

Public Briefing

February 6, 2013

Napoleonville, LA



Shaw Changing to CB&I

- The Shaw Group, Inc. is being acquired by CB&I
 - Shaw E&I, Inc. is a wholly owned subsidiary of The Shaw Group, Inc., therefore, Shaw E&I will be a wholly-owned subsidiary of CB&I
- Transaction expected to close mid Feb 2013
- *Transaction will not inadvertently impact the Shaw team or services being provided*



CB&I (NYSE: CBI) engineers and constructs some of the world's largest energy infrastructure projects. With premier process technology, proven EPC expertise, and unrivaled storage tank experience, CB&I executes projects from concept to completion.

ORW Transition to TBC

- Directive 4 of Amendment 4 requires TBC to take over operation and maintenance of the Observation Relief Wells (ORWs) 1 through 4
- ORWs 1, 2 and 4 operations and data collection to be turned over to TBC with Shaw oversight
- ORW-3 transition to TBC pending property access

Current Progress

- Reduce methane in MRAA
 - Indoor and sub-slab monitoring
 - Shallow Geoprobe wells
 - Venting
- Active 3D seismic potentially images hydrocarbons vs water
 - Stability of the disturbed rock (collapse) zone and void spaces
 - Passive Seismic data showing fluid flow and “burps”
 - Active 3D Seismic 2007 and 2013 survey
 - Geomechanical modeling
- Stability of western side of NSD and adjacent caverns
 - Passive Seismic data showing microseismic earthquakes
 - Vertical Seismic Profiling (VSP)
 - Geomechanical modeling

