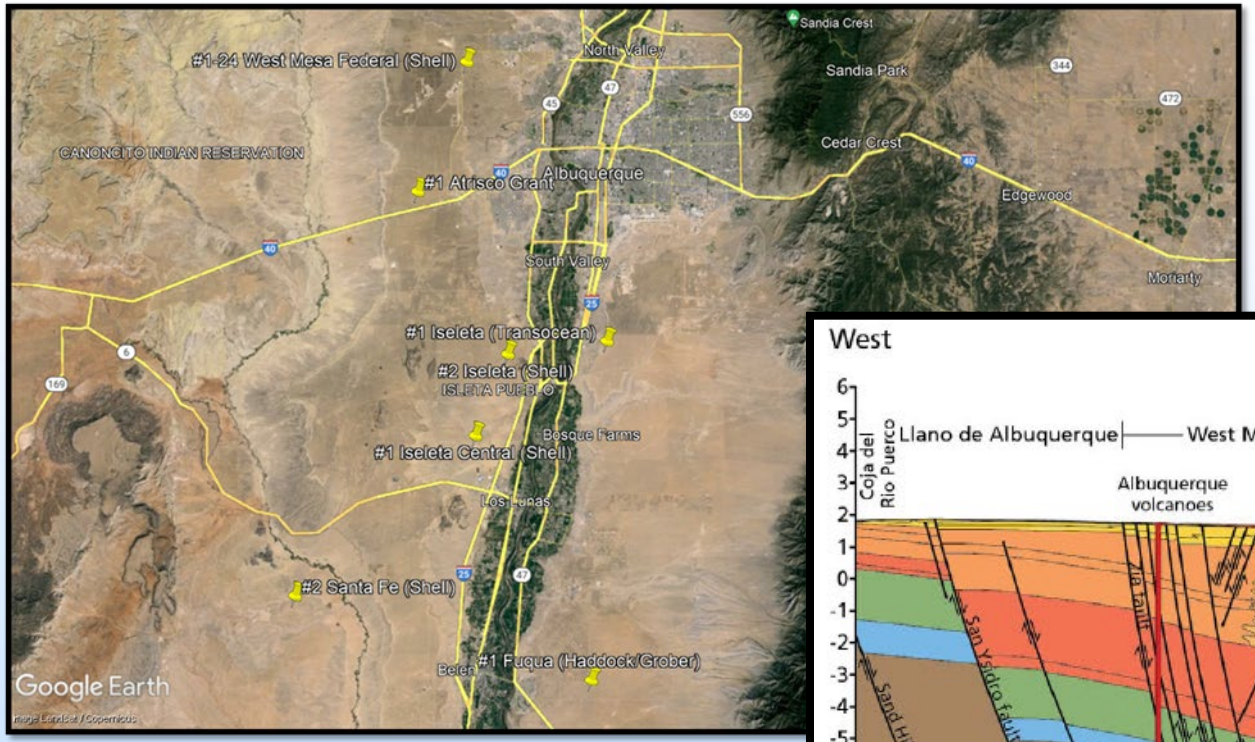
Compositionally diverse (not as much as TPVF)

