Improving the Monitoring, Verification, and Accounting of CO_2 Sequestered in Geologic Systems with Multicomponent Seismic Technology and Rock Physics Modeling

Project: DE-FE0001317

Principal Investigator: Bob A. Hardage
Bureau of Economic Geology, The University of Texas at Austin

Bureau of Economic Geology

PROJECT TEAM

Prime Contractor:

Bureau of Economic Geology,
The University of Texas at Austin

Industry Partners:

AOA Geophysics, Inc.
Ascend Geo, LLC.
RARE Technology
Austin Powder Company
Battelle Pacific Northwest National Laboratory
Geokinetics
Global Geophysical
Seismic Source

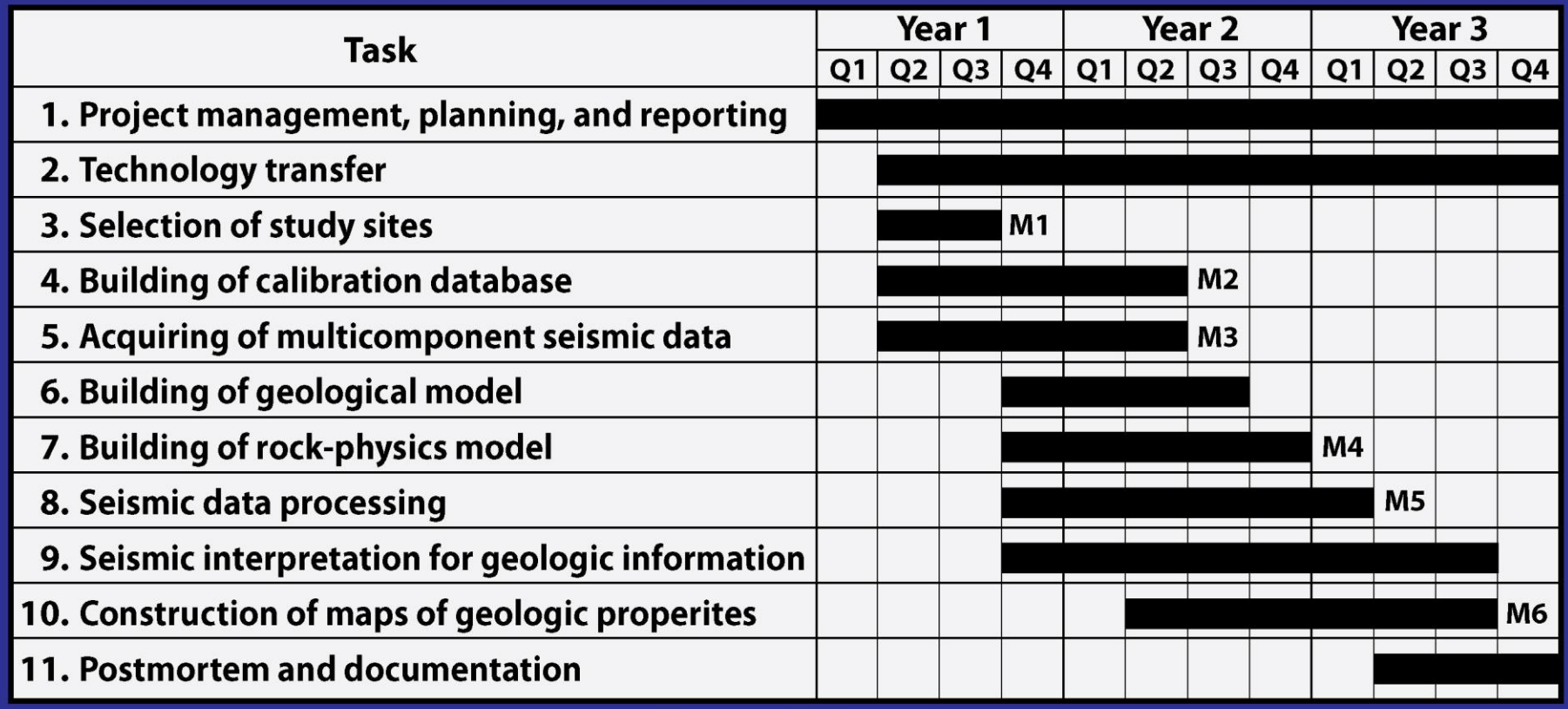
OBJECTIVES

- Acquire, process, and interpret multicomponent seismic data across a minimum of one brine reservoir site.
- Analyze log data to characterize reservoirs and seal units.
- Develop rock physics models that relate P and S seismic attributes to rock/fluid properties.
- Compile evidence establishing value of multicomponent seismic technology for CO_2 MVA tasks.

NEW TECHNOLOGIES

- Cable-free seismic data acquisition
- New S-wave seismic sources
- Fracture evaluation
- Elastic wavefield seismic stratigraphy
- Detection of intra-reservoir shaly zones

