

PRRC Carbon Storage Research Program

William Ampomah, PhD

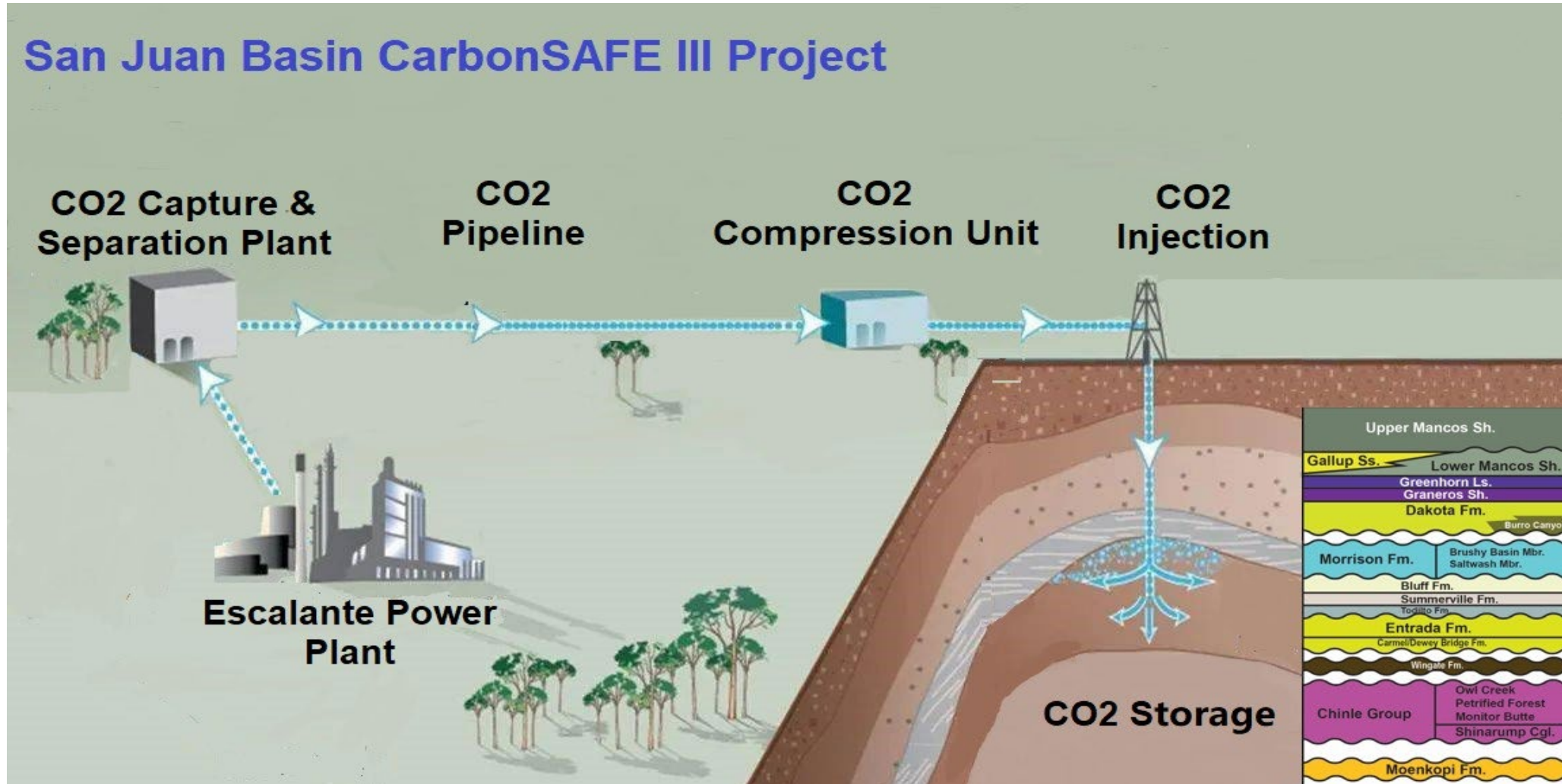
Assistant Professor- Petroleum Engineering, NMT
Section Head- REACT Research Group, PRRC/NMT

*NMT Research Symposium
March 1, 2024*

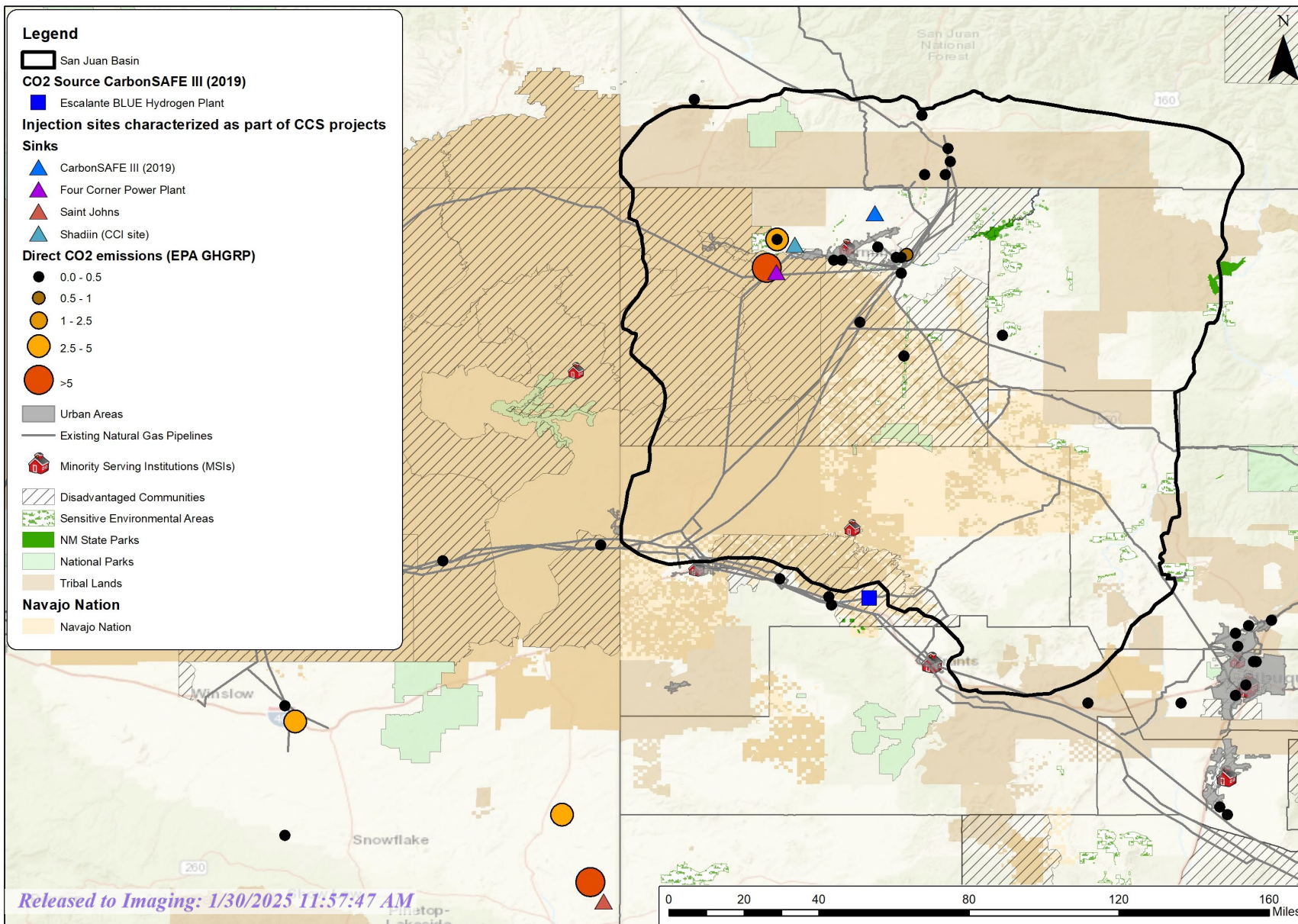
DOE Funded Projects- PRRC REACT Research Group