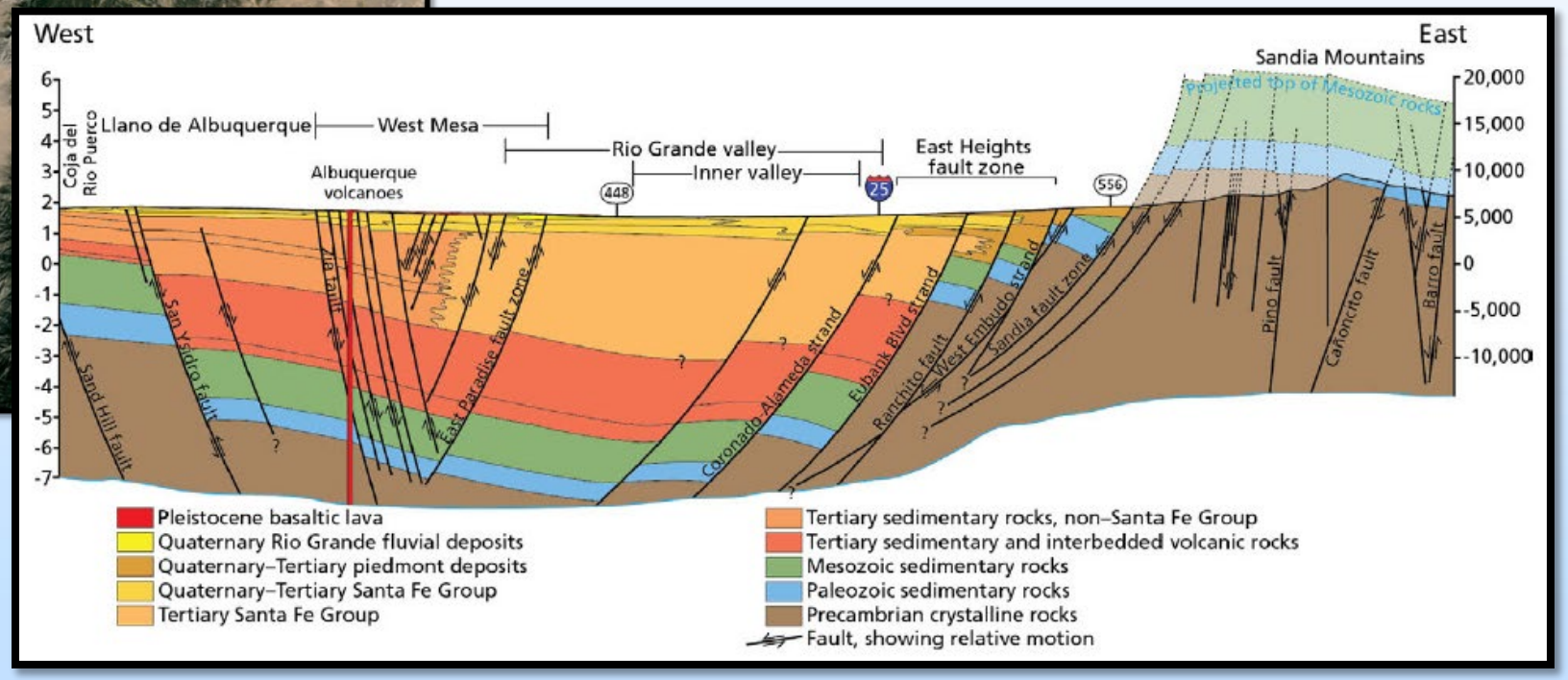
Approximately 1,200 feet of section contains numerous “horizons’ of igneous rocks

