Update on Results of SECARB " Early" Test of Monitoring Large Volume Injection at Cranfield

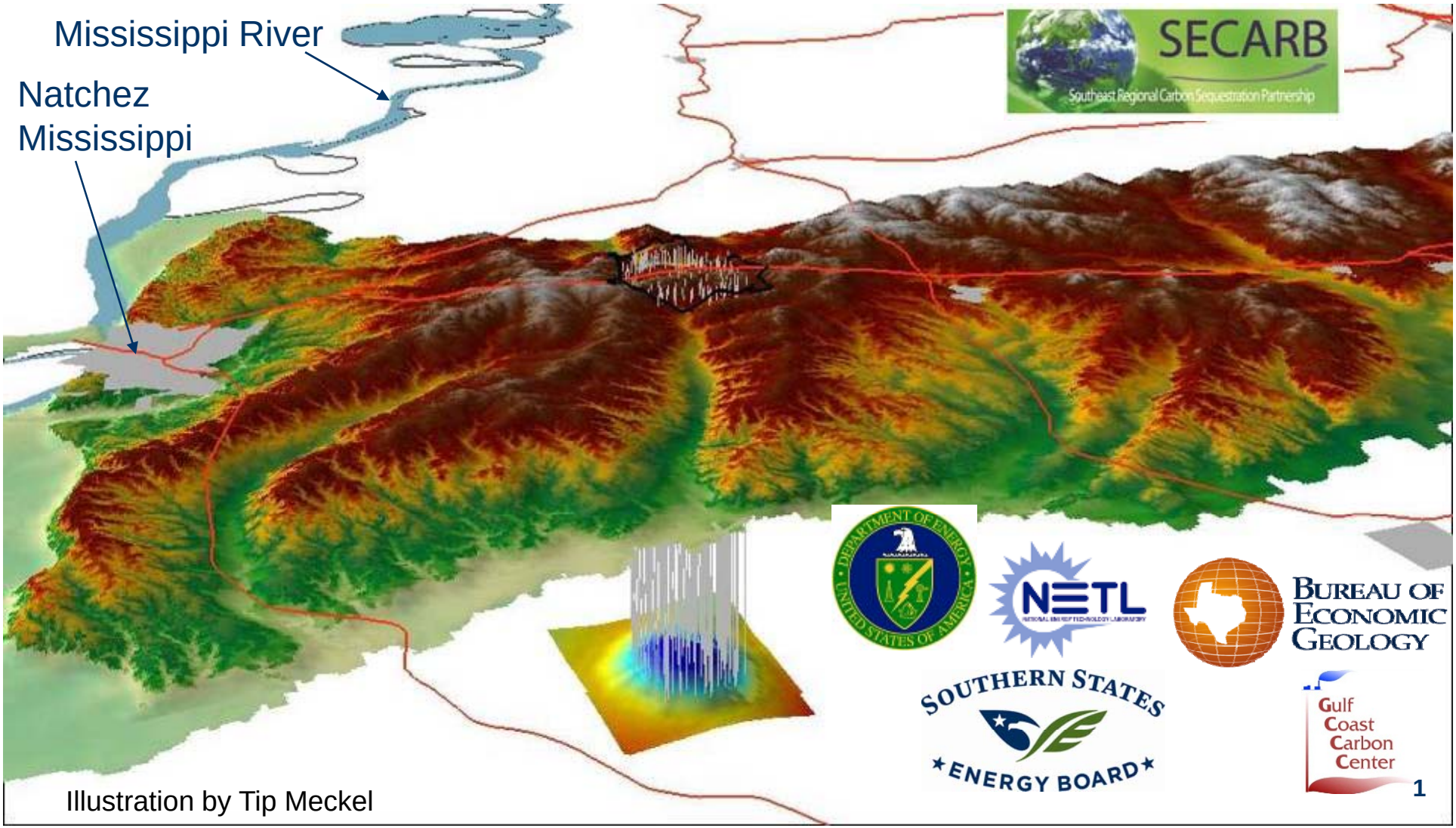

Illustration by Tip Meckel

Gulf Coast Carbon Center (GCCC)