- San Juan CarbonSAFE Phase III Project – [\$28 Million]
- San Juan Basin Fault Characterization Project – [\$ 1.5 Million]
- Subsurface Stress Characterization Project – [\$ 2 Million]
- Basalt CO2 Storage in NM – [\$1.2 Million]
- Southwest Regional Partnership for CO2 Sequestration [SWP] – [\$106 Million]
- Carbon Utilization Storage Projects [CUSP-Western US] – [>\$17 Million]
- Utah CarbonSAFE Phase II - [\$320,000]
- Four Corners Regional Initiative Project – [\$3.1 Million] ~ Starts in Spring 2024
- Four Corners Carbon Storage Hub – [\$52 Million] ~ Starts in Spring 2024
- Permian Carbon Storage Hub – [\$5 Million] ~ Starts in Spring 2024
- Four Corners Integrated Storage Project – [\$1.3 Million] ~ Starts in Spring 2024
- Southwest Regional Direct Air Capture Hub– [\$2.5 Million] ~ Starts in Spring 2024
- Hydrogen Subsurface Engineering Solutions – [1.2 Million] ~ Starts in Summer 2024

Overview of Carbon Storage



Overview: PRRC-NMT Carbon Storage Program



- SJB CarbonSAFE Phase III project
- Four Corners Carbon Storage Hub
- Four Corners Power Plant Integrated CCS Project
- Southwest DAC Hub
- Four Corners Regional Initiative

Key Project Facts

- Funding: \$28 Million Project
- Perform Site Characterization of storage complex within San Juan Basin
- Source CO2 from Escalante H2 plant, located in Prewitt, NM, USA.
- Initial UIC Class VI permit submitted in 2023
- Community and stakeholder outreach on CCS technology and its benefits