WORK TASKS



M1–6 = Milestones

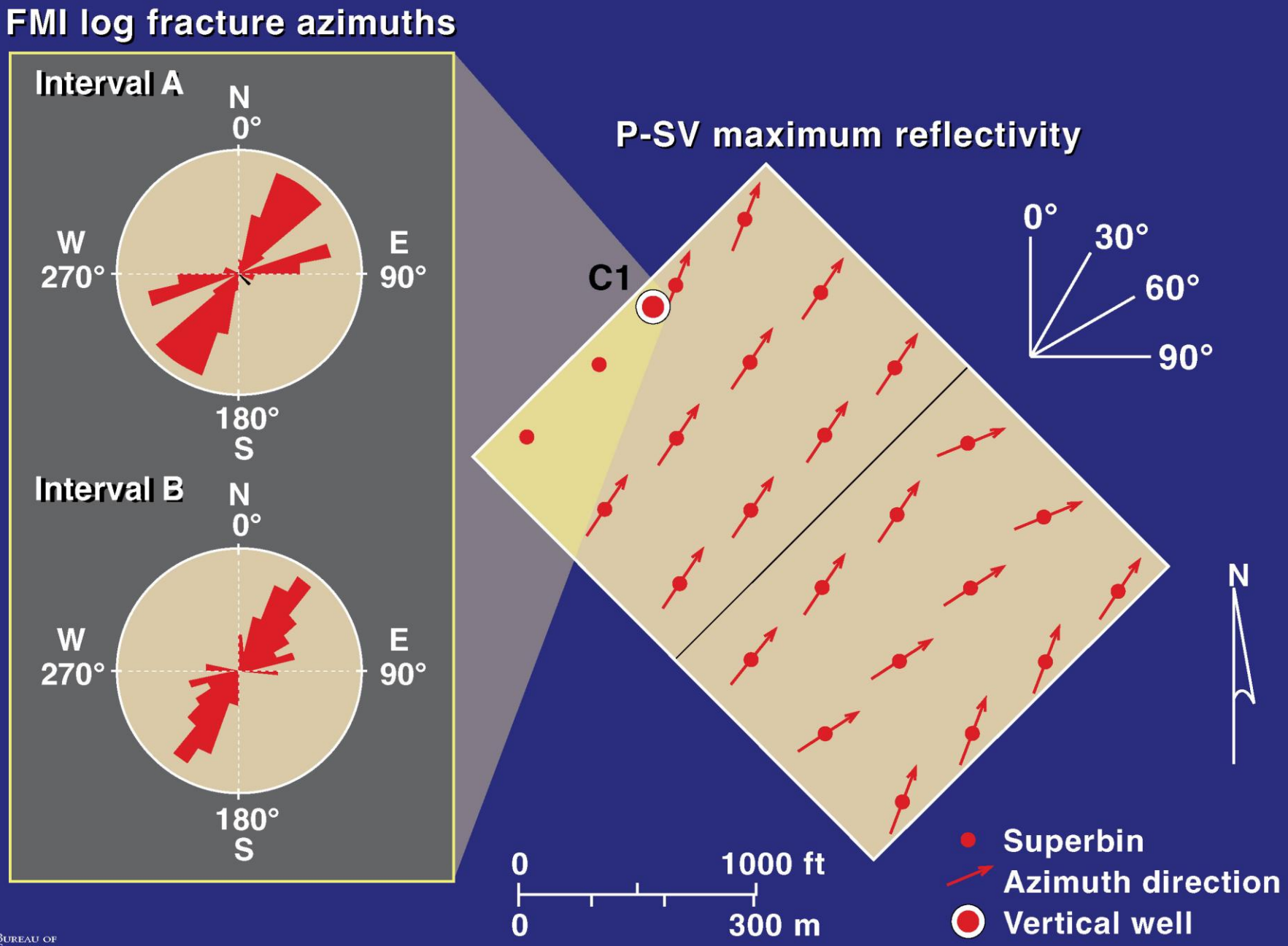
TECHNOLOGY TRANSFER

- Presentations at one or more workshops.
- One or more journal papers.
- One or more articles in GEOPHYSICAL CORNER.
- One or more oral papers at professional meetings.

CABLE-FREE SEISMIC DATA ACQUISITION

Heath, 2008

AXIS SOURCE 1


FMI log fracture azimuths
Interval A
N
0°
W
270°
E
90°
180°
S
Interval B
N
0°
W
270°
E
90°
180°
S
P-SV maximum reflectivity
C1
0°
30°
60°
90°
N
0
1000 ft
0
300 m
Superbin
Azimuth direction
Vertical well
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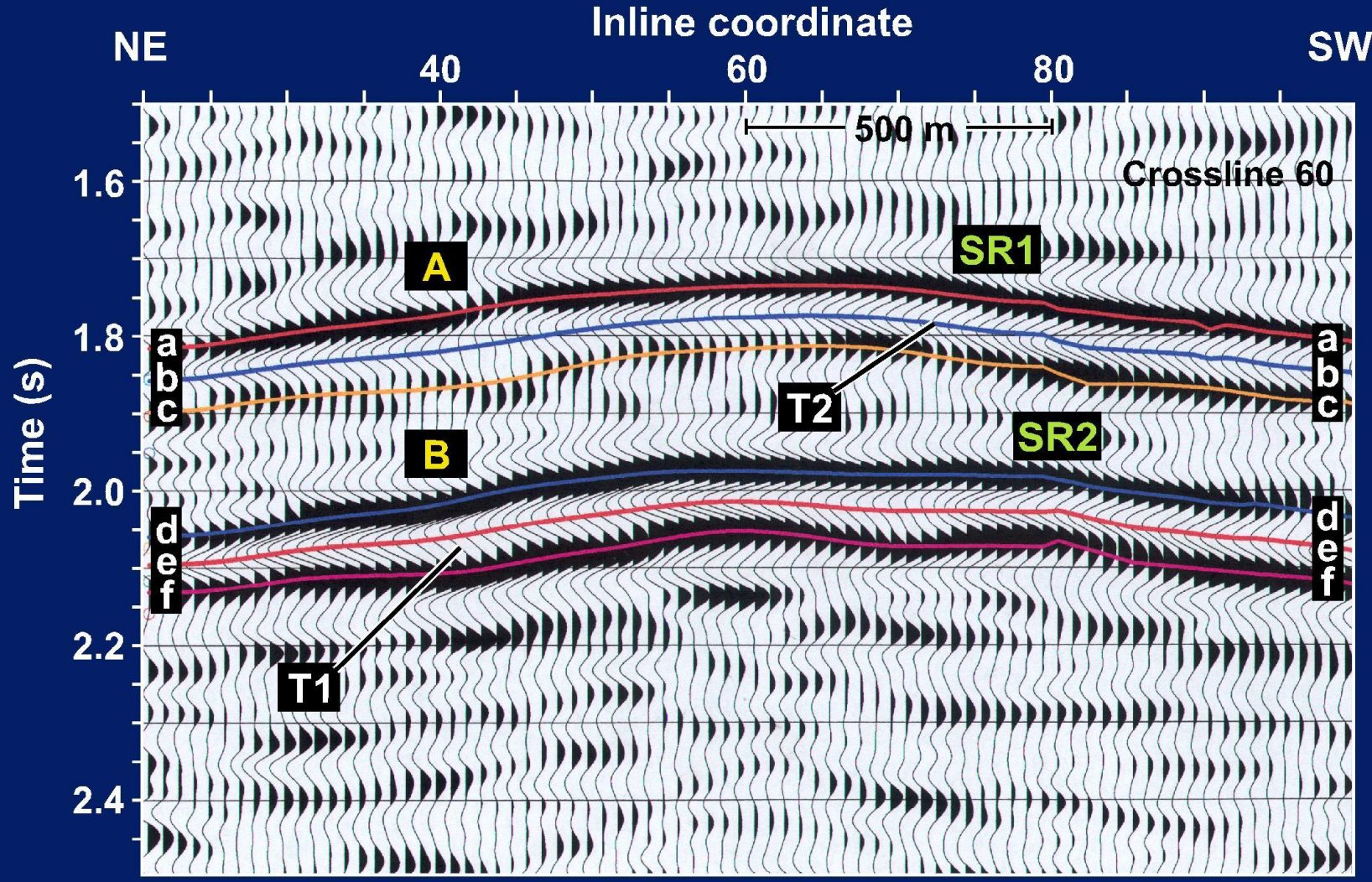
FAST-S IMAGE, CROSSLINE 60, STUDY AREA 1