Two regions of interest: Johnson Mesa & Don Carlos Hills

Technical Update

Subsurface Basalt – Albuquerque Basin

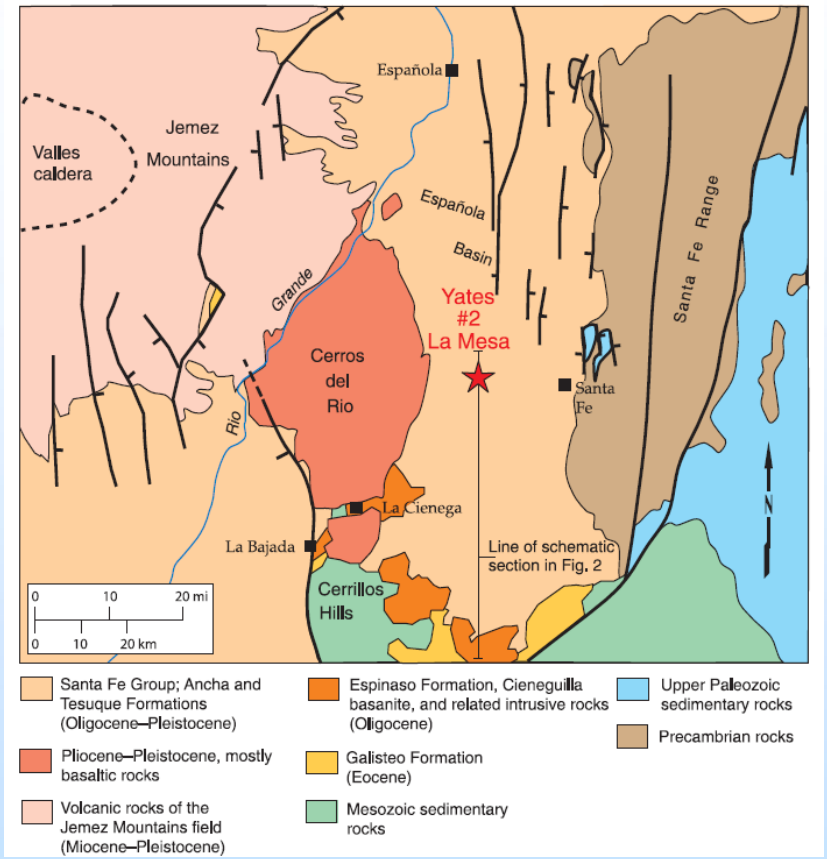




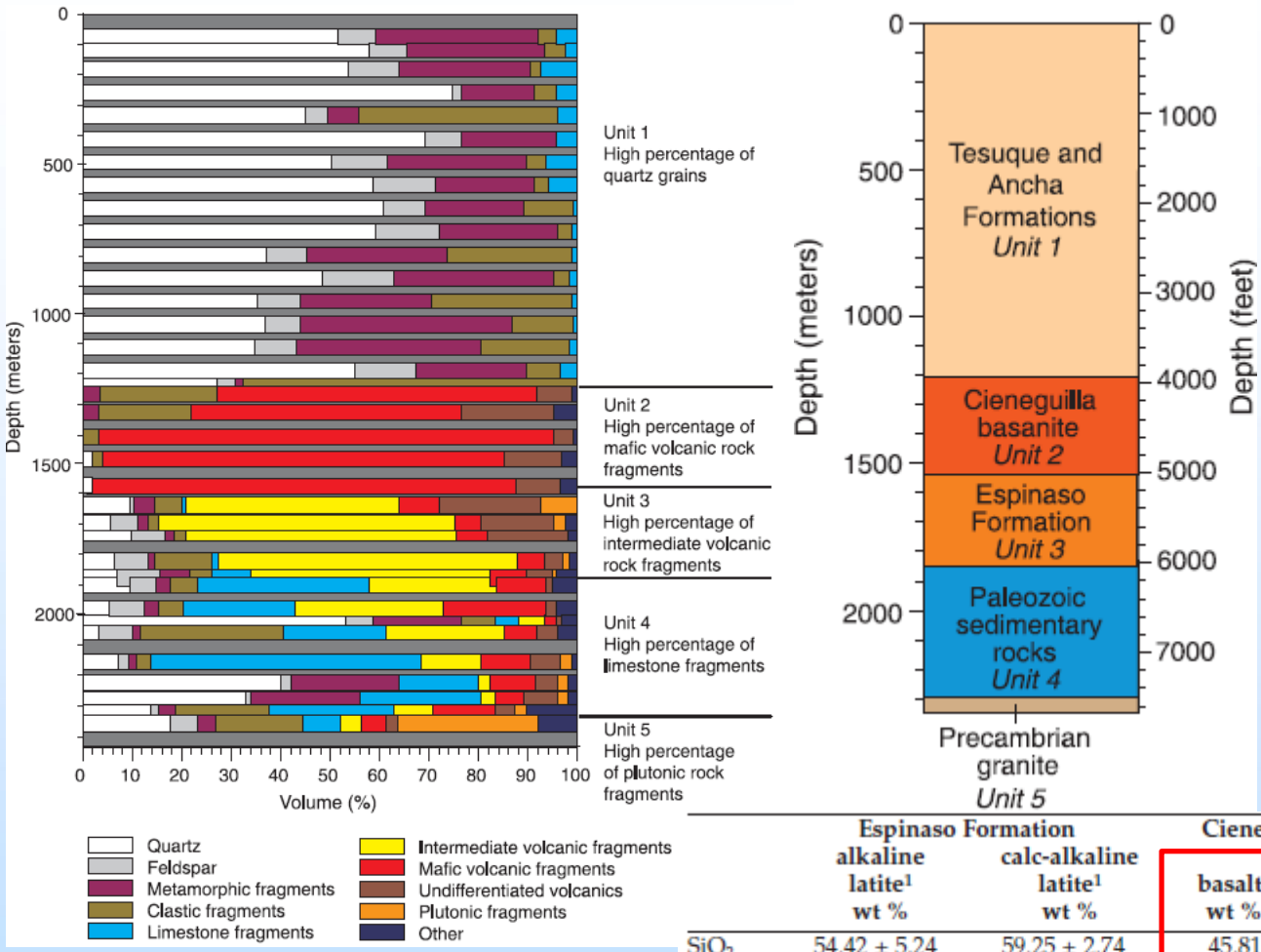
- Albuquerque Basin is a sub-basin in the Rio Grande Rift
- Wells with potential Basalt zones
- Most of the wells have cuttings or core available
- Shell #2 Isleta & Carpenter #1 Atrisco Grant (Arrows) may have the greatest potential

Technical Update

Other subsurface basalt in NM?