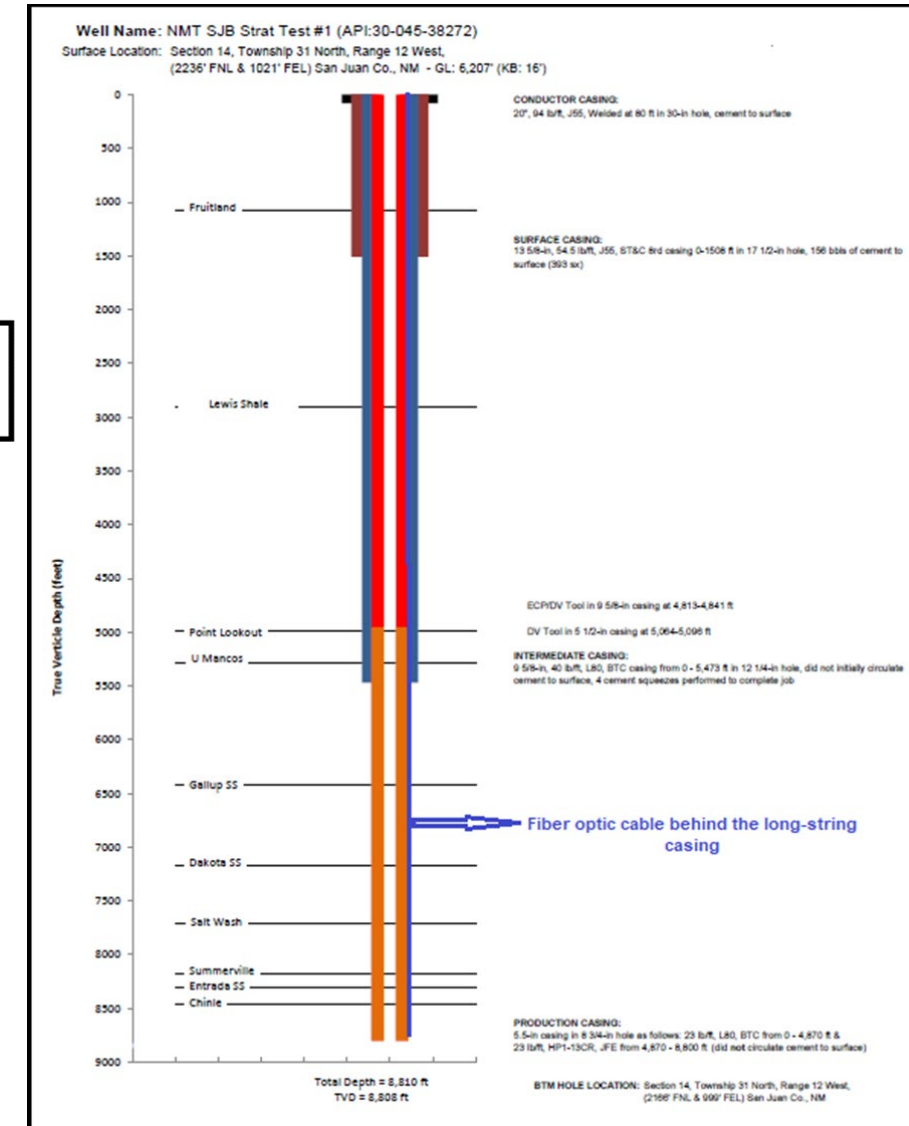
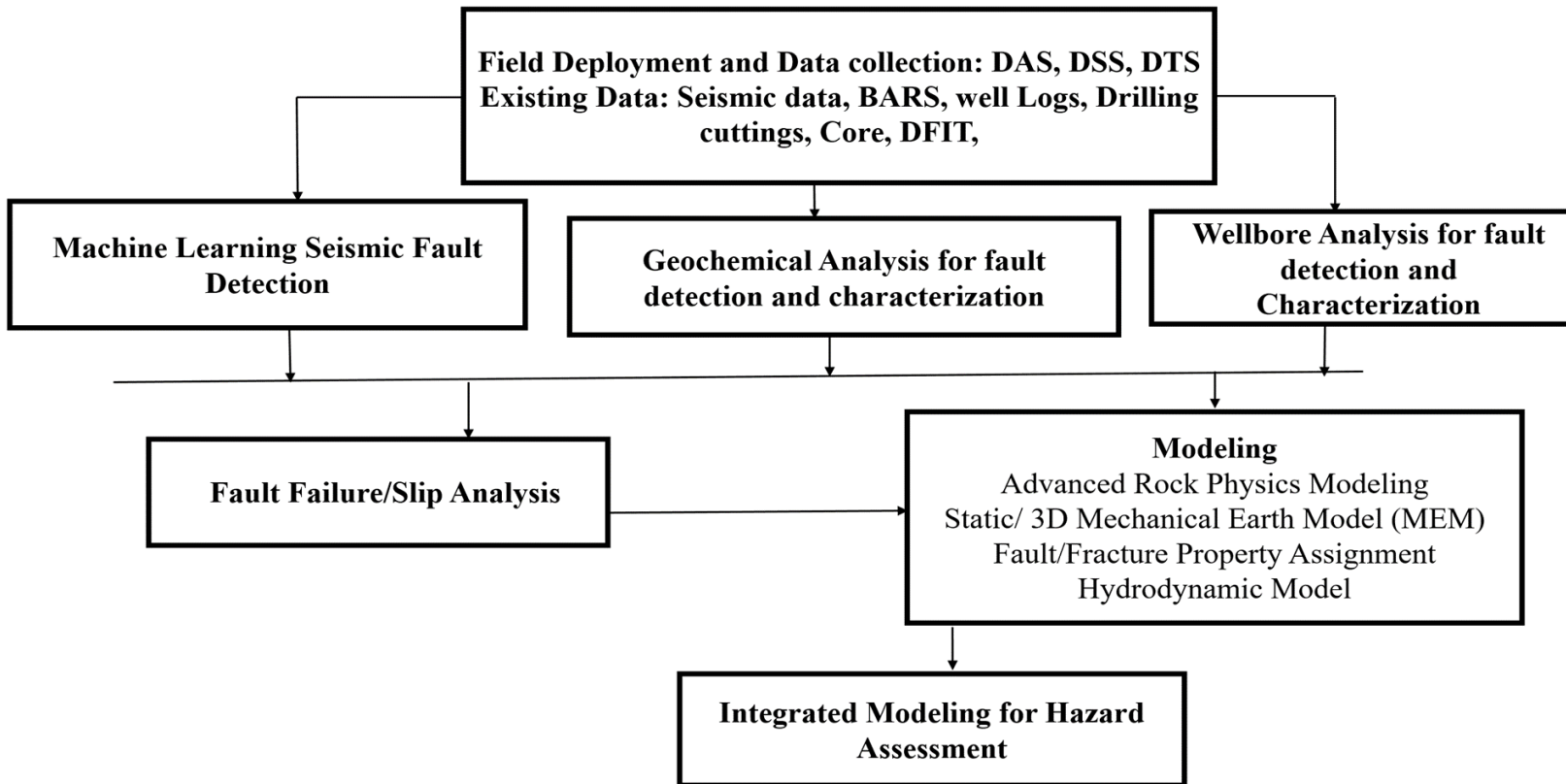
Characterization Plan

- Drilled characterization well, perform injectivity tests
- Recovered ~ 450 ft of Core, sampled drilling cuttings, advanced log suites measurements
- Perform suites of laboratory experiments and numerical models
- Purchased 100 sq.miles 3D seismic, acquire 3D VSP,
- Installed DAS/DTS/DSS Optical fiber behind casing