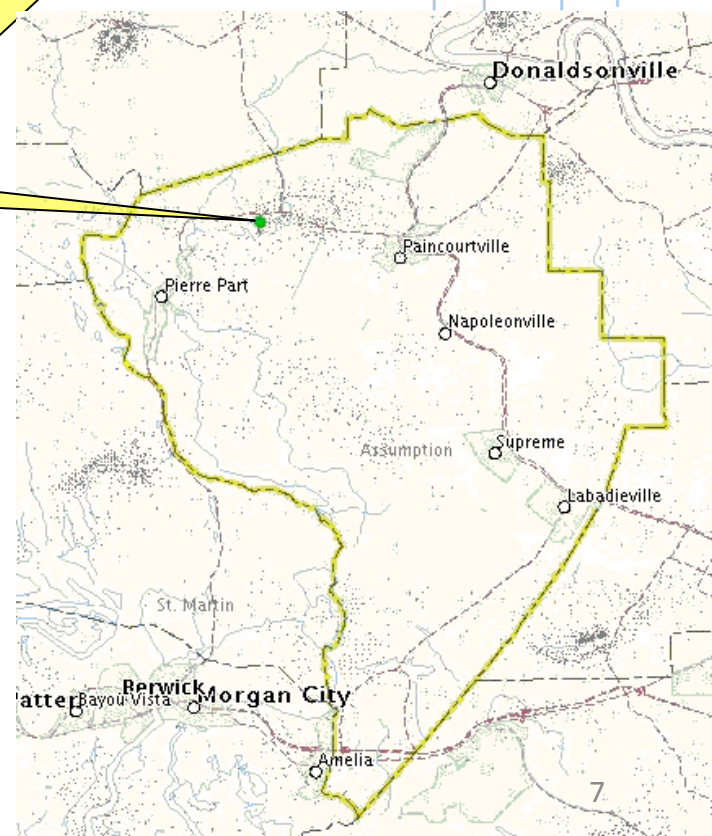
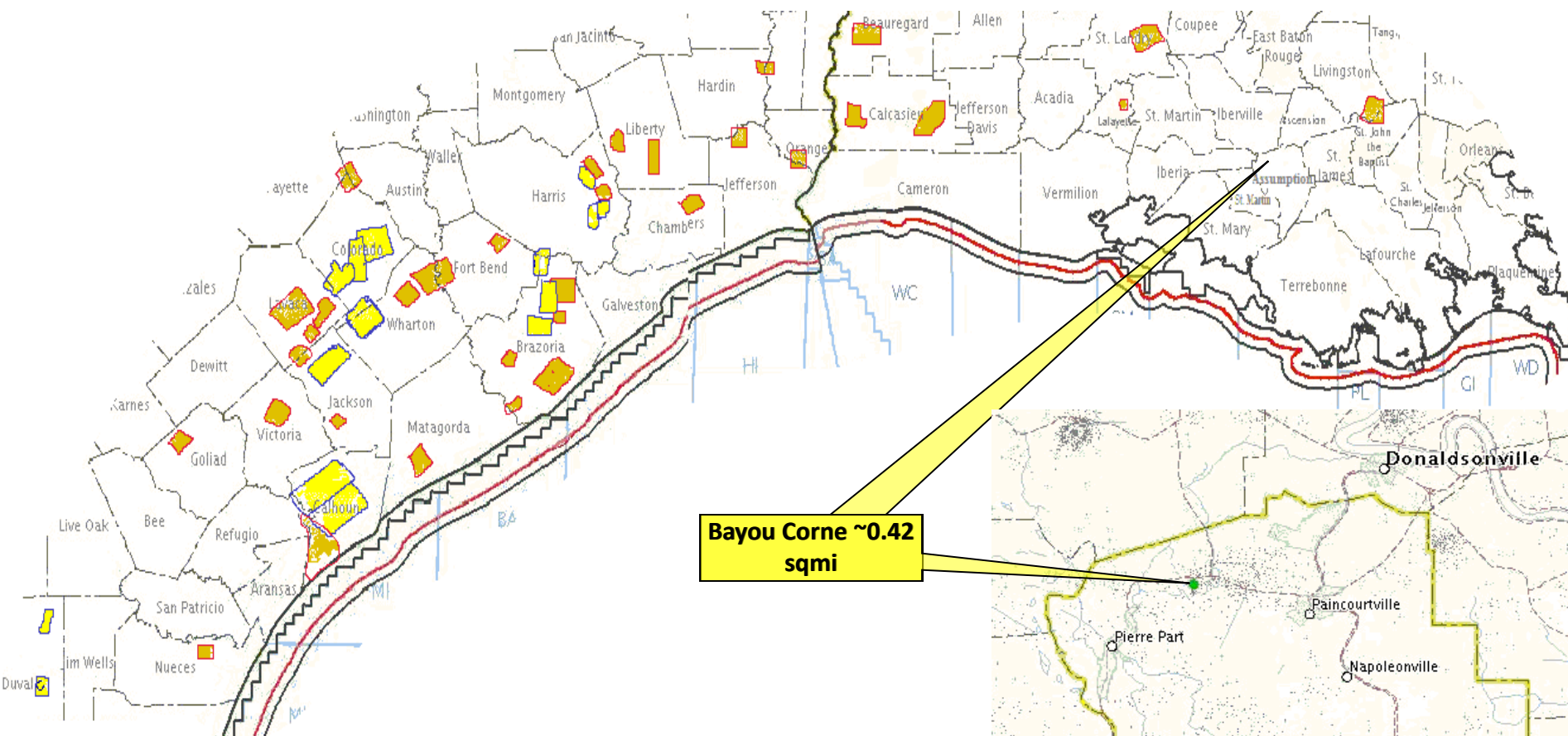
Shaw Team Additions

- Don Marlin – Petroleum Geophysicist
 - Independent evaluation of 3-D seismic
 - Quantifying/mapping/characterizing oil and gas reservoirs contributing to sinkhole