BEG Team

Susan Hovorka
Tip Meckel
J. P. Nicot
Rebecca Smyth
Ramon Trevino
Katherine Romanak
Changbing Yang
Dave Carr
Sigrid Clift
Jiemin Lu
Seyyed Hosseini
Jong Won Choi
Vanessa Nunez
Khandaker Zahid
Carey King
students
Scott Tinker
Ian Duncan

Gulf Coast Carbon Center

Collaborators

BEG- CEE
LBNL
LLNL
ORNL
USGS
New Mexico Tech
Mississippi State U
U of Mississippi
BP
ARI
SECARB
SWP
UT-PGE
UT- CCEP
UT- DGS
Univ Edinburgh

NETL: Bruce Brown
SSEB: Jerry Hill

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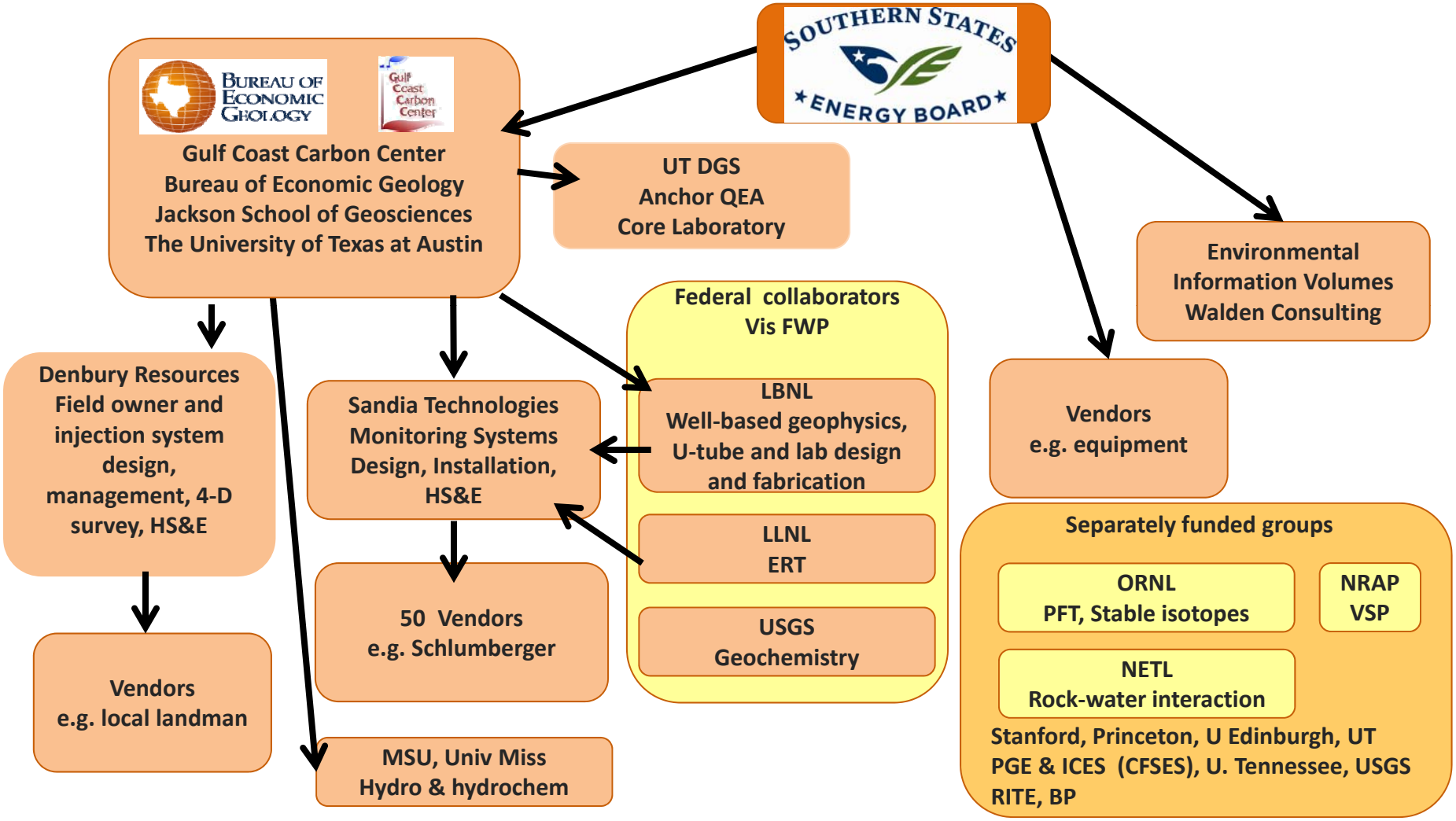
The University of Texas at Austin John A. & Katherine G. JACKSON SCHOOL OF GEOSCIENCES