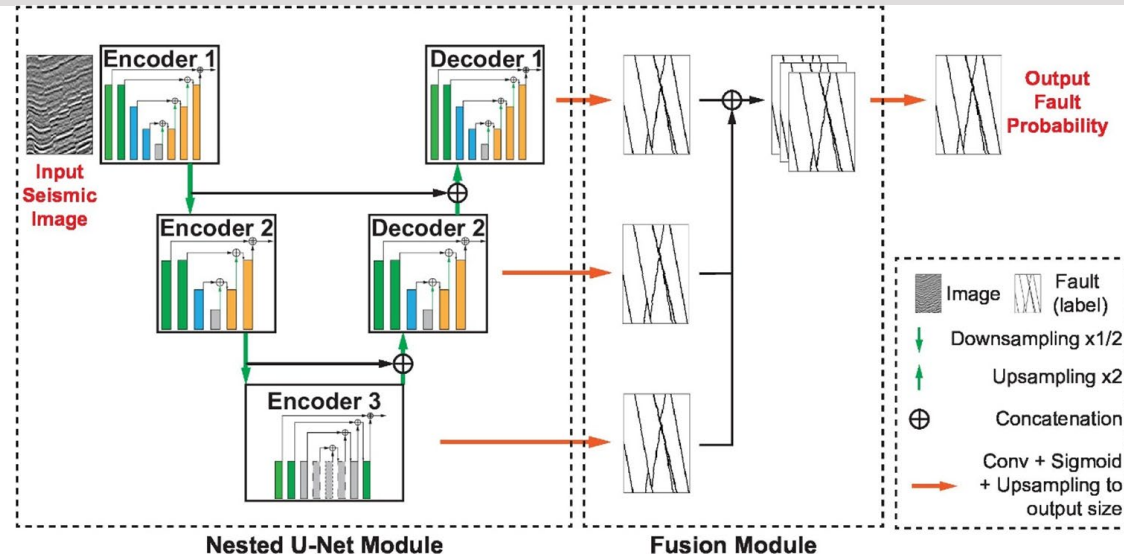


Fault Characterization Project

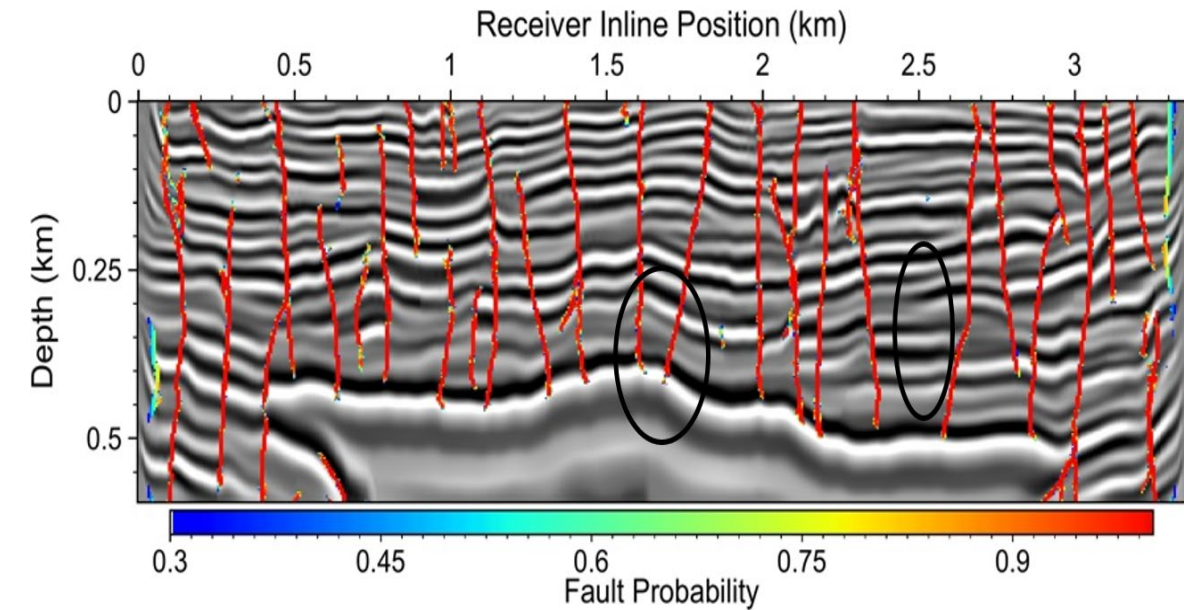
Project workflow



Fault Characterization Project- Machine Learning



Architecture of multiscale connection-fusion convolutional neural network method (MCFU).- Gao, Huang, Zheng, 2022



Fault Segmentation from Seismic Image via MCFU

Technology Advantages

- Improved in Faults Detection
- Reliable Large-scale Fault Mapping
- Enhanced cost efficiency

Fault Characterization Project- Fiber Optic Technology

Monitoring Solutions

DTS (temperature)



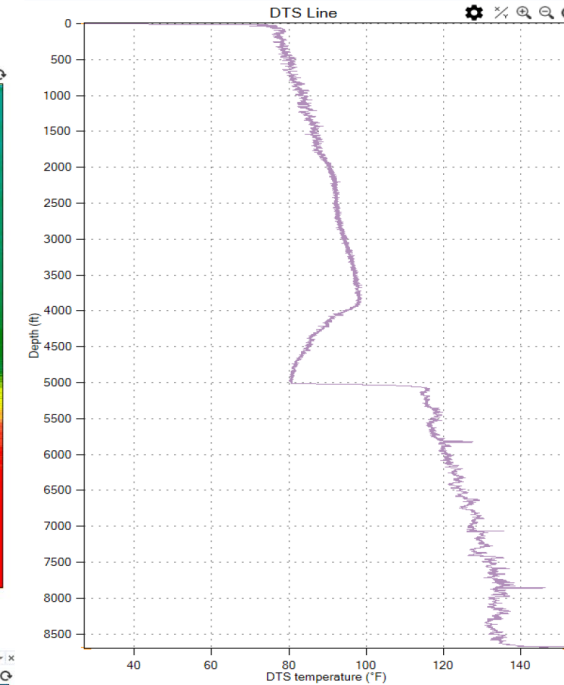
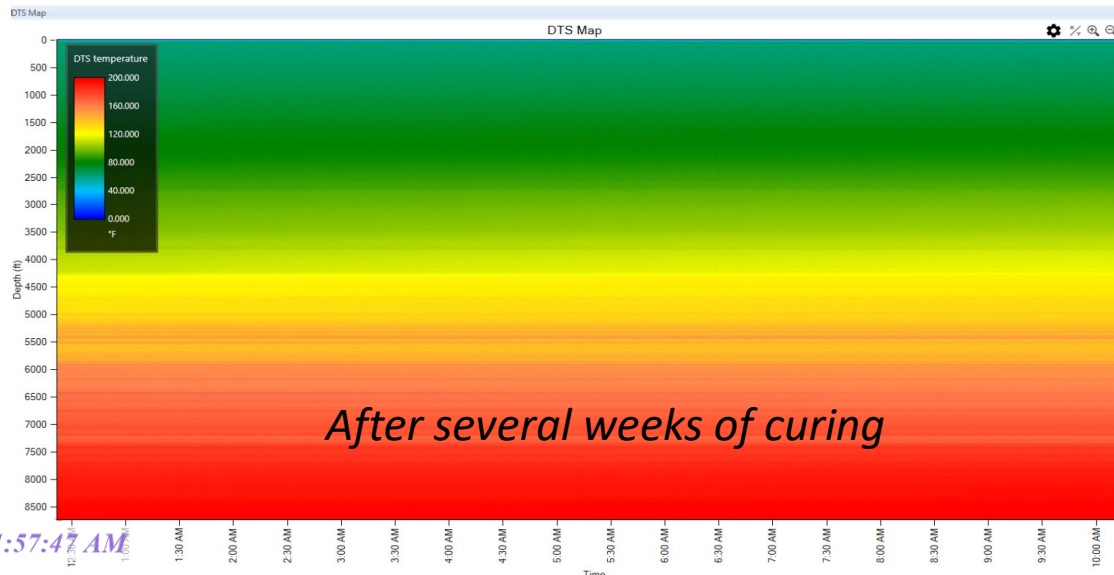
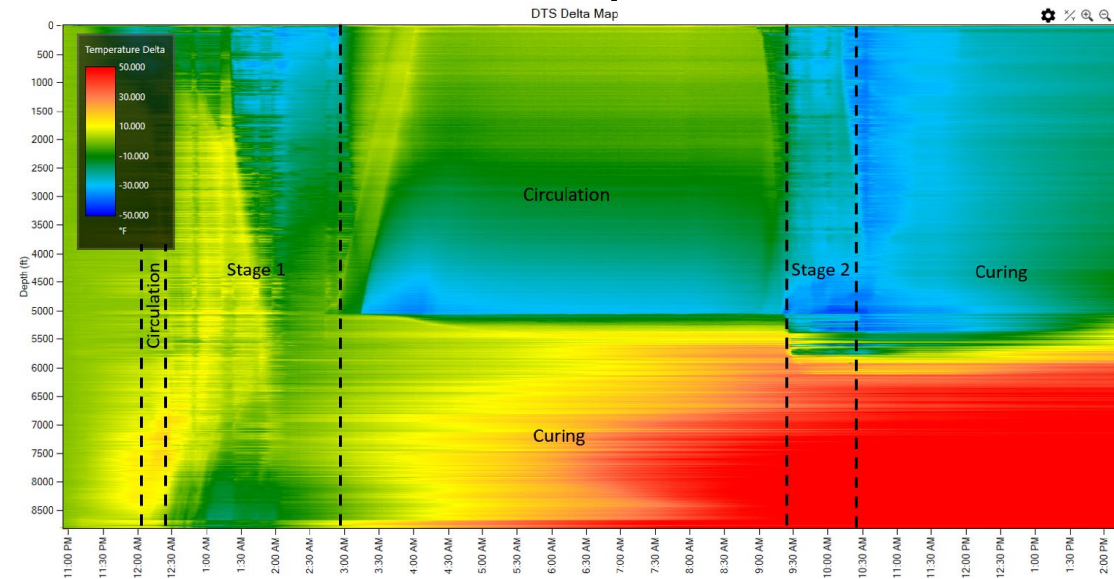
DAS (acoustic)



