Projects I haven't talked about before!

Richard A. Esposito, Ph.D.
Southern Company
Research & Technology Management

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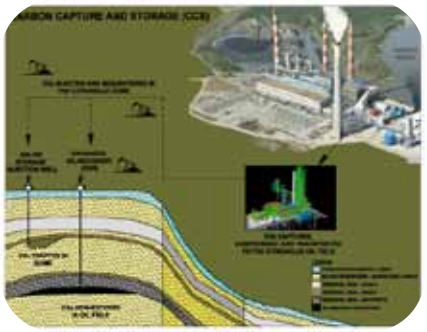
CCS Research & Development Program

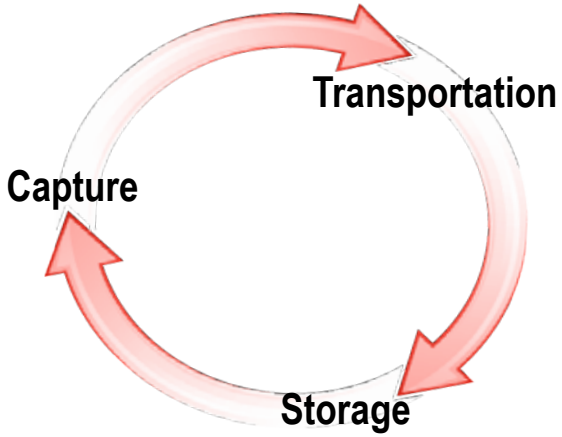
Efforts key to our long-term clean coal success

Plant Ratcliffe IGCC

Plant Barry CCS Demo



Carbon Capture Utilization Storage



Projects I haven't talked about before.

NCCC at PSDF

Characterization

Study those cap rocks

Advanced Resources International, Inc.

Geologic cap rock integrity lab

- Motivation behind the geology integrity lab:
  - Demonstrate long term storage integrity
  - Regulation of injection pressure
  - Reassure stakeholders that geologic sequestration is safe and secure

THE UNIVERSITY OF ALABAMA AT BIRMINGHAM

Cap rock integrity lab samples

Samples:

1) SECARB Black Warrior Basin Coal Seam CO_2 Storage Project, **Geologic Survey of Alabama**

2) **Montana State University**, Advanced CO_2 Leakage Mitigation using Engineered Biomineralization Sealing Technologies

3) SECARB Phase III 25-MW CCS Demo, Alabama Power Plant Barry **Advanced Resources International**

4) Site Characterization for CO_2 Storage from Coal-Fired Power Facilities in the Black Warrior Basin, Alabama Power Plant Gorgas, **University of Alabama**

Measurements:

Porosity by imbibition with brine

Permeability using N_2, He, and CO_2

Minimum capillary displacement pressure using brine and N_2 or CO_2

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Understanding CO_2 impacts to groundwater

- Motivation behind the study:
  - Public concern over CO_2 leakage and protection of groundwater resources
  - Need to inform regulators and industry of environmental risks
  - Lack of available field data showing possible impacts
  - Assess effectiveness of monitoring methods, early detection, and remedial options