Early Test Organization Chart



Early Test Workflow and Presentations

2008 Sue

Reservoir characterization;
production history;
Existing cores and logs;
Existing aquifer data

GEM and TOUGH2 models for experiment design

2009 David

Well construction;
Cross well seismic,
Multi-well hydro tests,
Logging, coring,
Petrography,
petrophysics
Soil gas recon,
Groundwater surveillance

Bold=topics discussed

GEM, TOUGH2
Geochemist workbench models for operations

2009-2010 Jiemin

U-tube geochemistry, P-site measurements
BHP BHT DTS ERT,
RST, Measurement
Groundwater
Surveillance

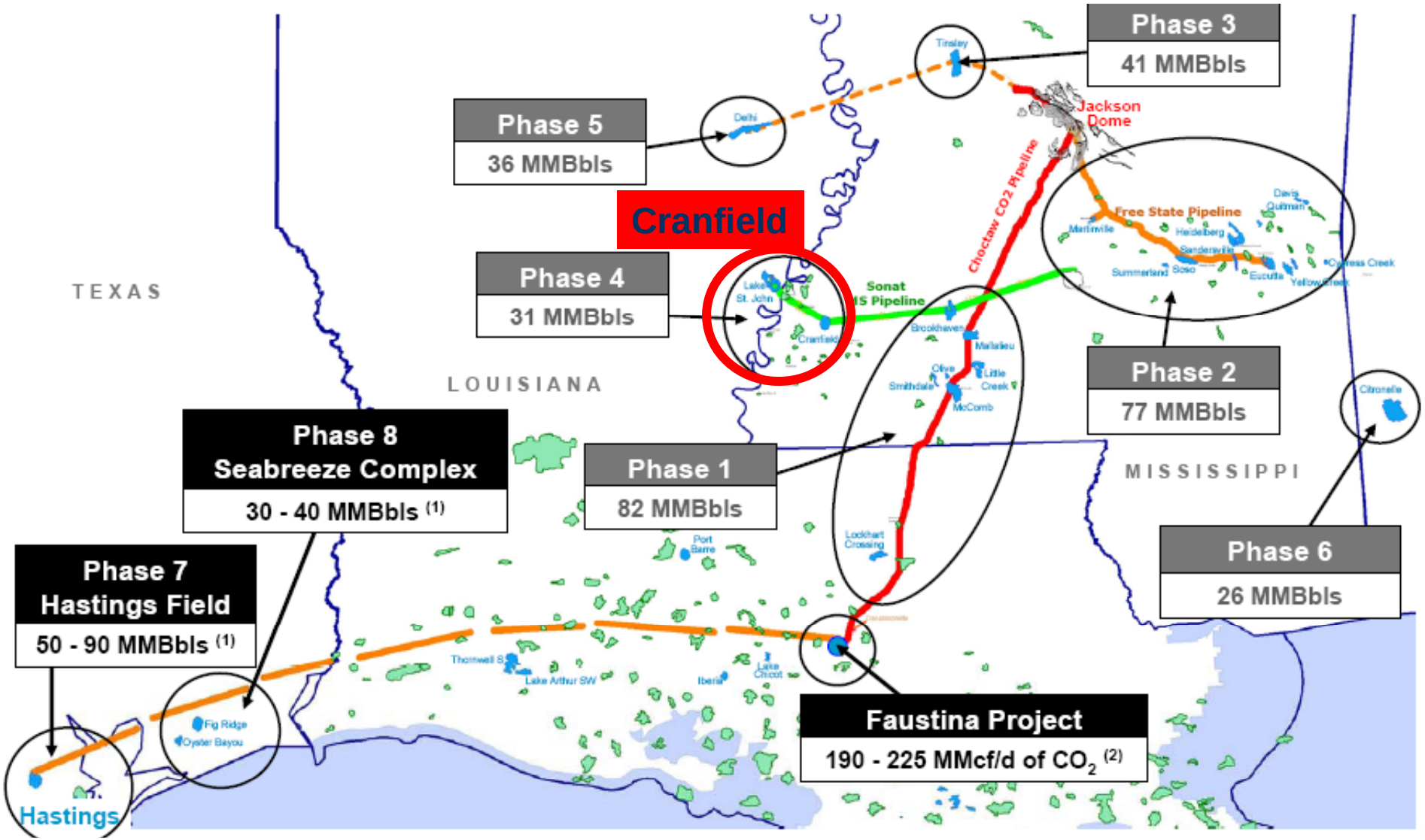
2010 Tom

Time-lapse cross well;
VSP, repeat 3-D,
Groundwater
Surveillance,
P-site measurements