DSS (strain)

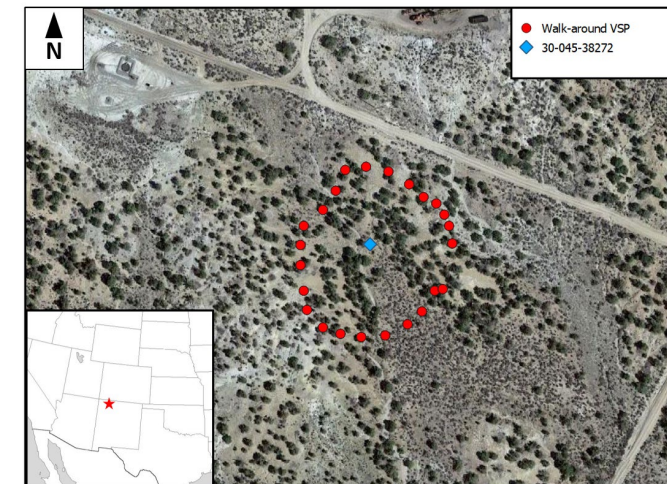


Data Interpretation

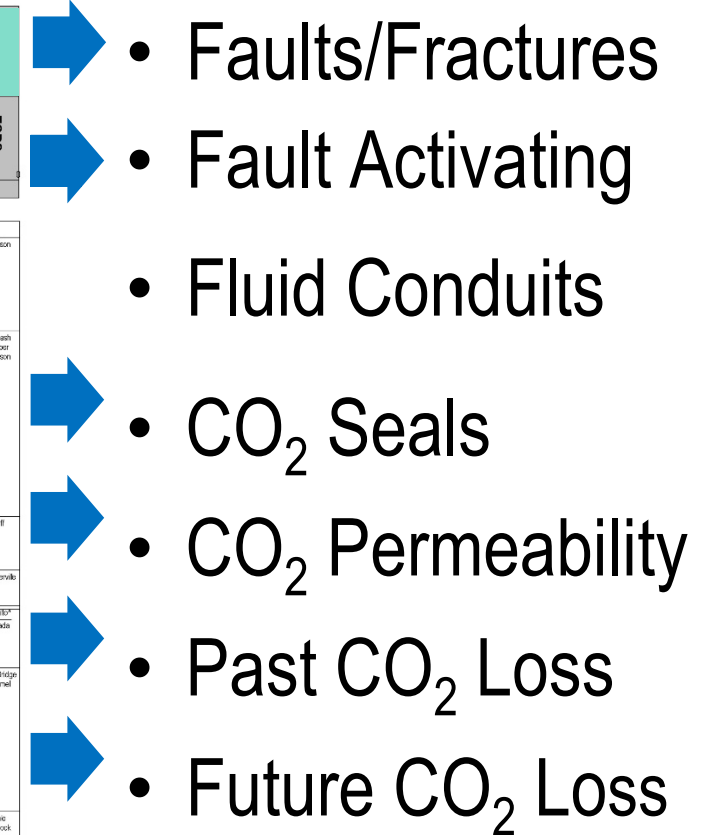


Assess Risks

- Faults/Fractures Detection and Characterization
- Matrix/Fractures/Faults Geomechanical Properties Evaluation
- Micro-seismicity Monitoring



Assess Risks



Application of Machine Learning in Simulation Modeling

ML models utilizes the following categories of data in our project

Reservoir Characteristic Data (Class *A* data)

Characterization

- Seismic data
- VSP data
- Well logs
- Core data
- Mechanical data
- Microseismic
- etc.

Fluid properties

- PVT data
- Fluid composition
- etc.

Rock/fluid interaction

- Relative permeability
- Capillary pressure
- etc.

Engineering Design Parameters (Class *B* data)

- Injection/production well specification
- Pattern design
- Well spacing
- Injection timeline
- Injection fluid
- Other project-specific design parameters
- etc.