Donald J. Marlin, CPG

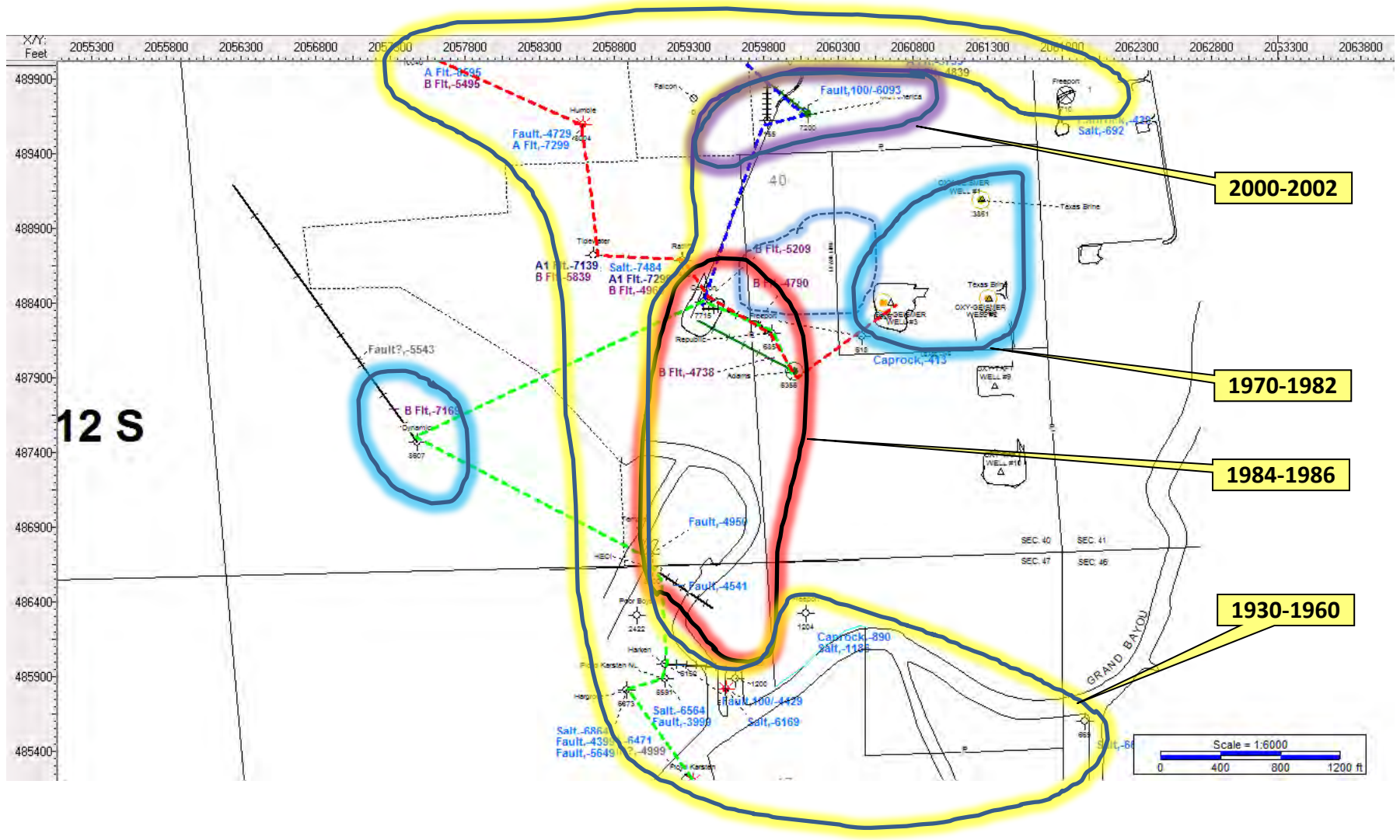
- Certified Professional Geologist, Certified Petroleum Geophysicist, Board Certified Geoscientist. Consulting to the State of Louisiana to make an independent review of the 3D seismic data.
- Bachelor's and Master's degrees in Geology from LSU Baton Rouge.
- 30 years experience in Gulf Coast. Authored papers on SE Louisiana subsurface /surface geology, 3D Seismic applications for environmental & groundwater reconnaissance, and 3D Seismic project management.
- Consulted for numerous exploration companies, state and university agencies, landowners, and individuals.
- Involved in the design, acquisition, processing, interpretation, and development drilling for numerous 2D & 3D seismic programs.
- Worked resulted in successful drilling of wells in the US and abroad.