Yates #2 La Mesa well located within the southern Española Basin, west of Santa Fe, New Mexico



Designation of lithostratigraphic units based on well-cutting compositions

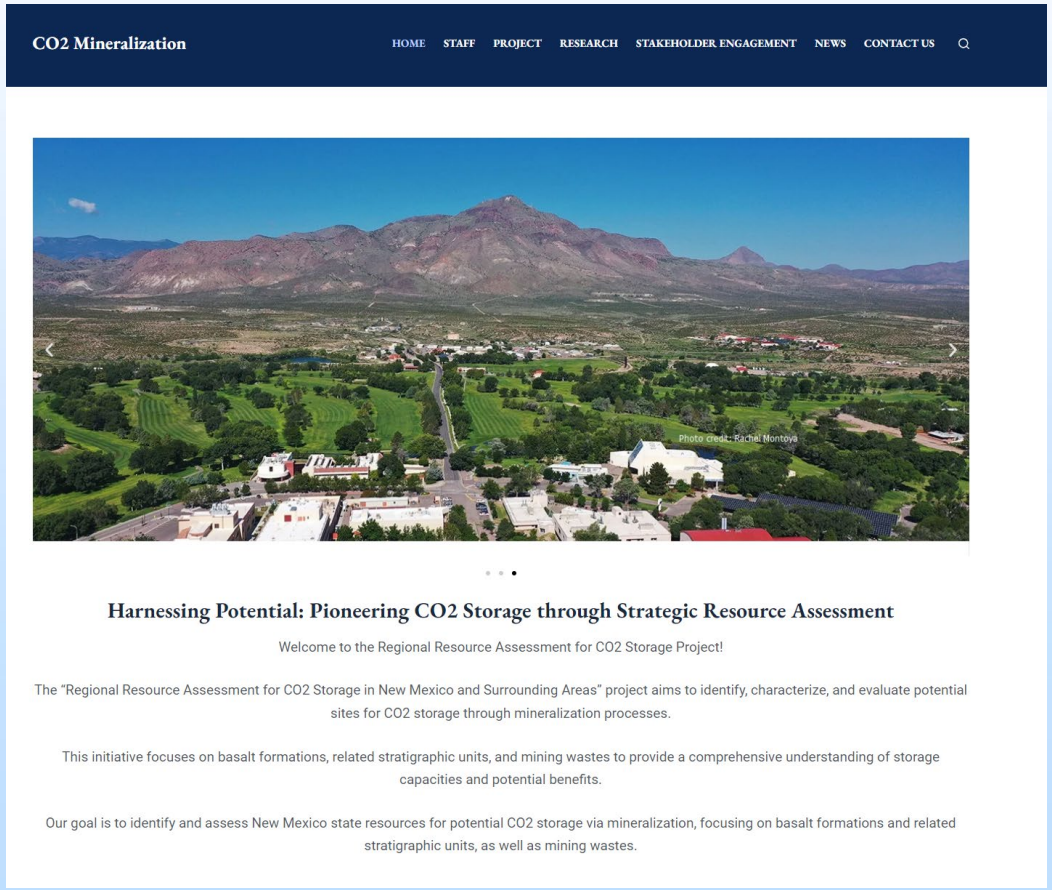
	Espinaso Formation		Cieneguilla basanite	
	alkaline latite[1] wt %	calc-alkaline latite[1] wt %	basalt[2] wt %	basanite (limburgite)[2] wt %
SiO_2	54.42 ± 5.24	59.25 ± 2.74	45.81	40.18
Al_2O_3	16.89 ± 1.65	17.13 ± 0.85	14.08	11.7
FeO	7.12 ± 2.52	5.83 ± 1.32	7.41	6.68
MgO	2.54 ± 1.23	1.95 ± 0.58	8.79	14.3
CaO	6.48 ± 2.05	5.57 ± 0.64	9.45	13.28
Na_2O	3.8 ± 0.73	3.97 ± 0.46	2.49	3.48
K_2O	**3.97 ± 0.77**	**2.65 ± 0.64**	**0.86**	**0.76**
TiO_2	1.41 ± 1.09	0.73 ± 0.18	1.63	2.66
P_2O_5	0.42 ± 0.26	0.25 ± 0.06	0.28	0.68
MnO	0.18 ± 0.03	0.15 ± 0.03	0.19	0.08