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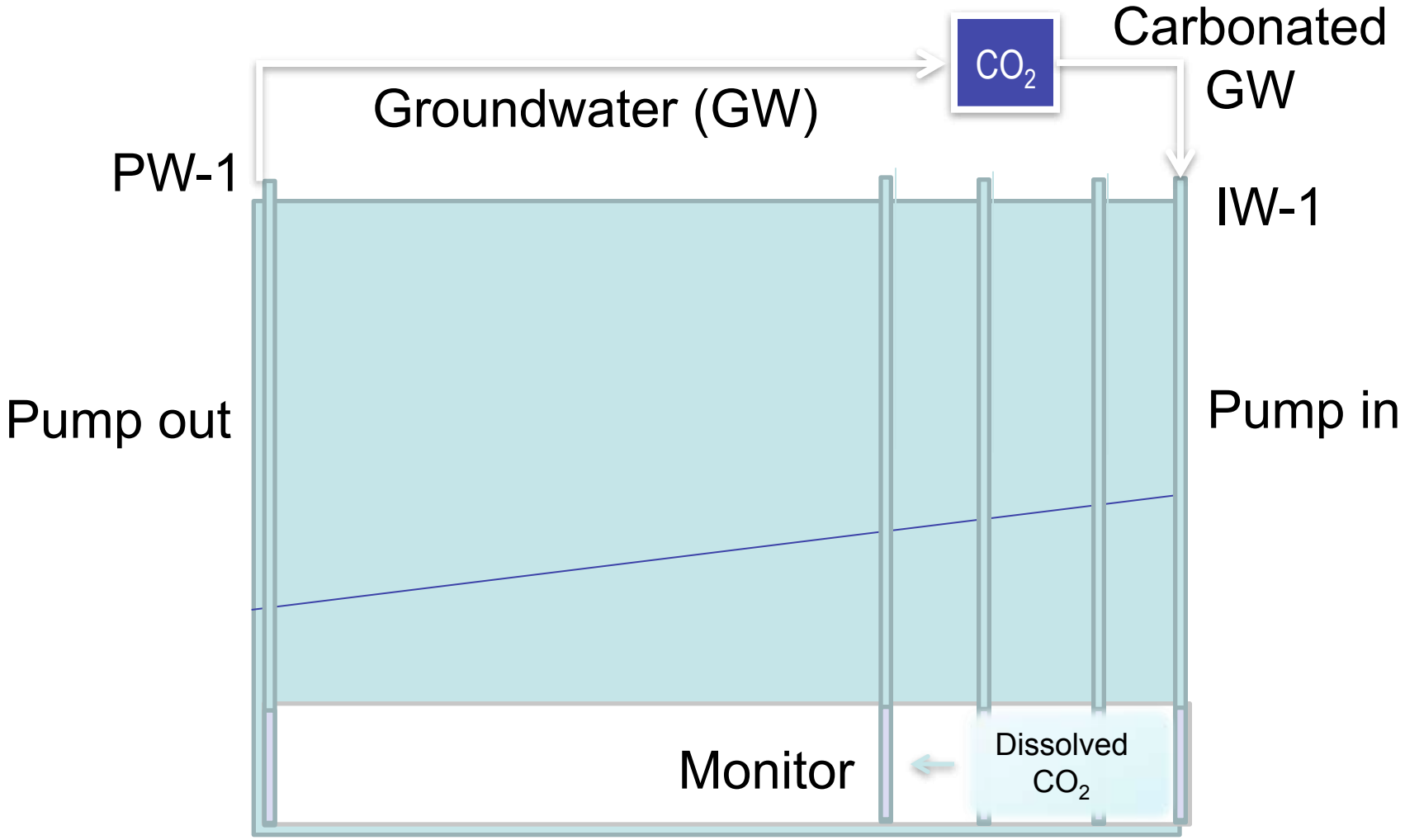
Controlled release in groundwater