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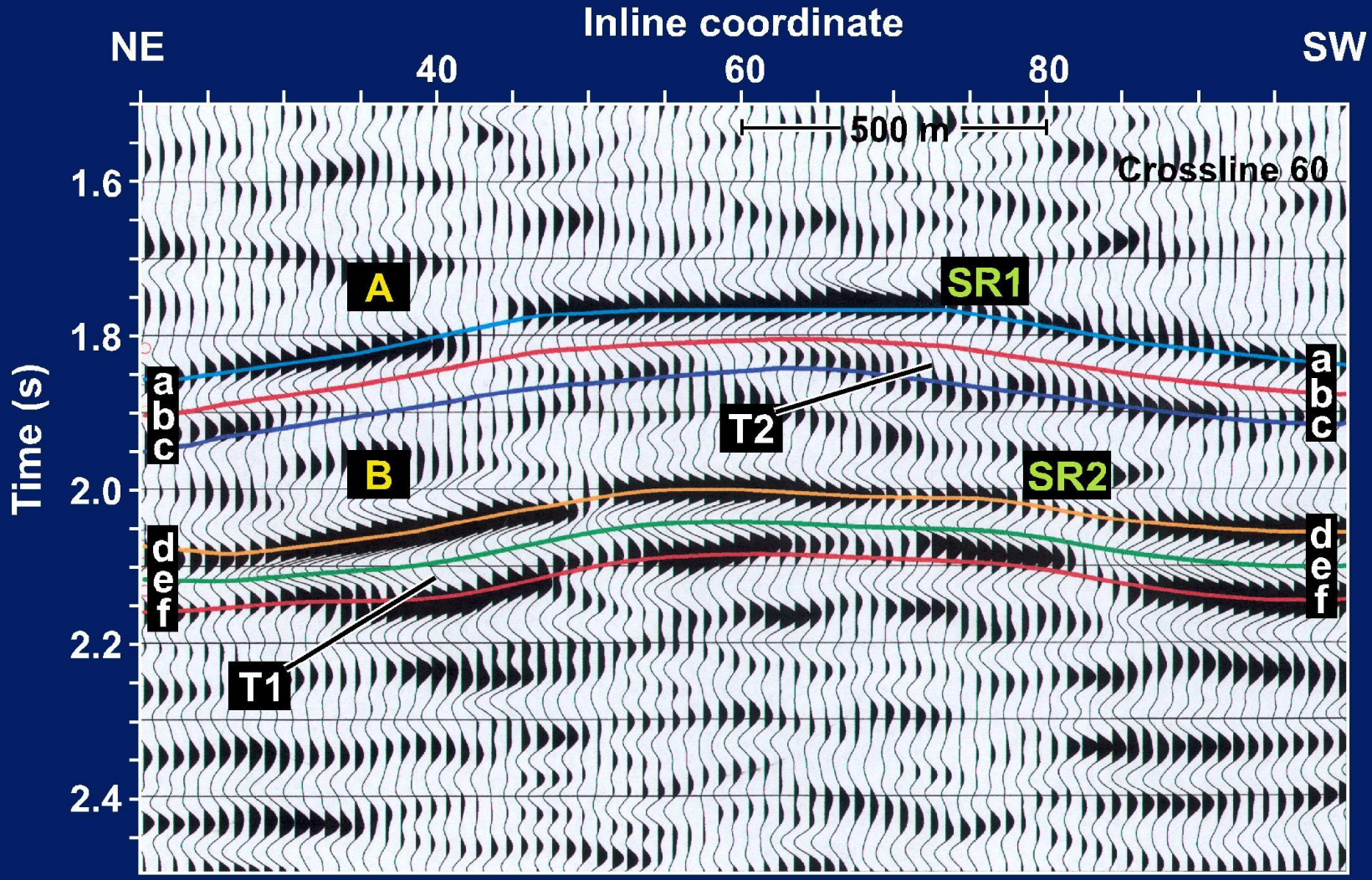
SLOW-S IMAGE, CROSSLINE 60, STUDY AREA 1



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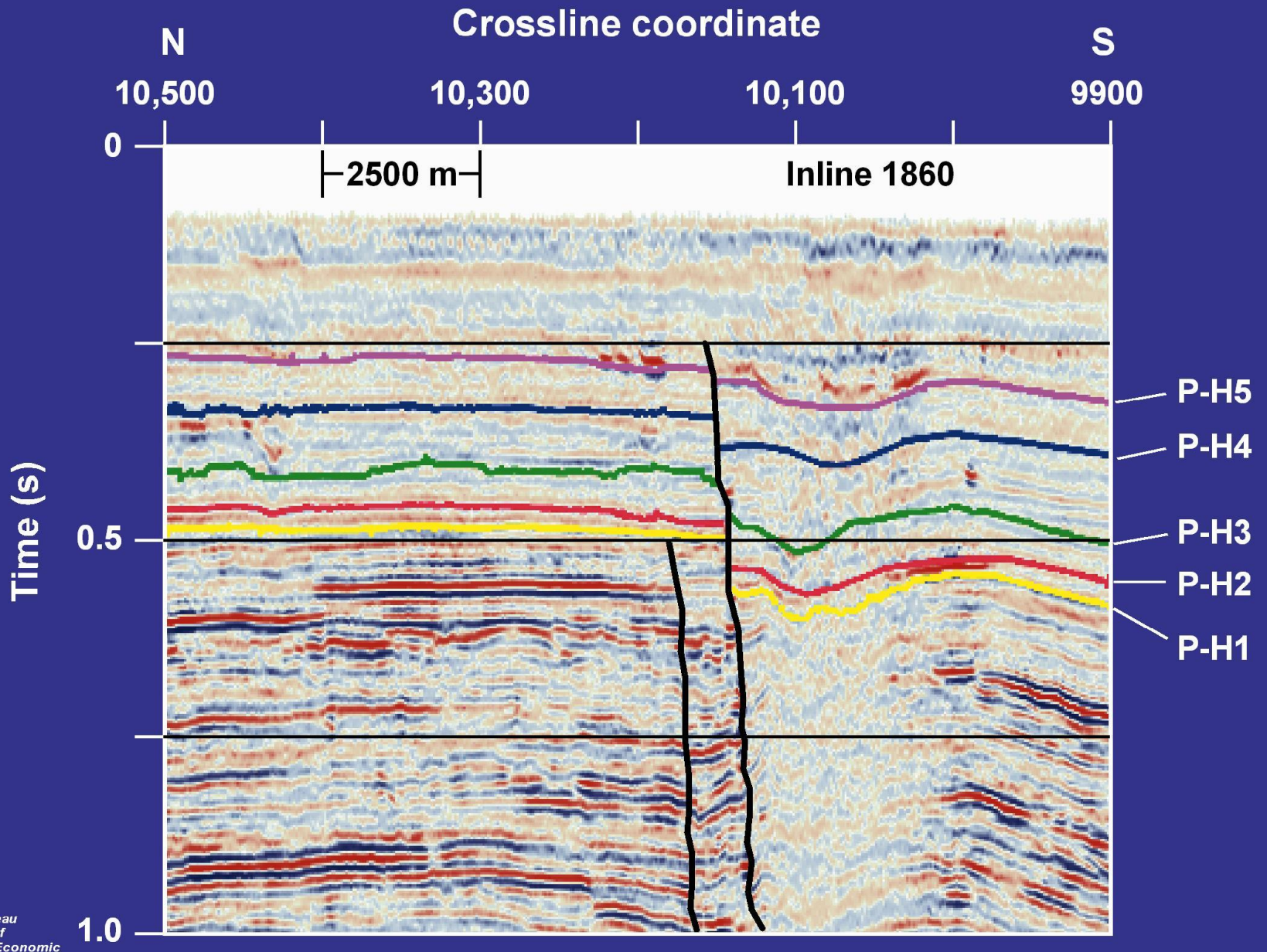
P-P WAVE STRATAL SURFACES