Project Response Data (Class *C* data)

- Oil production data
- Gas production data
- Water production data
- Pressure data
- Stress from VSP
- Moment Magnitude
- etc

In this project we will train two different version of proxies to assist the history matching:

1. Forward-looking *Proxy*:

$$A \times B \rightarrow C$$

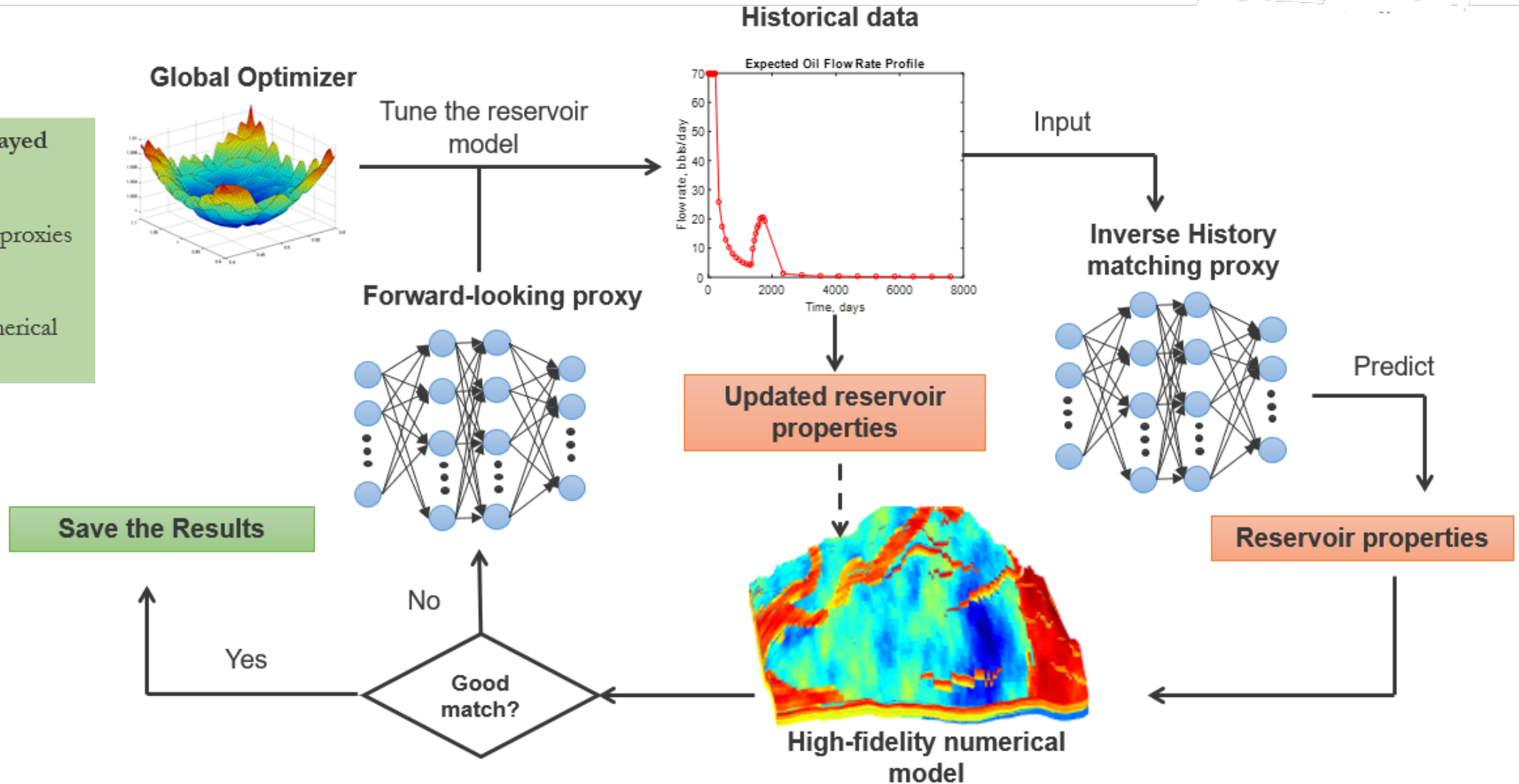
2. Inverse History matching *Proxy*:

$$C / B \rightarrow A$$

Application of Machine Learning in Simulation Modeling

The workflow displayed comprehensively employed:

- Forward-looking proxies
- Inverse proxies
- Global optimizer
- High-fidelity numerical model