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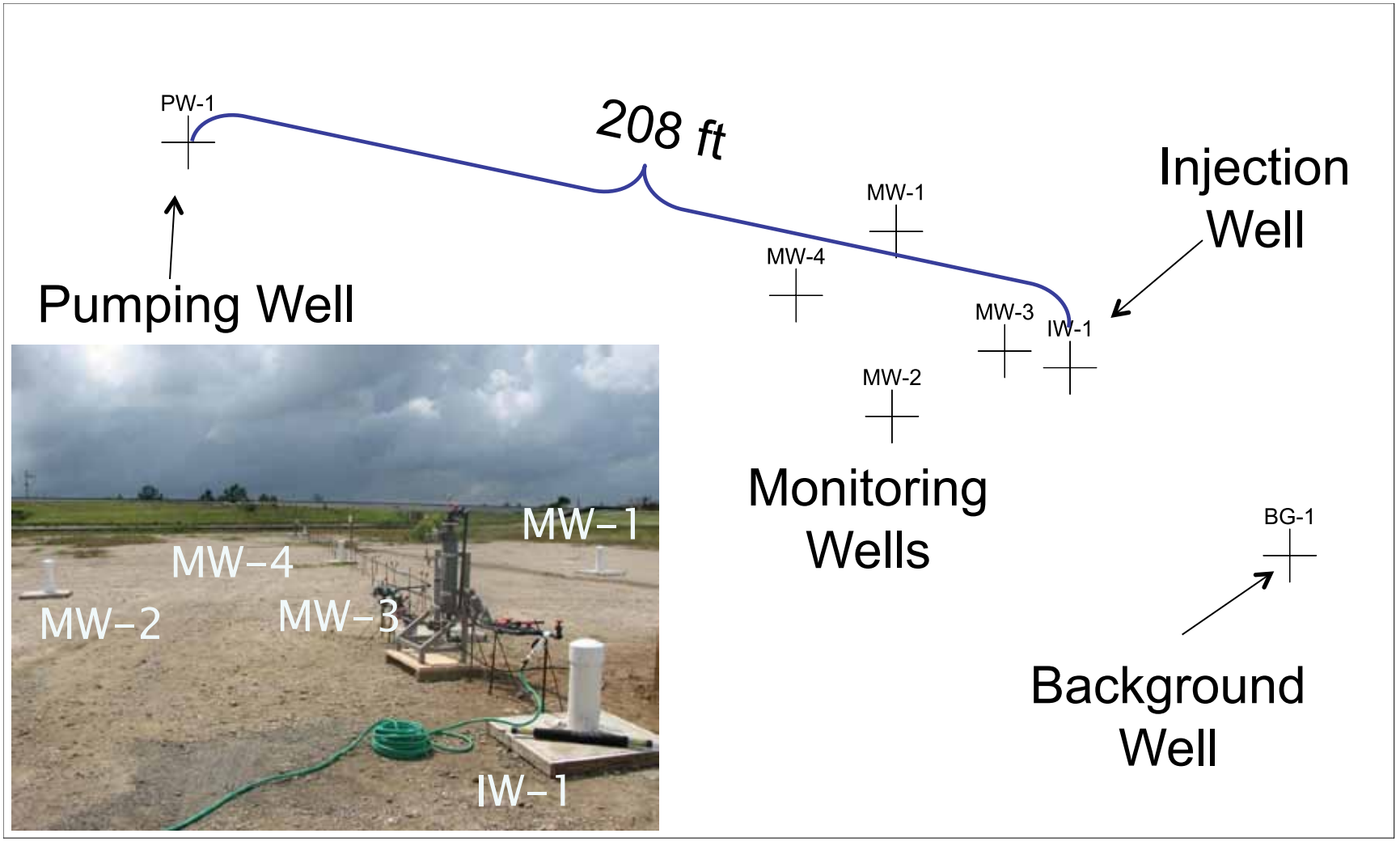
Experiment well field layout



Well leakage mitigation using biomineralization

- Motivation behind the leakage mitigation study:
  - Wellbores are identified as a leakage pathway risk in many storage systems
  - Biological control of permeability
  - Sealing leaking boreholes
  - Sealing fractures and cap rocks
  - Reassure stakeholders that geologic sequestration is safe and secure