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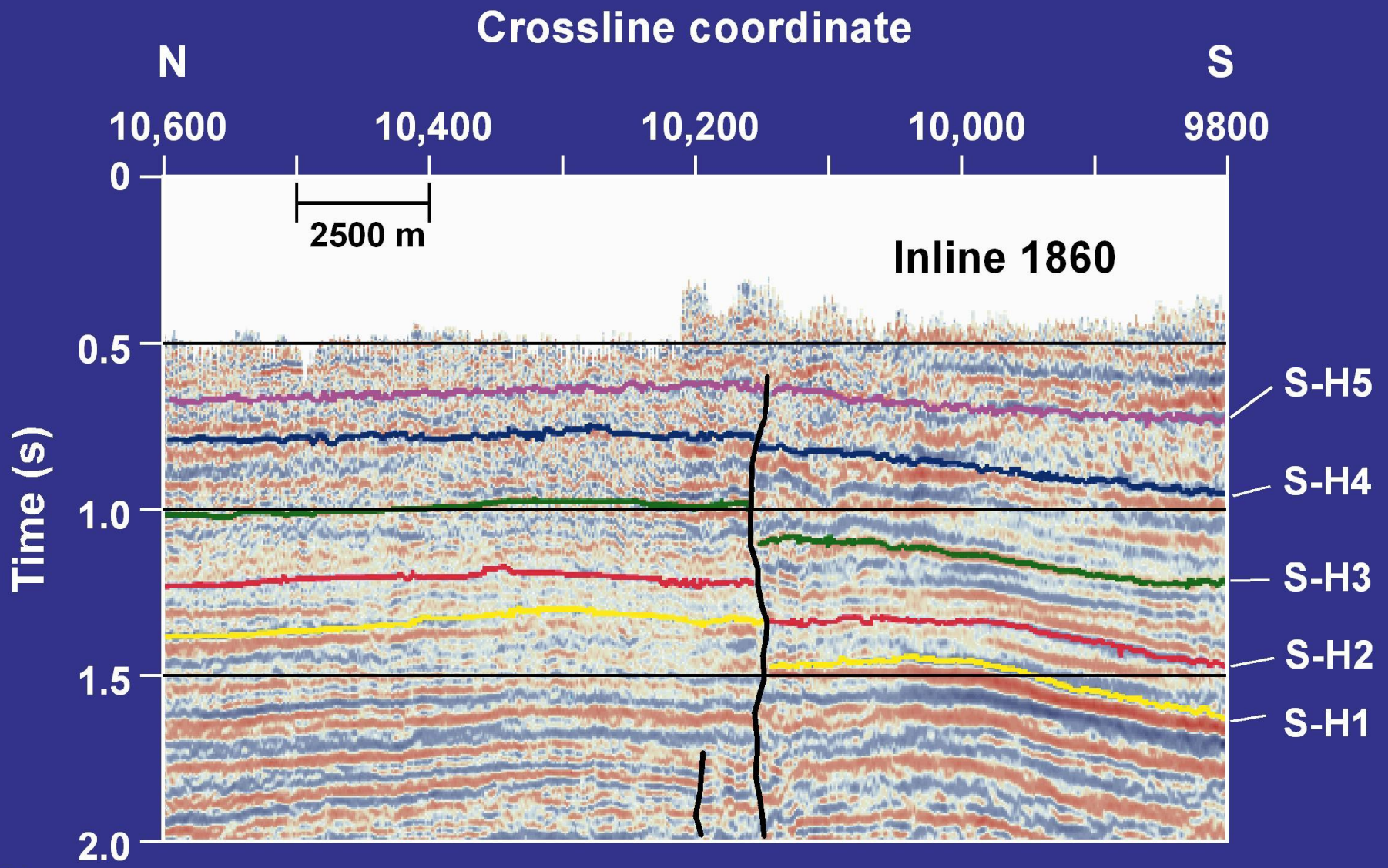
P-SV WAVE STRATAL SURFACES