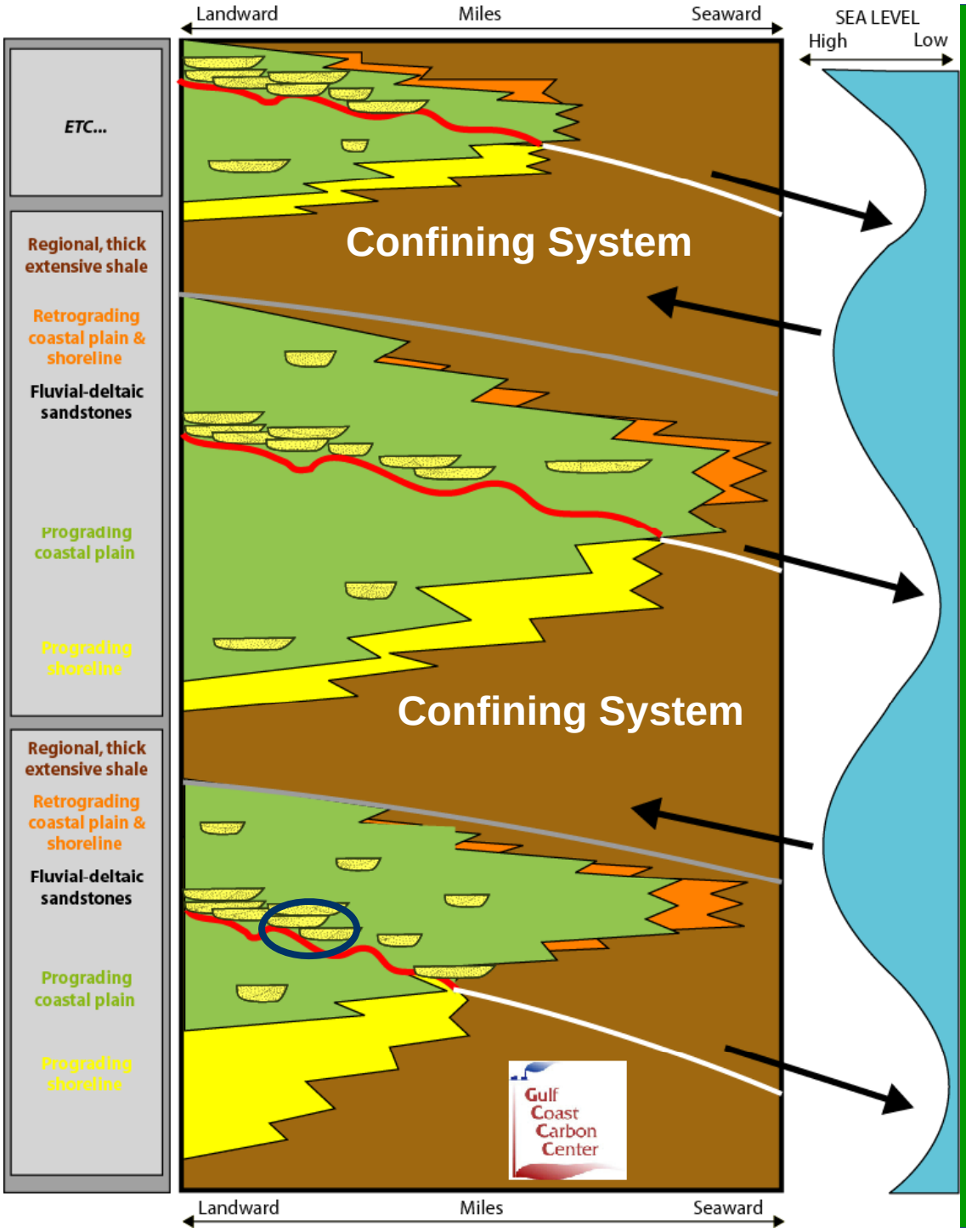
2011 Seyyed

GEM, TOUGH2
Geochemist workbench models for assessment

Source of CO_2 for Early Test



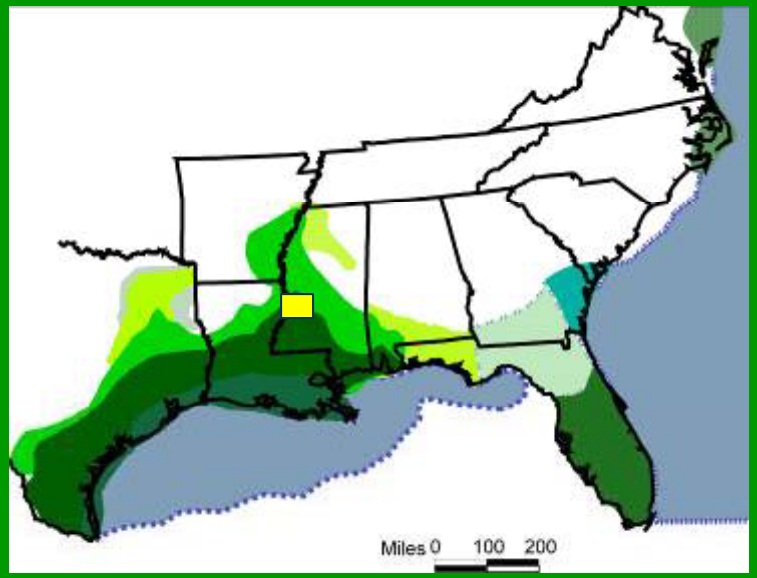
Courtesy of Denbury Resources, Inc.