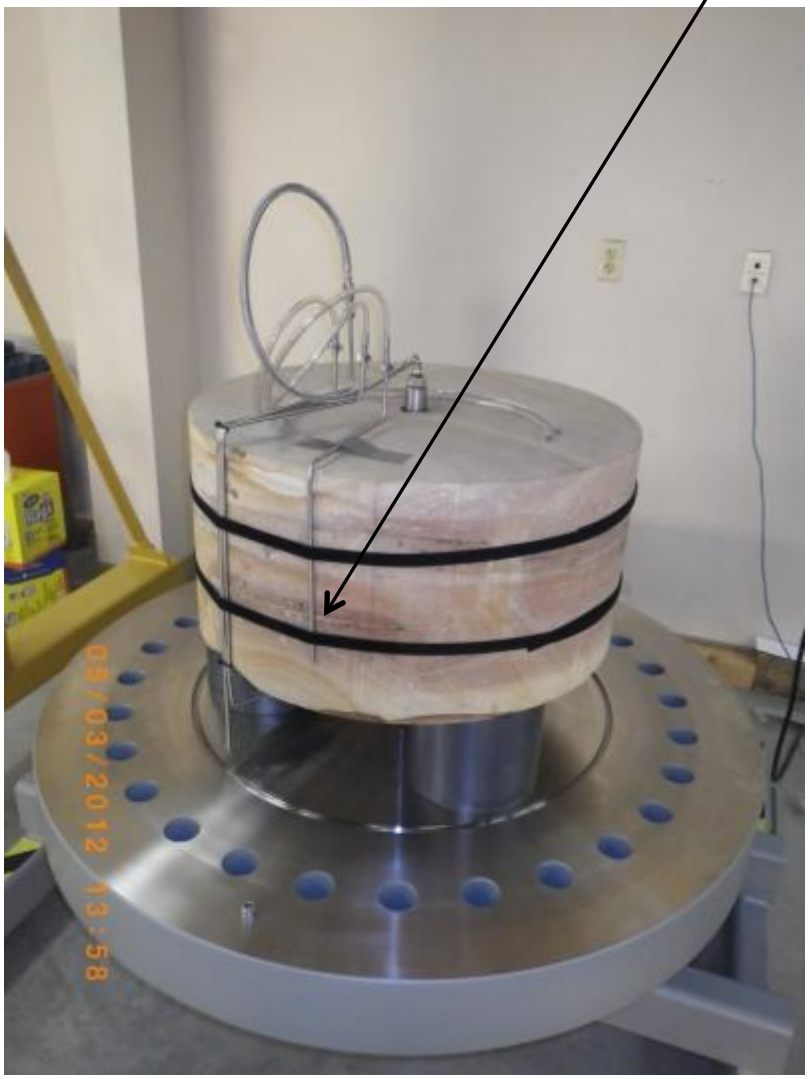
MONTANA STATE UNIVERSITY

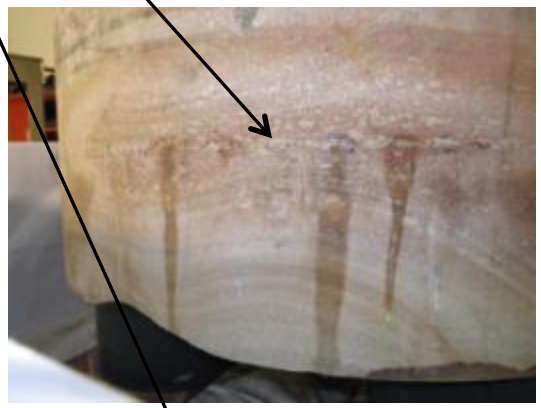
Sample collection in the field

Sample collection for field-scale lab study

MONTANA STATE UNIVERSITY

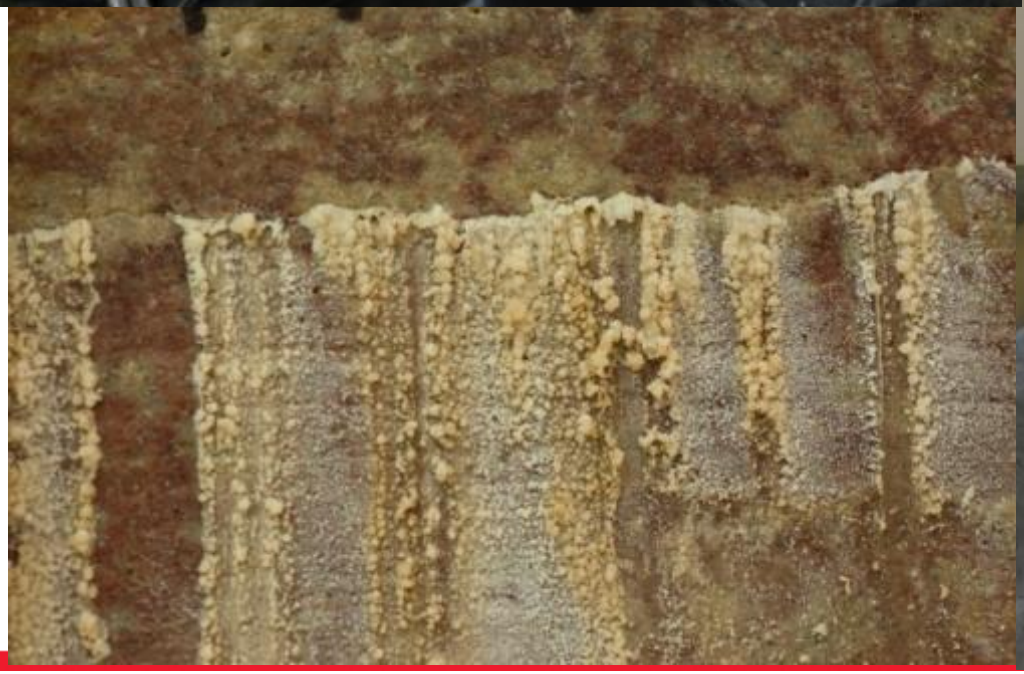