Basalt Storage Project

PI: Dr. Sai Wang, PRRC
Funding: 1.2 Million

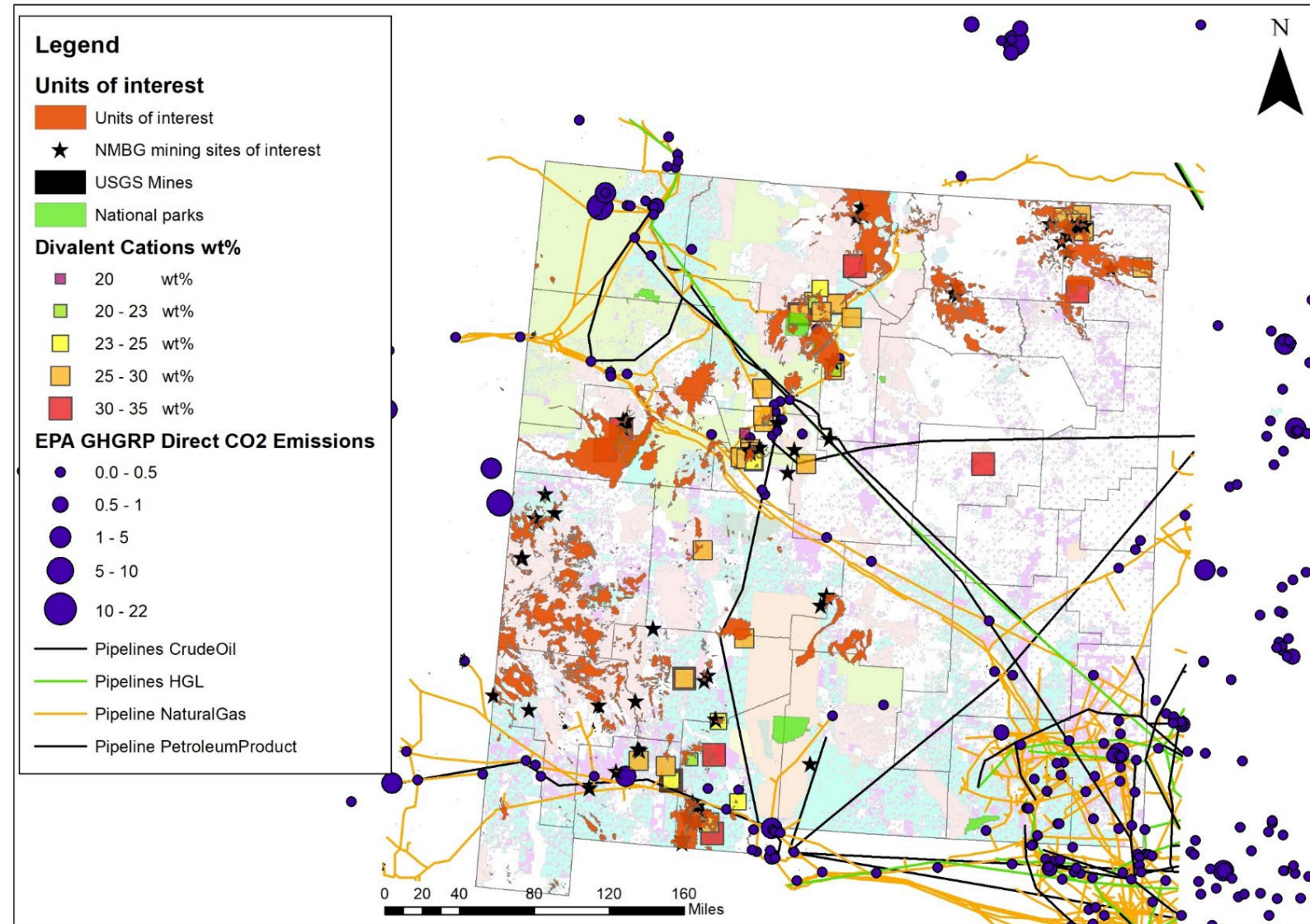
Project Overview

Overall Objective:

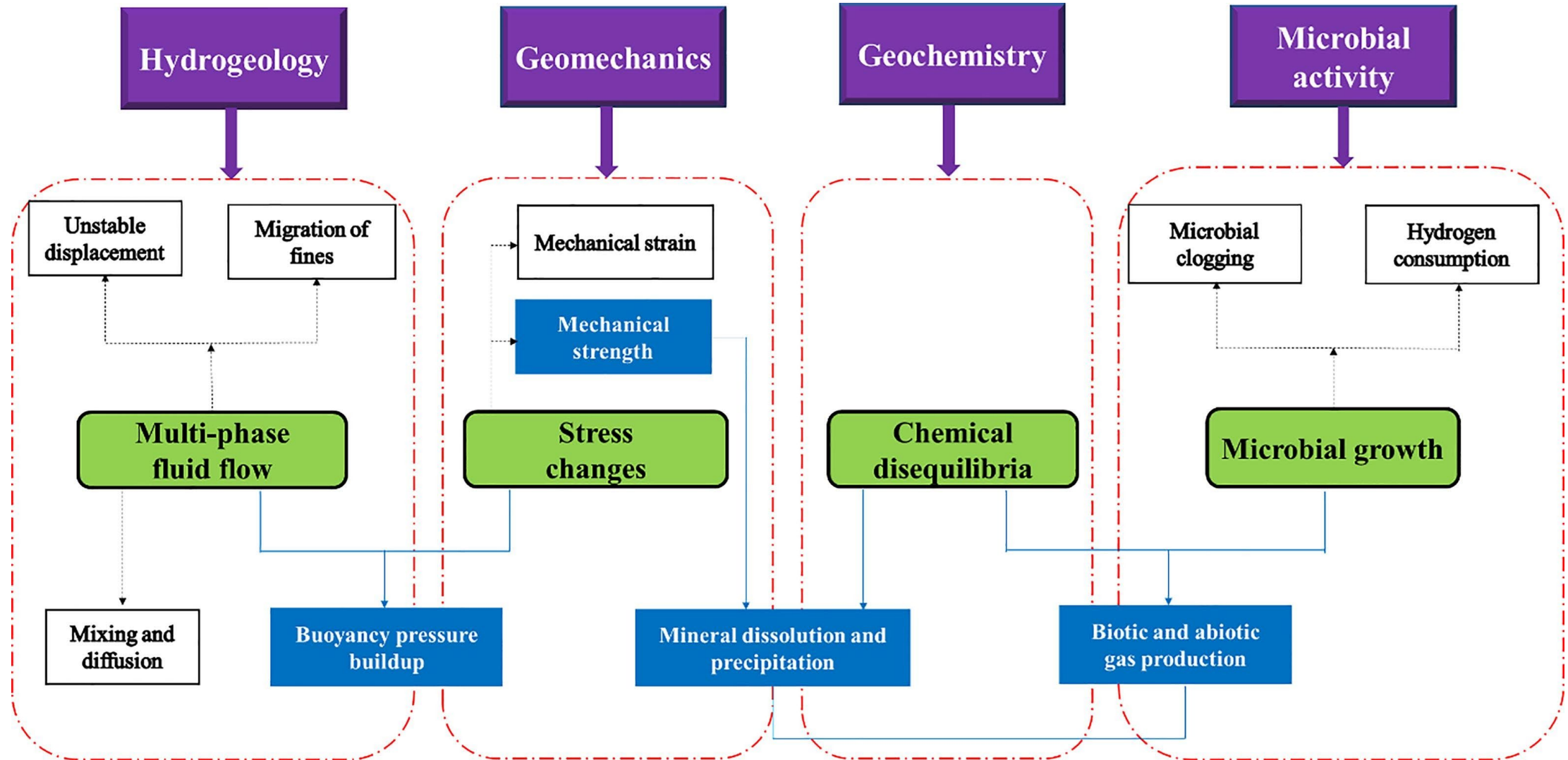
Identify and access statewide resources for potential CO₂ storage via mineralization processes, including mafic/ultramafic formations (basalts), stratigraphic units, and mining wastes in New Mexico.

Targeted Storage Sites:

Identify and characterize potential storage sites/complexes to determine storage capacity.