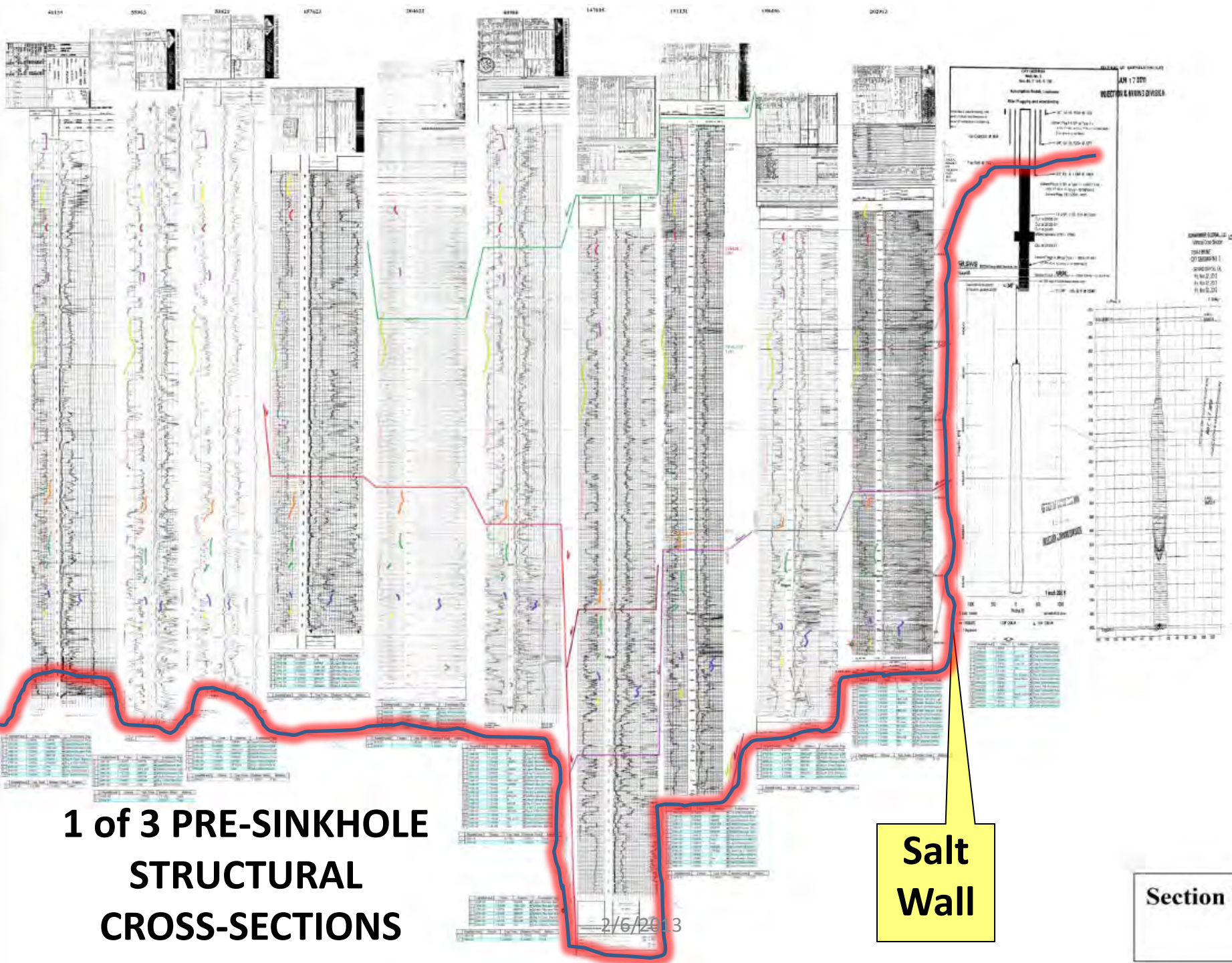
Marlin's major 3D activity 1992 – present versus Bayou Corne