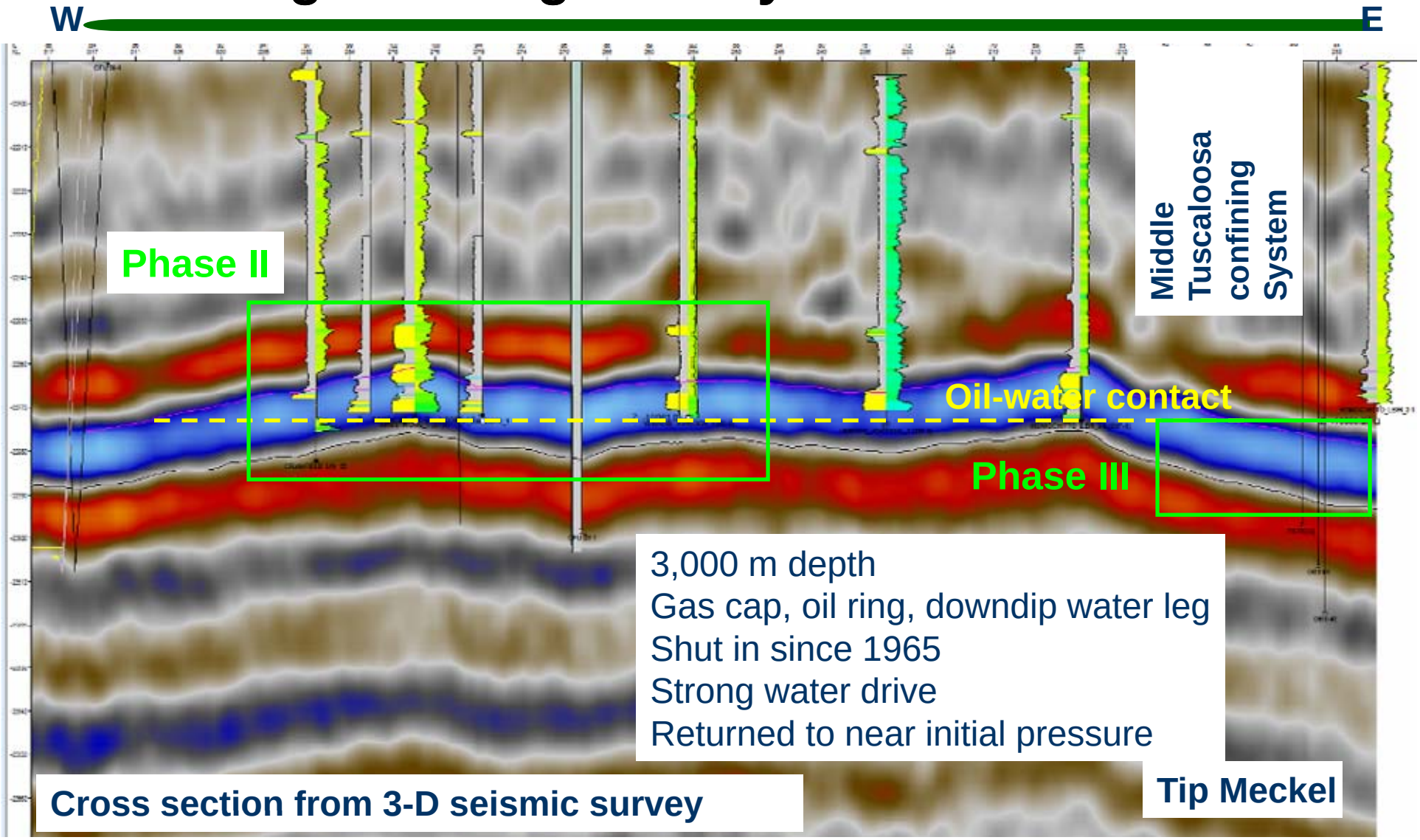
Regionally significant sequestration target for Early Test: Gulf Coast Wedge

Repetitive depositional units