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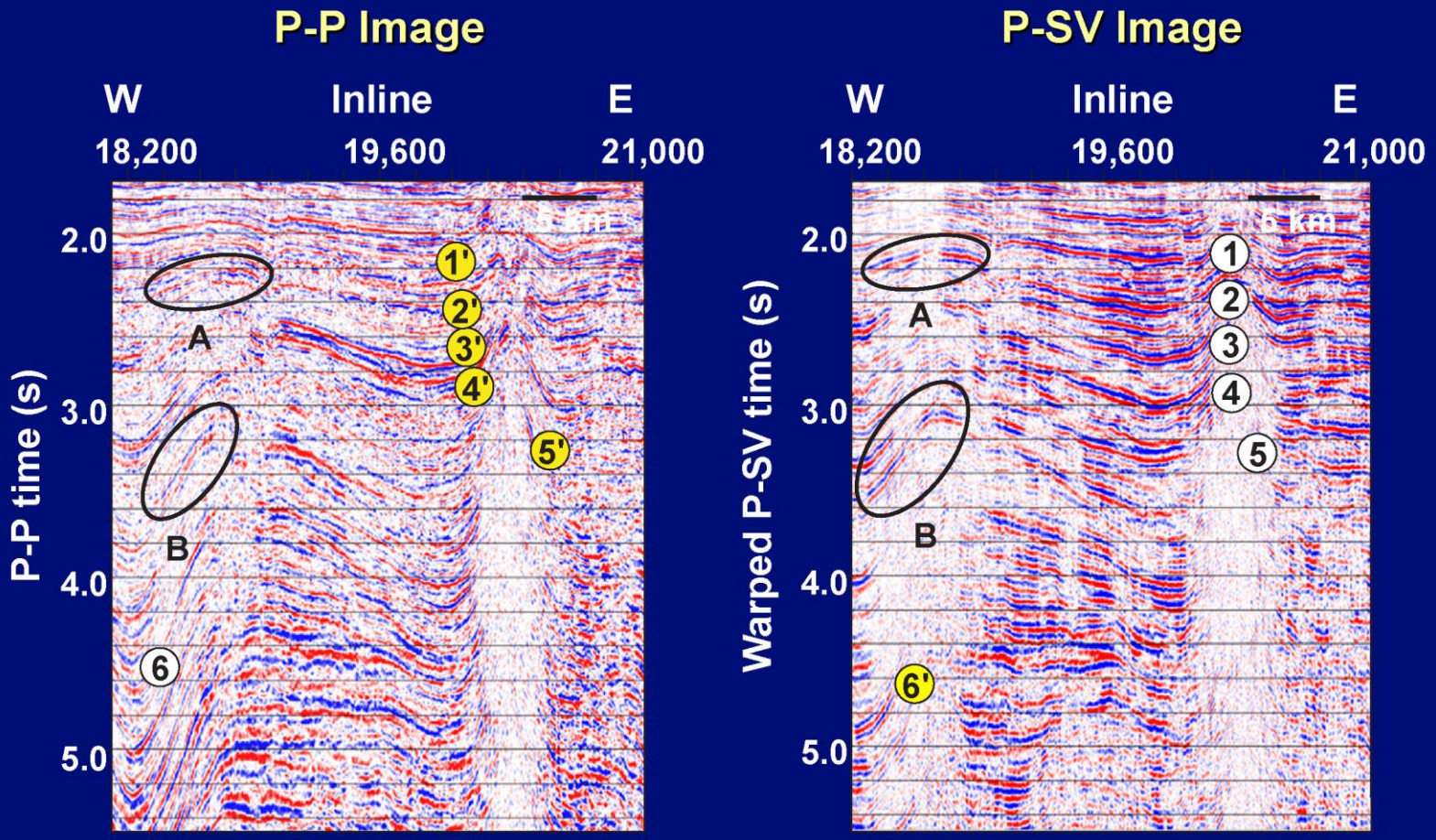
SHELF B - NORTH

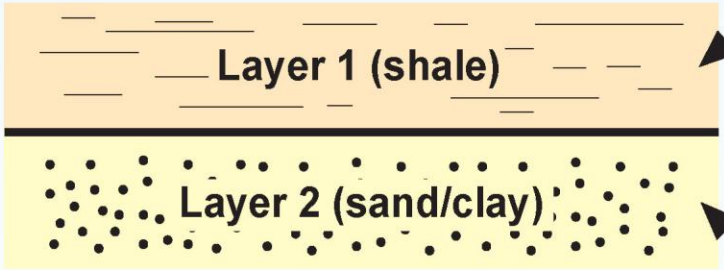


A Depth-equivalent geology

2 Unique to one seismic mode

2' Position in companion image space

CLAY CONTENT EARTH MODEL



$$V_P = 4.7 \text{ km/s}$$

$$V_S = 0.76969 V_P - 0.86735 \text{ (km/s)}$$

$$\rho = V_P^2 + 0.373 V_P + 1.458 \text{ (gm/gm}^3\text{)}$$

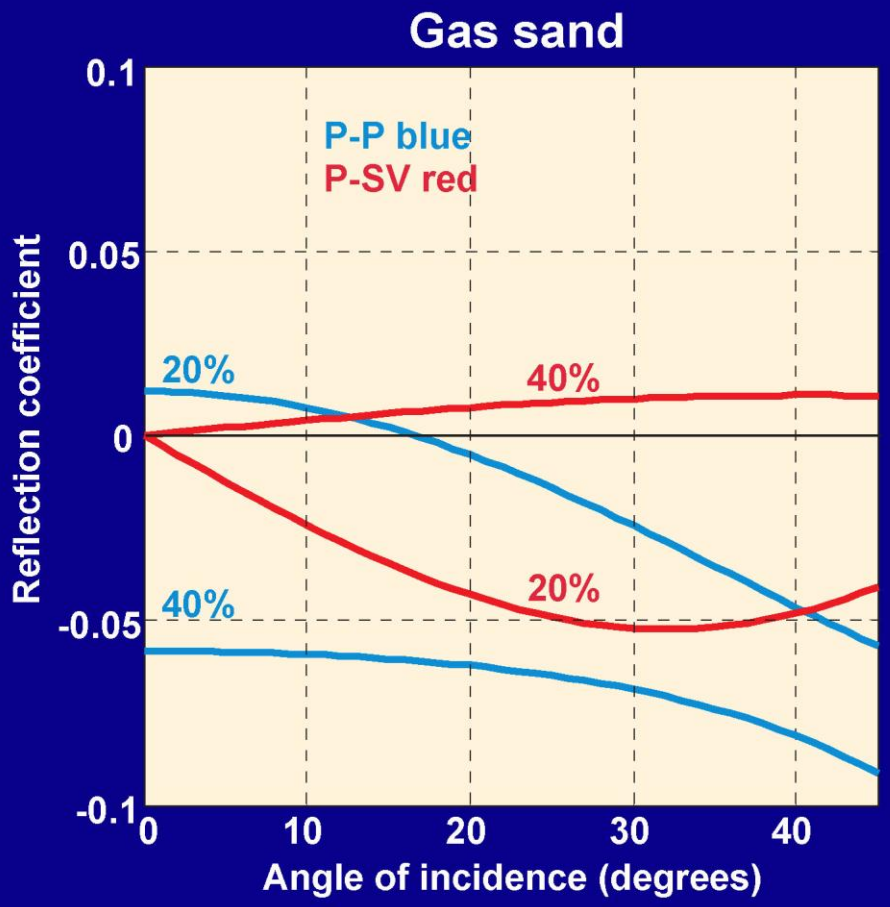
$$V_P = 5.59 - 6.93\phi - 2.18c \text{ (km/s)}$$