Before images of induced fractures





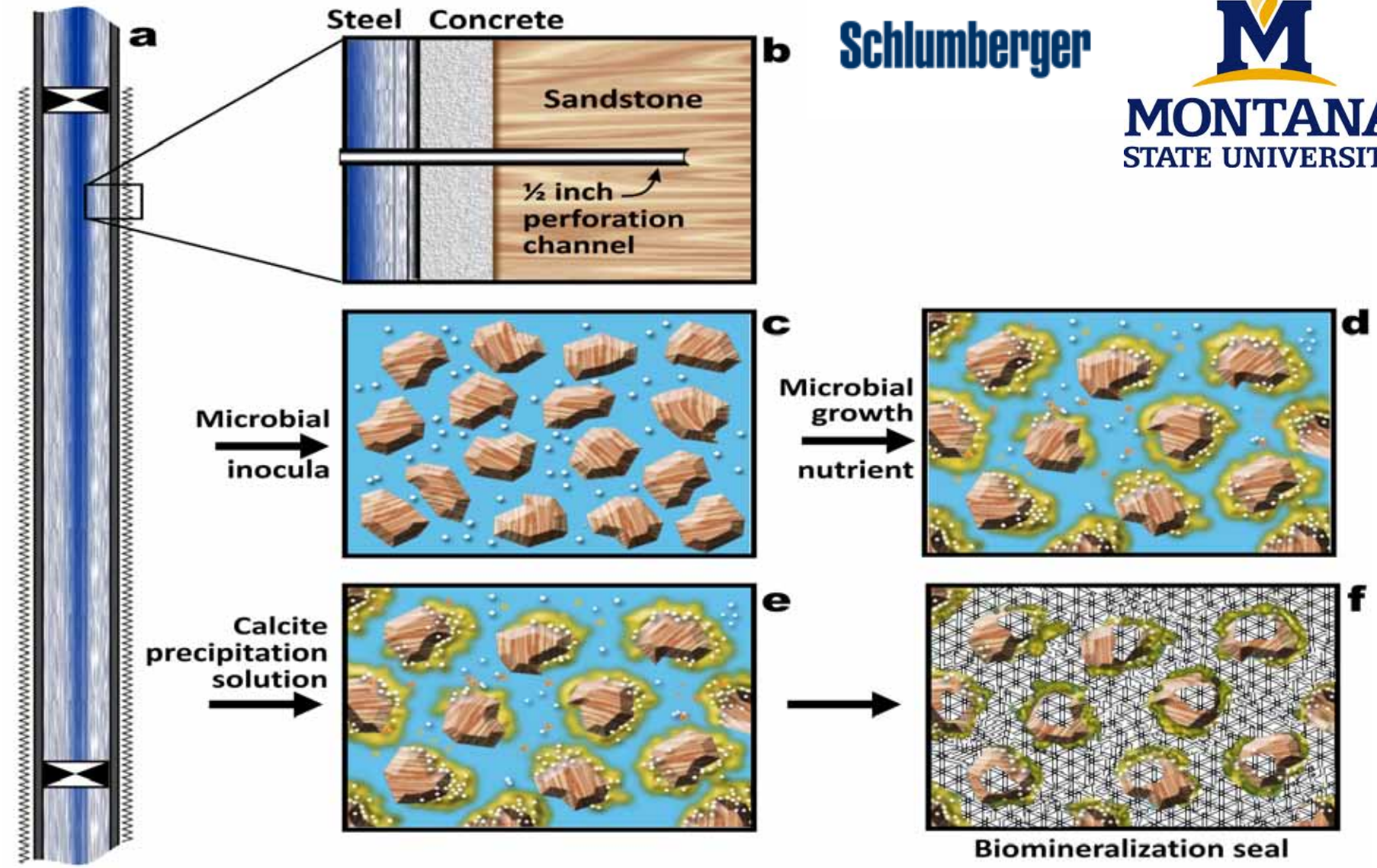
The core was hydraulically fractured under ambient conditions right before loading into the vessel. Distinct flow channels were formed.