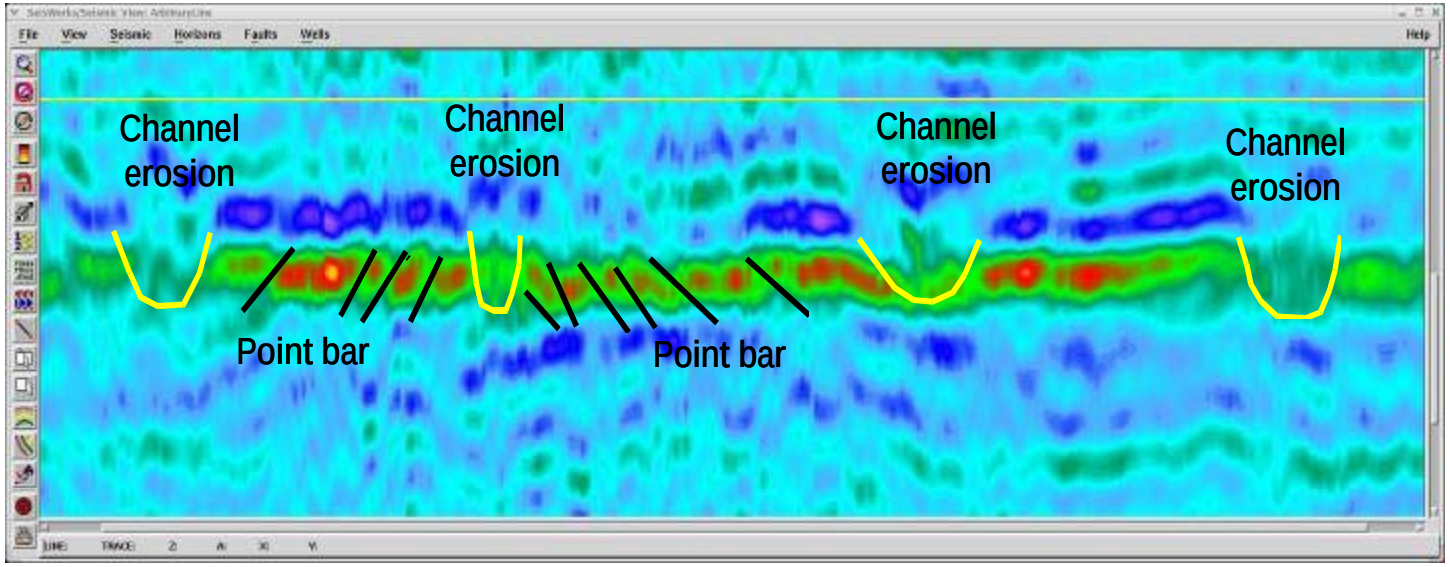
- **Results transferable to:**
  - **older and younger units**
  - **other parts of region**