PRRC Hydrogen Subsurface Research



ARPA-E – DOE sponsored project

Recipient: New Mexico Tech (PI: Robert Czarnota)

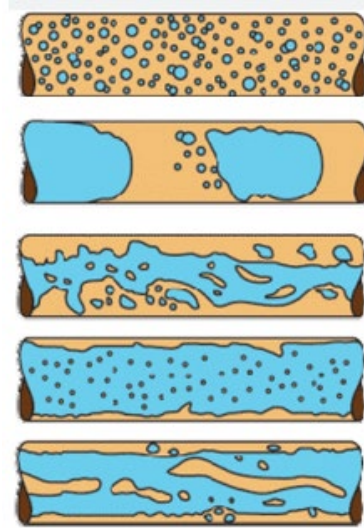
Sub-recipient: Sandia National Laboratories

Award: \$1,200,000

Timeline: 2 years (kick-off in May 2024)

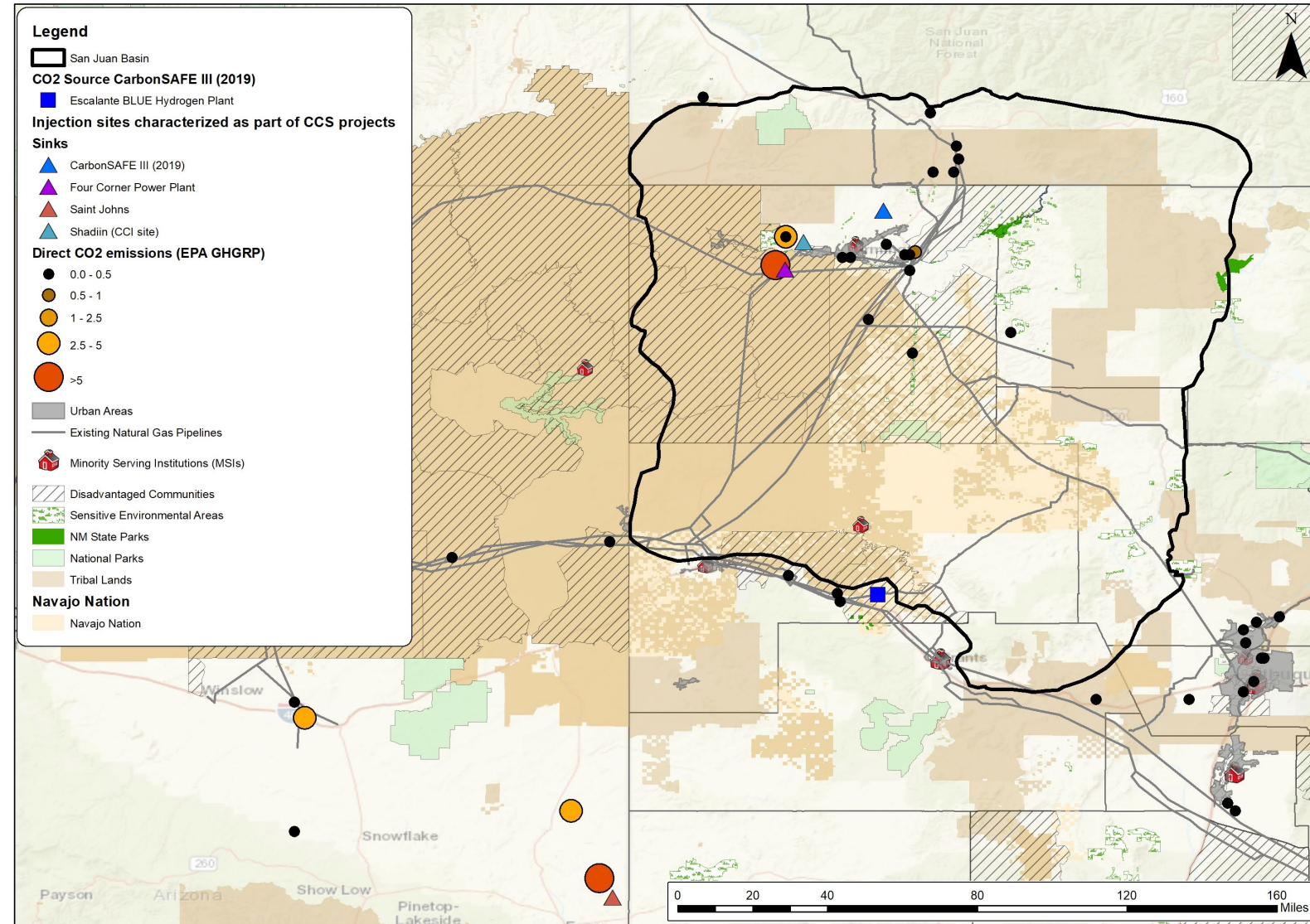
Project Title: Subsurface Engineering Solutions and Management for Sustainable In-Situ Hydrogen Production and Economic Extraction

Summary: New Mexico Institute of Mining and Technology is developing subsurface engineering approaches for **geologic hydrogen reservoir management**, including ways to **mitigate the risk of induced seismicity and hydrogen leakage**. In addition to conducting laboratory experiments to explore hydrogen generation rates from ultramafic rocks and transport using steam (multiphase flow), the team will test methods **to estimate rock volume expansion** and **identify ecological indicators of hydrogen leakage**.



Complex flow of
H₂/steam in
tight channels of porous
media

Four Corners Carbon Storage Hub



- \$52 Million Project
- Develop 3 storage sites in the San Juan Basin to store at least 50 million tons of CO2
- Drill two stratigraphic wells to collect subsurface data
- Acquire about 1000 ft of Core for analysis
- Perform detailed experimental and numerical analysis on acquired data
- Prepare and submit UIC Class VI applications for 3 sites

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<https://www.emnrd.nm.gov/oed/contact-us>

State of New Mexico
Energy, Minerals and Natural Resources
Oil Conservation Division
1220 S. St Francis Dr.
Santa Fe, NM 87505

CONDITIONS

Action 426698

CONDITIONS

Operator: NEW MEXICO ENERGY MINERALS & NATURAL RESOURCE 1220 S St Francis Dr Santa Fe , NM 87504	OGRID: 264235
	Action Number: 426698
	Action Type: [IM-SD] Well File Support Doc (ENG) (IM-AWF)

CONDITIONS

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pgoetze	None	1/30/2025