Outreach Activity

Website in development

- Collaboration with Arizona Geological Survey to synchronize outreach in the region.
- Share project information
- Share CO_2 mineralization research

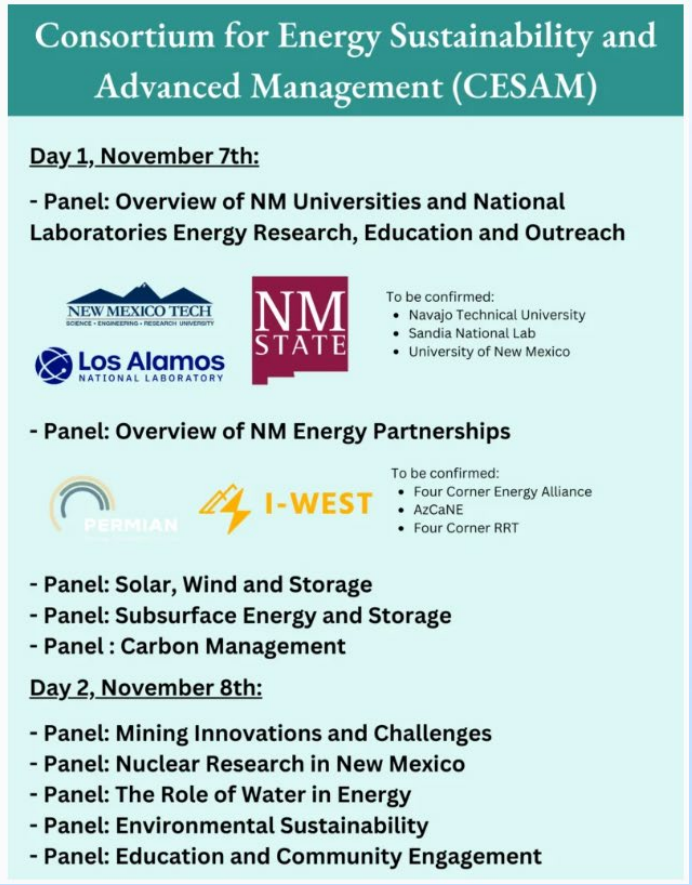
https://co2rocks.net/



Workshop in preparation

- November 7th-8th, 2024 in Socorro, New Mexico
- The event gather around 100 energy stakeholders from NM
- Collaboration with the Consortium for Sustainable Energy and Advanced Management (CESAM)

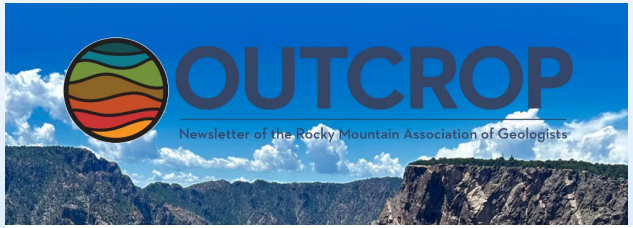
https://nm-secm.org/outreach/



Outreach Activity

Article in development

- Will be released in the Outcrop magazine published by the Rocky Mountain Association of Geologist in November 2024. https://www.rmag.org/
- Another in preparation for Spring, 2024 for the Lite Geology Magazine (NMT)

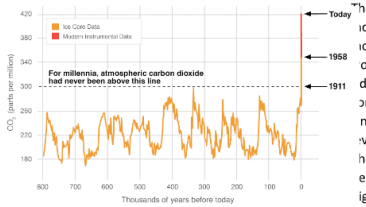


Turning CO_2 into Stone: The Potential and Challenges of CO_2 Mineralization for Carbon Sequestration