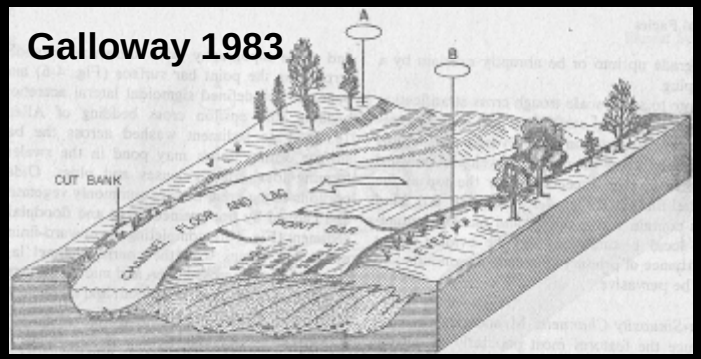


Geologic Setting of Early Test Site at Cranfield



Geologic Characteristics of Injection Zone





Meander fluvial model

Stratal slicing of 3-D volume
Hongliu Zeng

Interim Conclusions of Early Test

- Injection start July 2008
- 2.8 Million metric tons stored
- 1 million metric ton/year rate achieved Dec 2009
- Monitored with standard and novel approaches
  - History match pressure response
  - Above-Zone Monitoring Interval (AZMI)
  - Fluid flow measured/monitored with multiple tools in complex flow field
  - Quantification of dissolution
  - Knowledge sharing, outreach, risk assessment
- Export to commercial EOR/sequestration projects

(1) RCSP Program Goal

Predict storage capacities within +/- 30%

- Capacity and injectivity well known at project start.
- Advance understanding of efficiency of pore-volume occupancy (E factor).
- Measure saturation during multiphase plume evolution (completed).
- Increase predictive capabilities (underway through modeling).