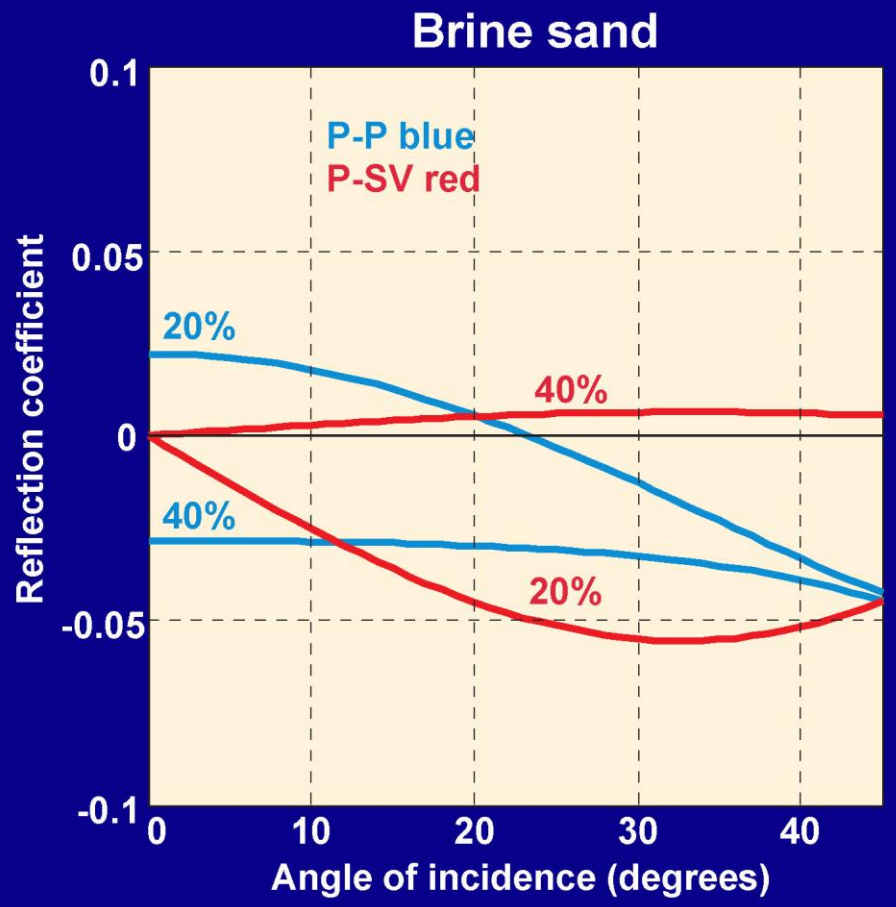
$$V_S = 3.52 - 4.91\phi - 1.89c \text{ (km/s)}$$

$$\rho = \rho_{fl}\phi + (1 - \phi)[c\rho_{cl} + (1 - c)\rho_Q] \text{ (gm/gm}^3\text{)}$$

c = Clay volume fraction fl = Pore fluid cl = Clay Q = Quartz

EFFECT OF CLAY CONTENT ON REFLECTIVITY (Sand ϕ = 20%)





20%
40% Clay content

MIDWEST REGIONAL CARBON SEQUESTRATION PARTNERSHIP

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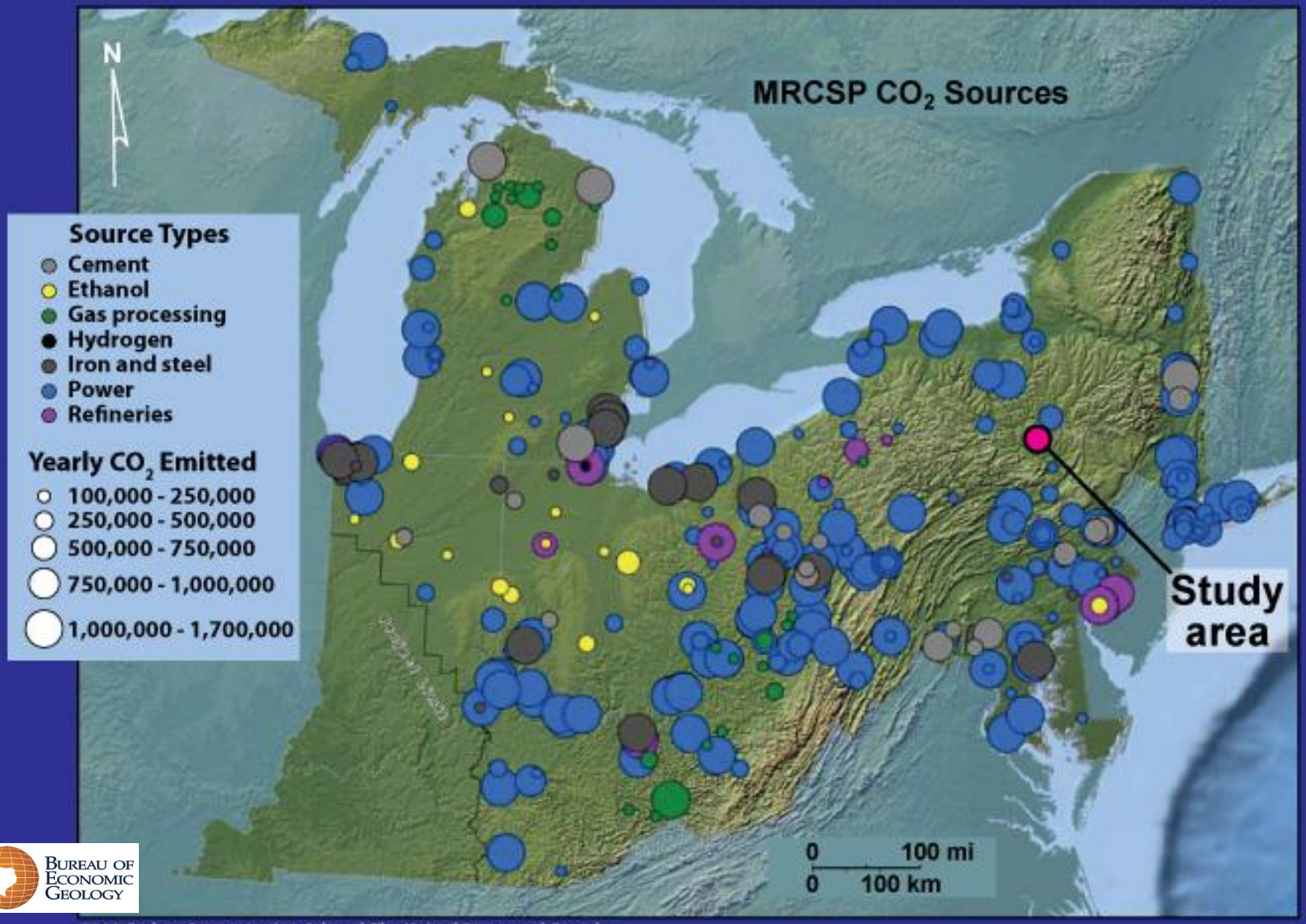
CO_2 SOURCES IN THE MRCSP REGION