To combat climate change, humanity is turning to innovative technologies to reduce atmospheric carbon dioxide (CO_2) levels. Among these, CO_2 mineralization for Carbon Capture and Sequestration (CCS) stands out as a promising solution. This process not only captures CO_2 emissions from industrial sources and the atmosphere but also permanently stores them in solid minerals, preventing them from subsurface leakage and contributing to global warming. This article delves into the importance of CO_2 mineralization, highlights its implementation on an industrial scale, explains its principles, contrasts it with other sequestration methods, outlines its advantages and challenges, and presents a recent project in New Mexico, led by New Mexico Institute of Mining and Technology, aiming to harness this technology for environmental sustainability.

Why CO2 mineralization is a necessity

The concentration of CO_2 in the atmosphere has surged to levels not seen in millions of years, primarily due to human activities such as fossil fuel combustion and deforestation. This increase in greenhouse gases is a major driver of climate change, leading to extreme weather events, rising sea levels, and loss of biodiversity. Thus, reducing atmospheric CO_2 levels is crucial. CO_2 mineralization offers a way to effectively removing it from the atmosphere for millennia.

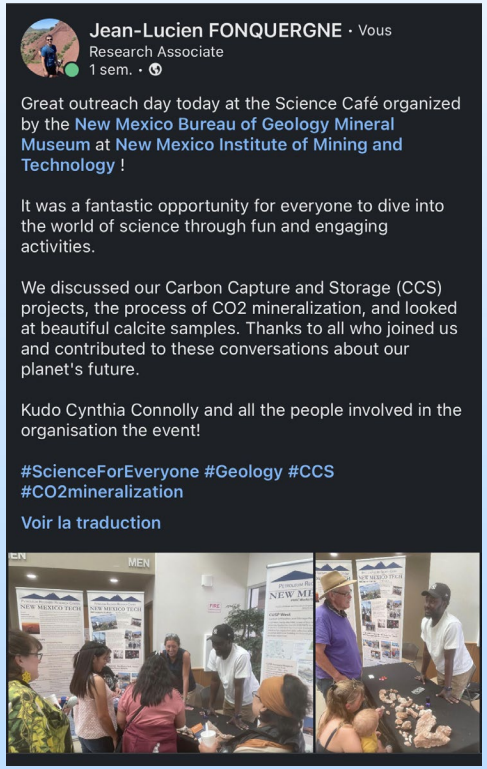


he atmospheric concentration of CO_2 has ncreased by 50% since the onset of ndustrial times in the 18th century. Data om National Oceanic and Atmospheric dministration's Observatory shows a ontinuous rise in atmospheric CO_2 levels nce 1958, while ice core samples reveal CO_2 vels during Earth's last three glacial cycles. he historical increase in CO_2 from 365 parts er million (ppm) in 2002 to over 420 ppm, ighlights the impact of human activities on climate change.

Figure 1: Evolution of CO_2 concentration in the atmosphere. *Data source Reconstruction from ice cores. Credit NOAA (https://climate.nasa.gov/vital-signs/carbon-dioxide/?intent=121)*

Community Engagement

- Initial Assistance & Validation Meeting, November 9, 2023
- Outreach and engagement with land owners from the Don Carlos hill and Johnson Mesa, near the sites of interest. More than 15 landowners engaged via meetings, phone calls or mail.
- Engagement with Freeport, mining company.
- Contact with University of Eastern New Mexico for outreach event.
- Engagement with students and New Mexico communities at the Science Café in Socorro, NM.



Jean-Lucien FONQUERGNE · Vous
Research Associate
1 sem. ·

Great outreach day today at the Science Café organized by the New Mexico Bureau of Geology Mineral Museum at New Mexico Institute of Mining and Technology !

It was a fantastic opportunity for everyone to dive into the world of science through fun and engaging activities.

We discussed our Carbon Capture and Storage (CCS) projects, the process of CO2 mineralization, and looked at beautiful calcite samples. Thanks to all who joined us and contributed to these conversations about our planet's future.

Kudo Cynthia Connolly and all the people involved in the organisation the event!

#ScienceForEveryone #Geology #CCS #CO2mineralization

Voir la traduction

Acknowledgements

The project would like to thank DOE for the award opportunity through DE-FE0032257 and our partners.