(2) RCSP Program Goal

Evaluate protocols to demonstrate 99% CO_2 retained

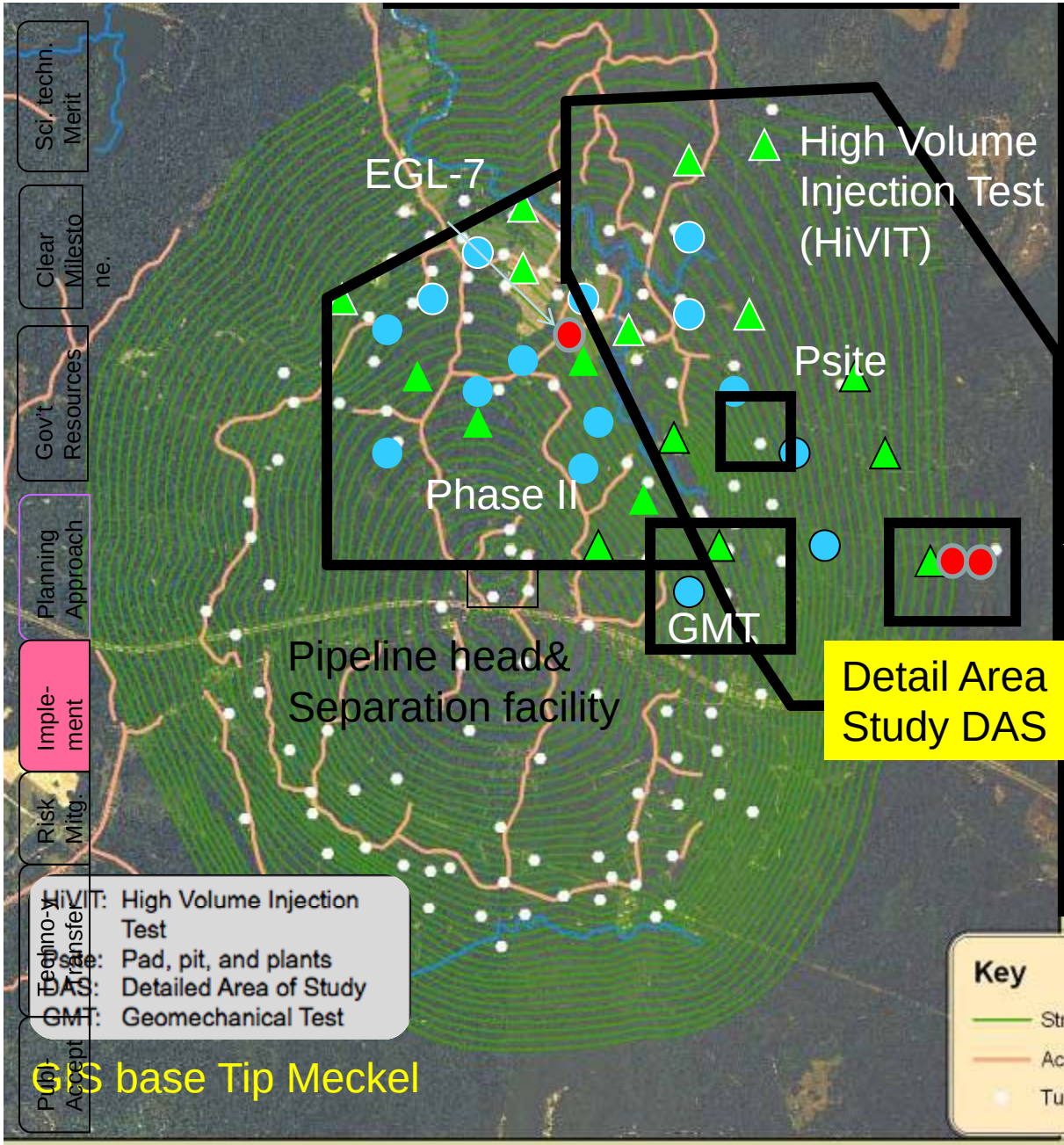
- Permanence of geologic system well understood prior to test. Assess methods for documenting well performance.
- Measure changes above the injection zone along well, above zone monitoring interval (AZMI), and at surface (P site) over long times (underway).
- Plume confined by 4-way closure. Uncertainty – amount of radial flow (down dip/out of pattern).
- Completed certification framework assessment of leakage risk. Confirmed well performance as highest uncertainty and focus of monitoring research.

(3) RCSP Program Goal

Contribute Technical Expertise and Lessons Learned, Development of Best Practices Manuals

- Participated in developing BPMs for MVA, characterization, risk and reservoir modeling
- O&E in public and technical arenas.
- Hosted site visits, responses to local and trade media, Fact Sheets, website postings of project information.

Five Study Areas



- Injector
- Producer (monitoring point)
- Observation Well

GCS base Tip Meckel

Sci./techn. Merit
Clear Milestone.
Gov't Resources
Planning Approach
Imple-ment
Risk Mitg.
Techno-xf. Transfer
Pub. Accept.

Bureau of Economic Geology

Gulf Coast Carbon Center

Early Test MVA Design

Area tested	Whole plume	Focus study
Atmosphere	Not tested	Not tested
Soil gas	Time-lapse surveys at active and P&A well pads	"P site" methodology assessment
Groundwater	Monitoring well at each injector	EGL-7 UM cored test well. Push-pull test
Shallow production	Not tested	Not tested
AZMI	Not tested	DAS pressure and EGL 7 pressure + fluids
Geo Mechanical test	Not tested	GMT-failed
Injection zone	Geochemistry breakthrough	DAS multi-well multi tool array