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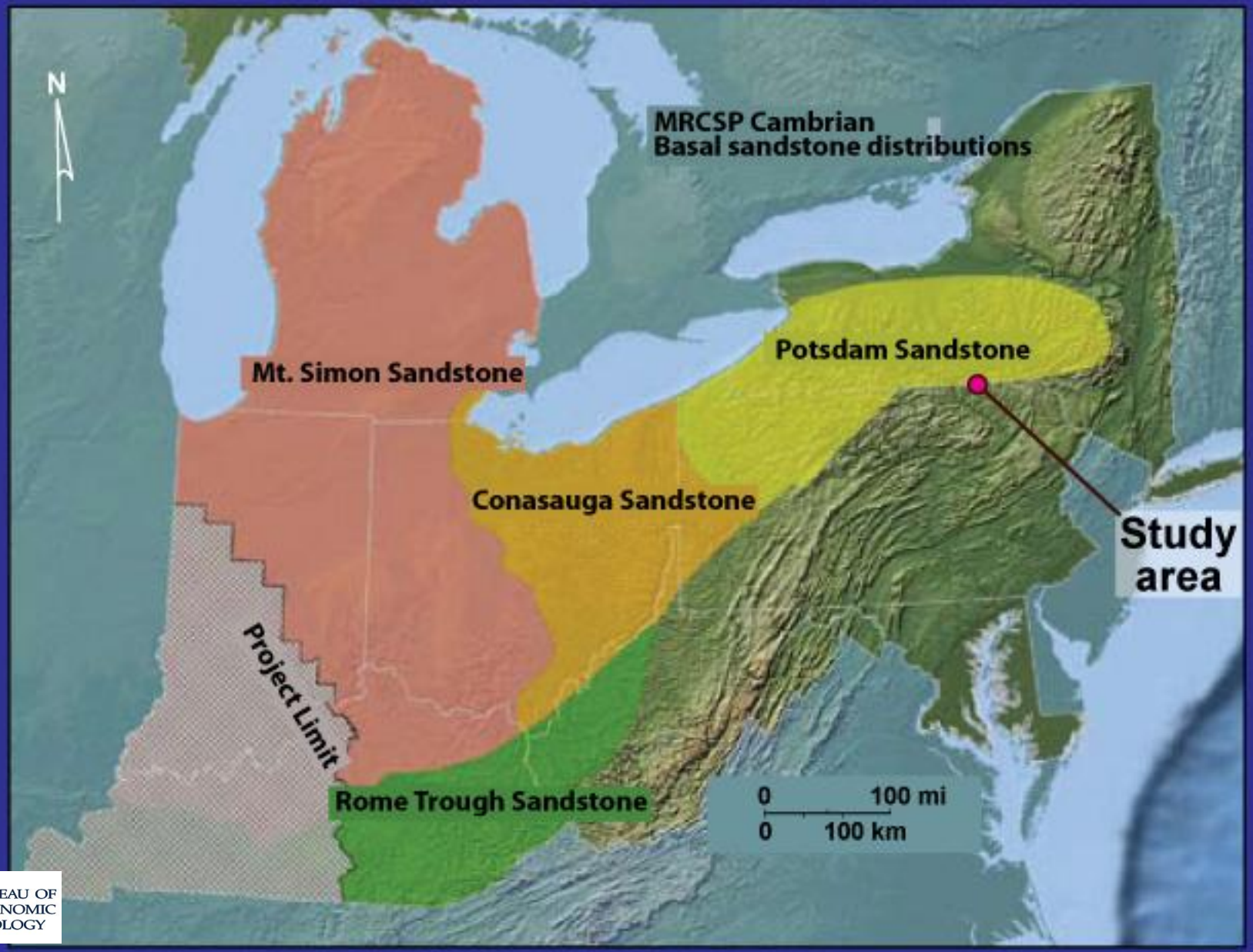
MRCSP: DEEP SALINE FORMATIONS