After images of sealed fractures



High Pressure Vessel for 30” Cores

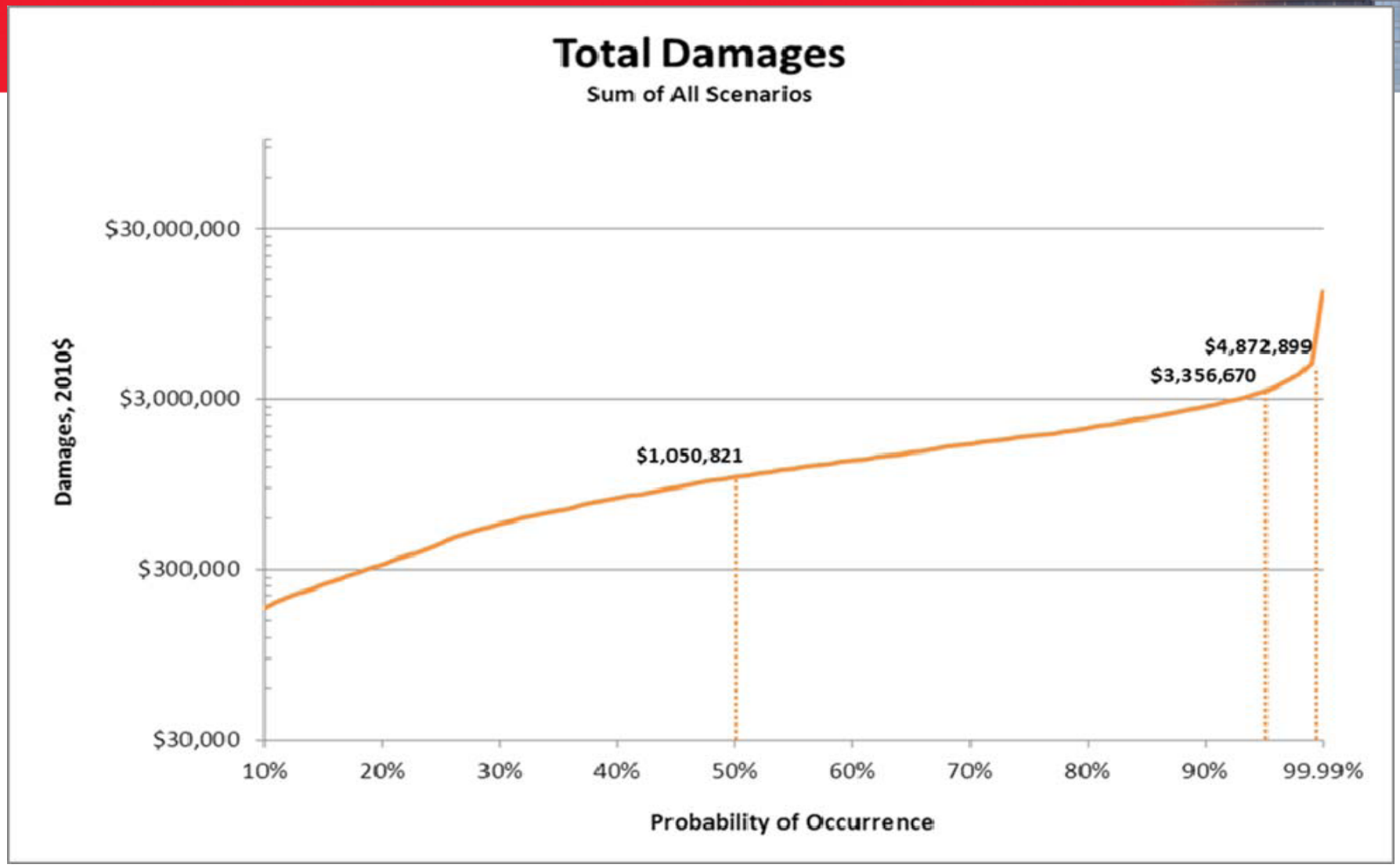
Proof of concept to field demonstration



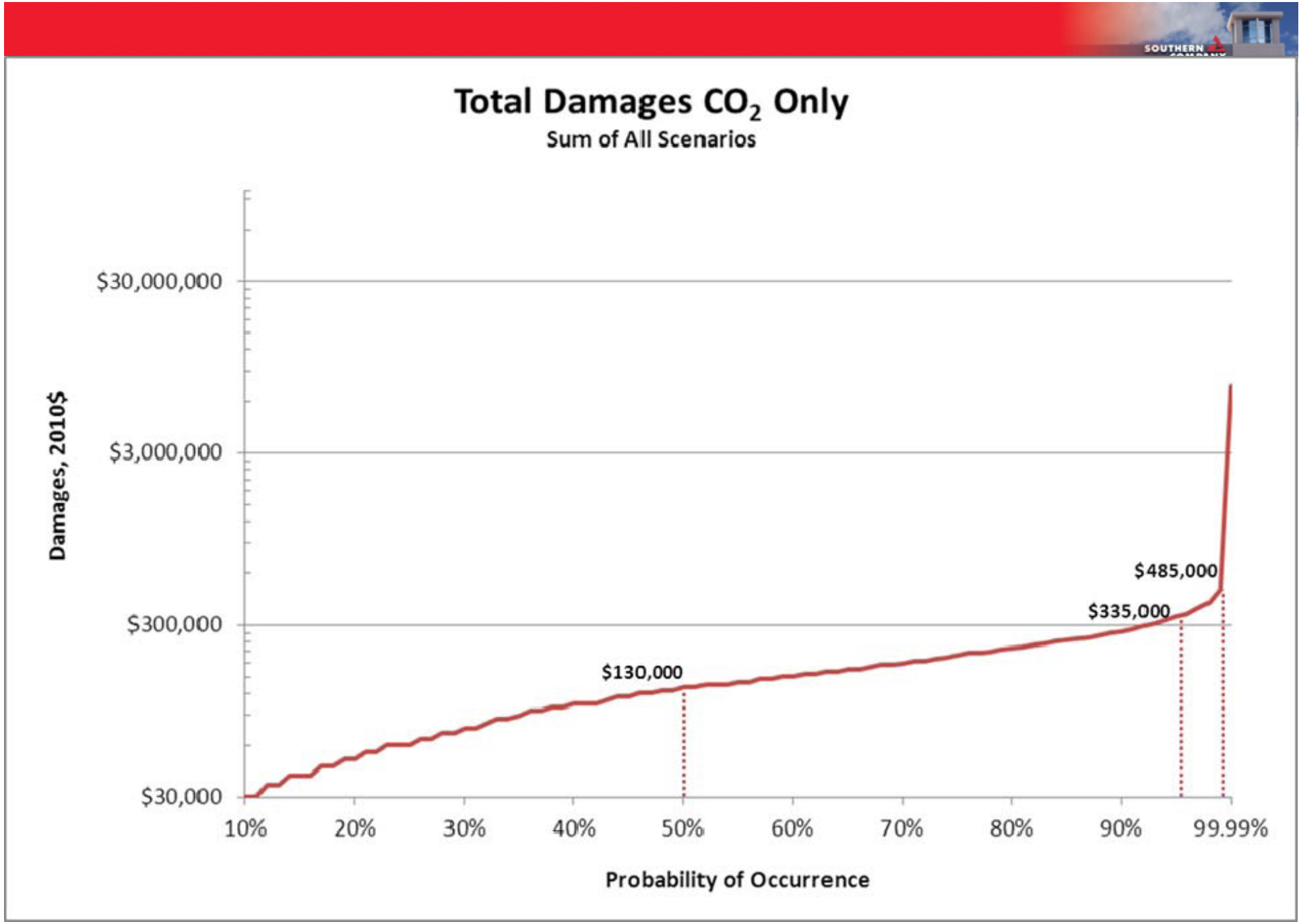
Valuation of the risks of CCS

- Motivation behind the valuation study:
  - Develop a credible and widely applicable framework for calculating the financial damages associated with accidents from CCS projects
  - Gain a better understanding of project liabilities and reservoir specific sensitivities for project development, including the circumstances and timeframe under which these liabilities may present
  - Useful tool in the public debate around policy options for addressing guidance to EPA on permitting financial assurance requirements
  - Foundation for communicating risk and risk management to stakeholders
  - Help inform the discussion around the need and role of 3rd party captive insurance programs, the public role in long-term stewardship of CCS, and project finance

IEc



Results are presented in $2010. As shown, ‘most likely’ (50th percentile) estimated damages total approximately $1.05 million. ‘Upper end’ (95th, 99th percentiles) total approximately $3.36 million and $4.87 million, respectively.


Total Damages CO_2 Only
Sum of All Scenarios
$30,000,000
$3,000,000
$300,000
$30,000
Damages, 2010$
$485,000
$335,000
$130,000
10%
20%
30%
40%
50%
60%
70%
80%
90%
99.99%
Probability of Occurrence

Research Experience in Carbon Sequestration

RECS is heading to Southern Company again in 2013

Thirty students selected to participate in a two week workshop where they learned about CCS and CCUS from experts in industry, the research community, NGOs and the government; along with participating in group exercises, workshops, and field trips.

RECS
Research Experience in Carbon Sequestration

SECARB-ED
Southeast Regional Carbon Sequestration Technology Training Program

www.recsco2.org

Other supported projects

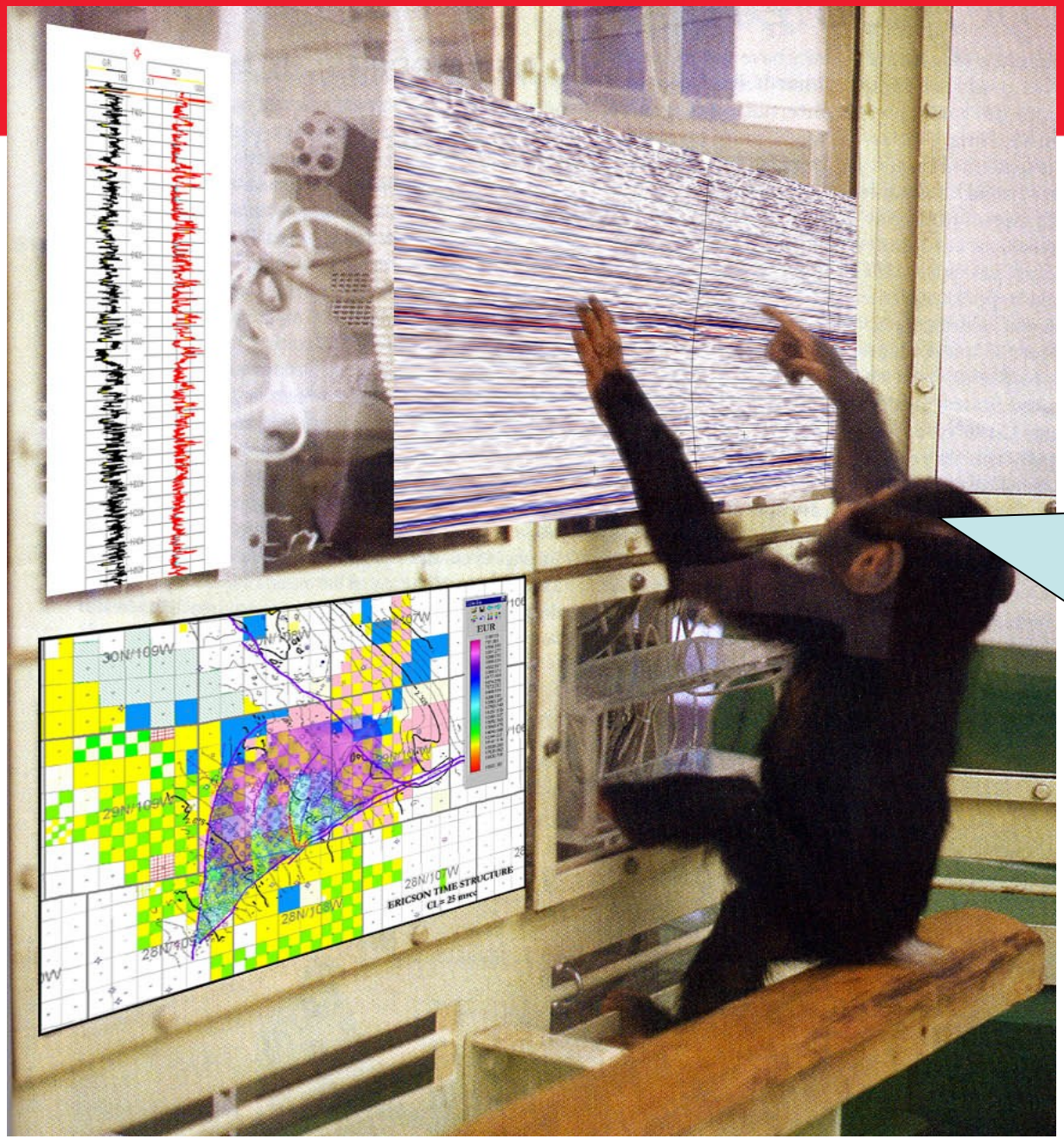
- Development of Standards for Geologic Storage of CO_2 (CSA)
- CCS Technology and Pipeline Infrastructure Study (LANL)
- Florida Panhandle Pipeline Infrastructure Model (University of North Florida)
- Carbon Sequestration Simulation Center (UAB)

CSA Group

Los Alamos NATIONAL LABORATORY EST. 1943

UNF UNIVERSITY of NORTH FLORIDA

UAB THE UNIVERSITY OF ALABAMA AT BIRMINGHAM



And this is where the CO_2 will maybe go. I thinks it's OK, but we'll see later. If it COME back up I am back to the ZOO!