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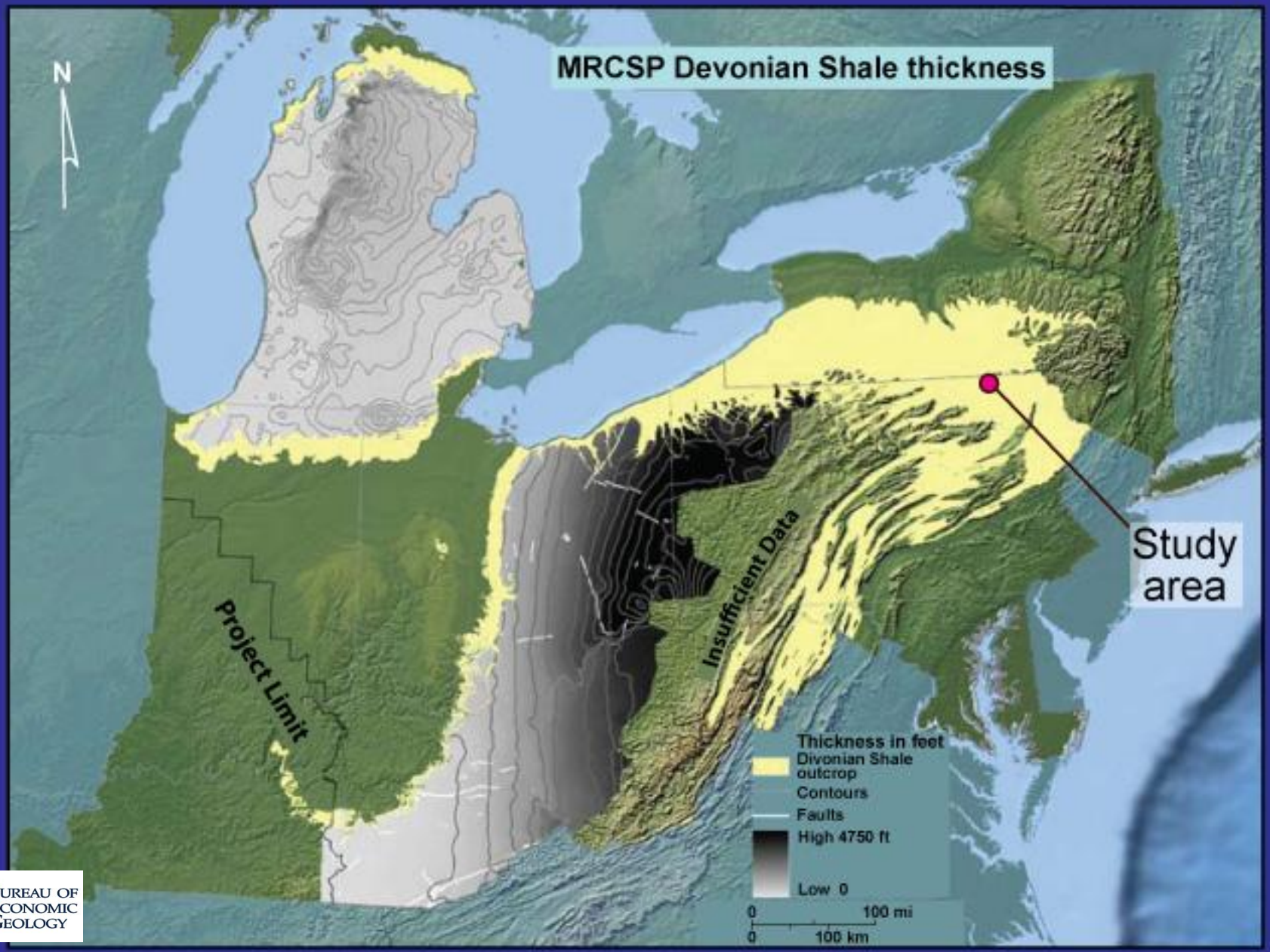
ESTIMATED DEEP SALINE FORMATION CO_2 STORAGE RESOURCE

Deep Saline Formation	Potential CO_2 Storage Resource (million metric tons CO_2)	
	Low Estimate (P15)	High Estimate (P85)
Mt. Simon Formation	21,700	86,900
St. Peter Sandstone	8,800	35,300
Medina/Tuscarora Sandstone	7,900	31,500
Rose Run Sandstone	5,700	23,100
Oriskany Sandstone	1,900	7,800
Sylvania Sandstone	1,500	6,000
Wastegate Formation	400	1,800
Basal Conasauga Sandstones	400	1,700
Potsdam Sandstone	1,200	4,500
Rome Trough Sandstones	100	500
TOTAL Deep Saline	49,600	199,100

MRCSP ORGANIC SHALES



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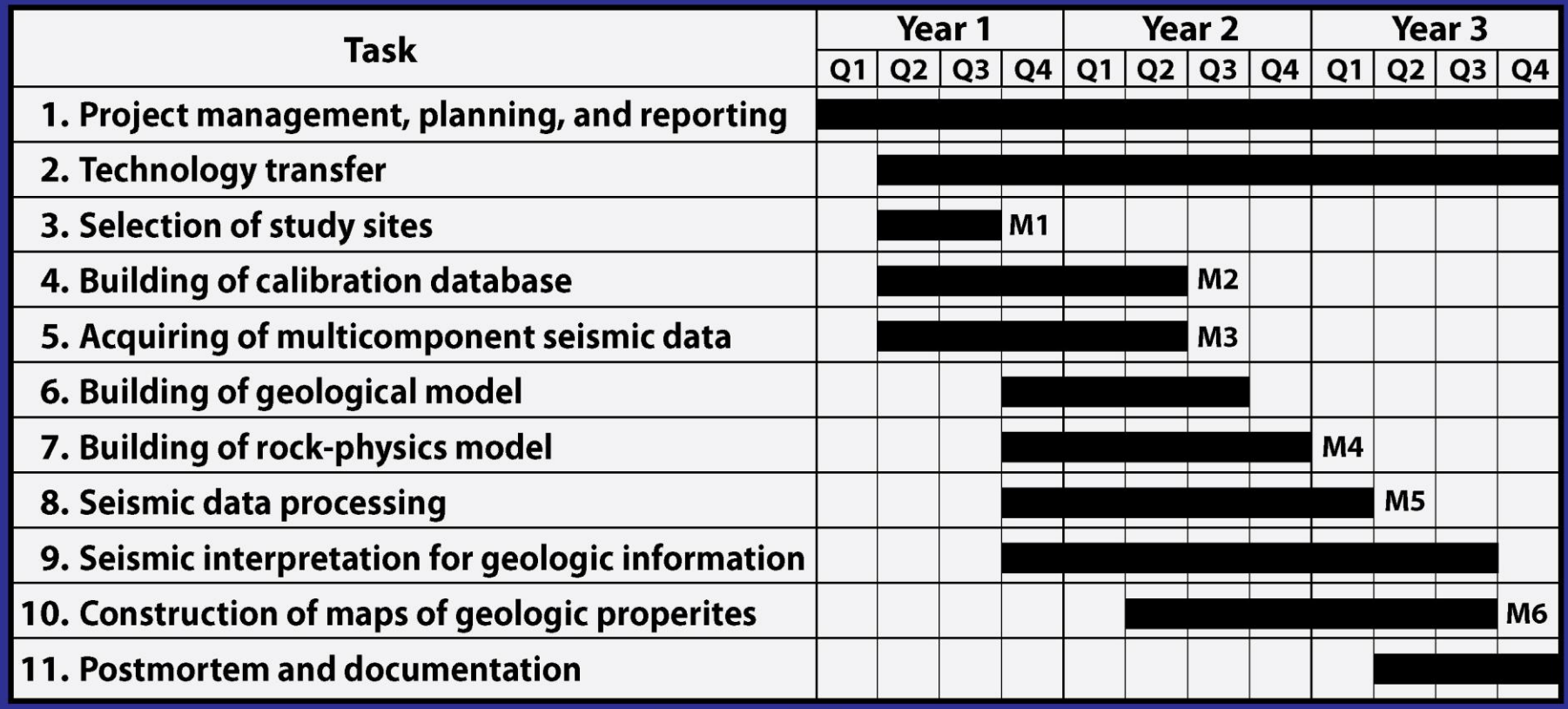
WORK TASKS



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