Note: Marlin's 2D / Subsurface activity in 1980's not shown

January 2013 : Study historical well data and tie to 2007 3D seismic subset to create a pre-sinkhole subsurface model:





**1 of 3 PRE-SINKHOLE
STRUCTURAL
CROSS-SECTIONS**

**Salt
Wall**

Section B

2/6/2013

SECTION B
SECTION & BEAMS DIVISION
DATE: 1/7/2010

REVISIONS

NO.	DESCRIPTION	DATE
1	ISSUED FOR PERMITS	1/7/2010
2	ISSUED FOR CONSTRUCTION	1/7/2010
3	ISSUED FOR CONSTRUCTION	1/7/2010
4	ISSUED FOR CONSTRUCTION	1/7/2010
5	ISSUED FOR CONSTRUCTION	1/7/2010

SCALE: 1/8" = 1'-0"

100 50 0 50 100

FOOT

SECTION B

SECTION B

MMLGM
3192

MMPM

REPUBLIC #1

HECI #1

MMLGM

MMPM

MMOM

OXY #3 Cavern

Detail
Of
Section

5033

EL@5210

EL@5210

EL@5210

2/6/2015

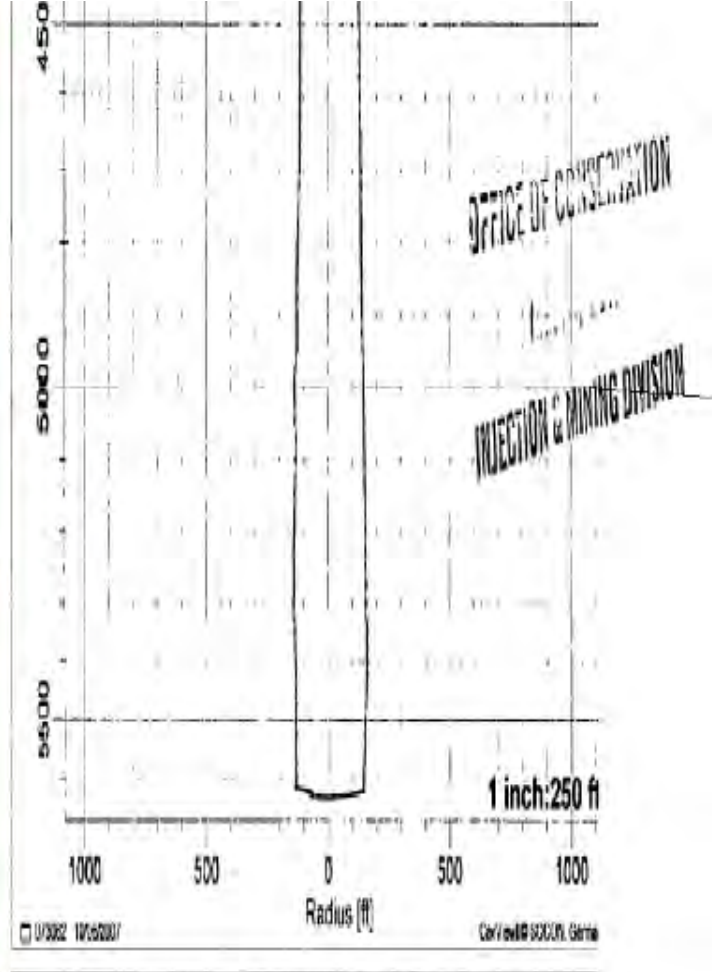
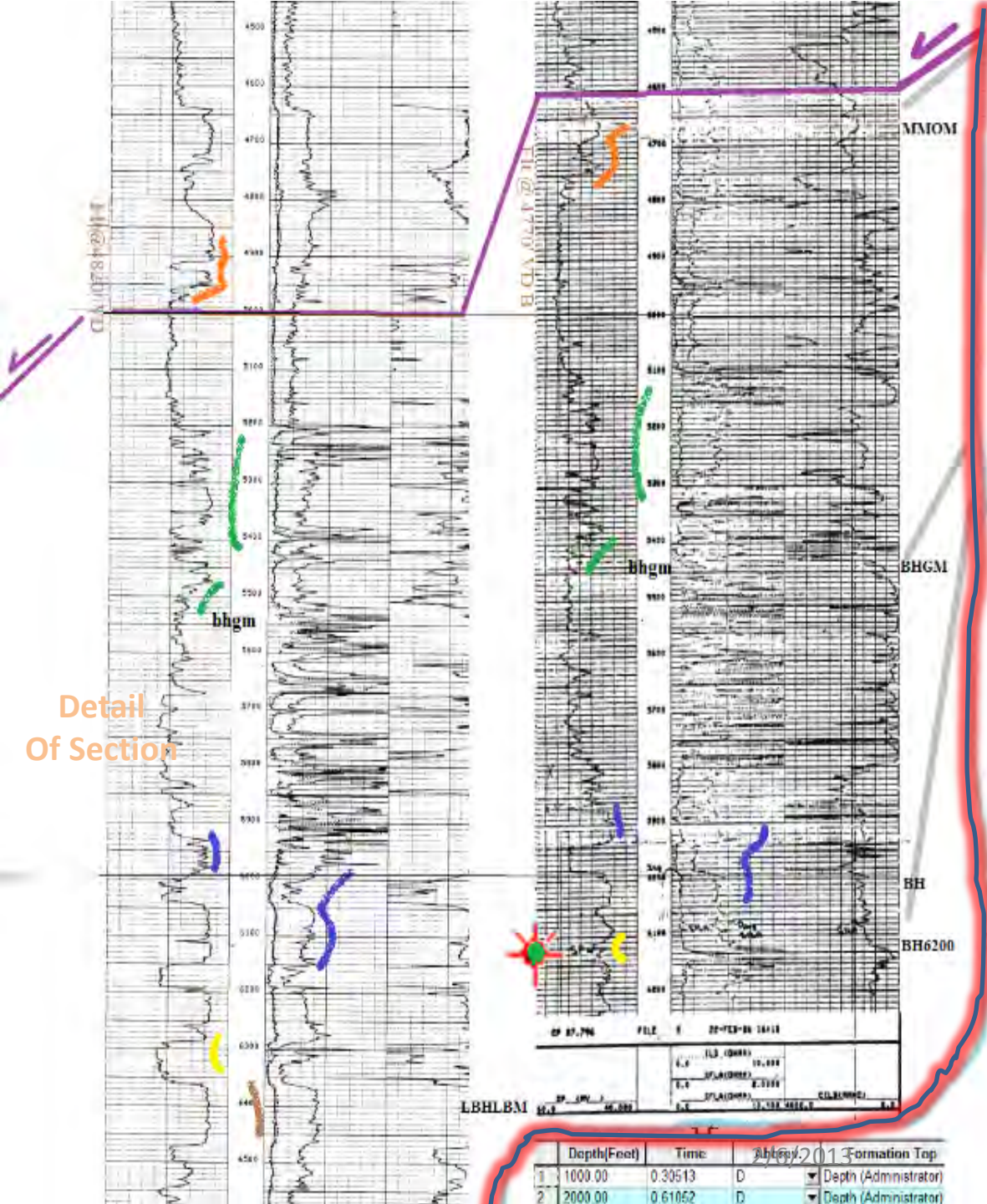
Depth [ft]

3000
3500
4000
4500
5000

Salt
Wall

OFFICE OF CONSERVATION
INJECTION & MINING DIVISION

Detail
Of Section

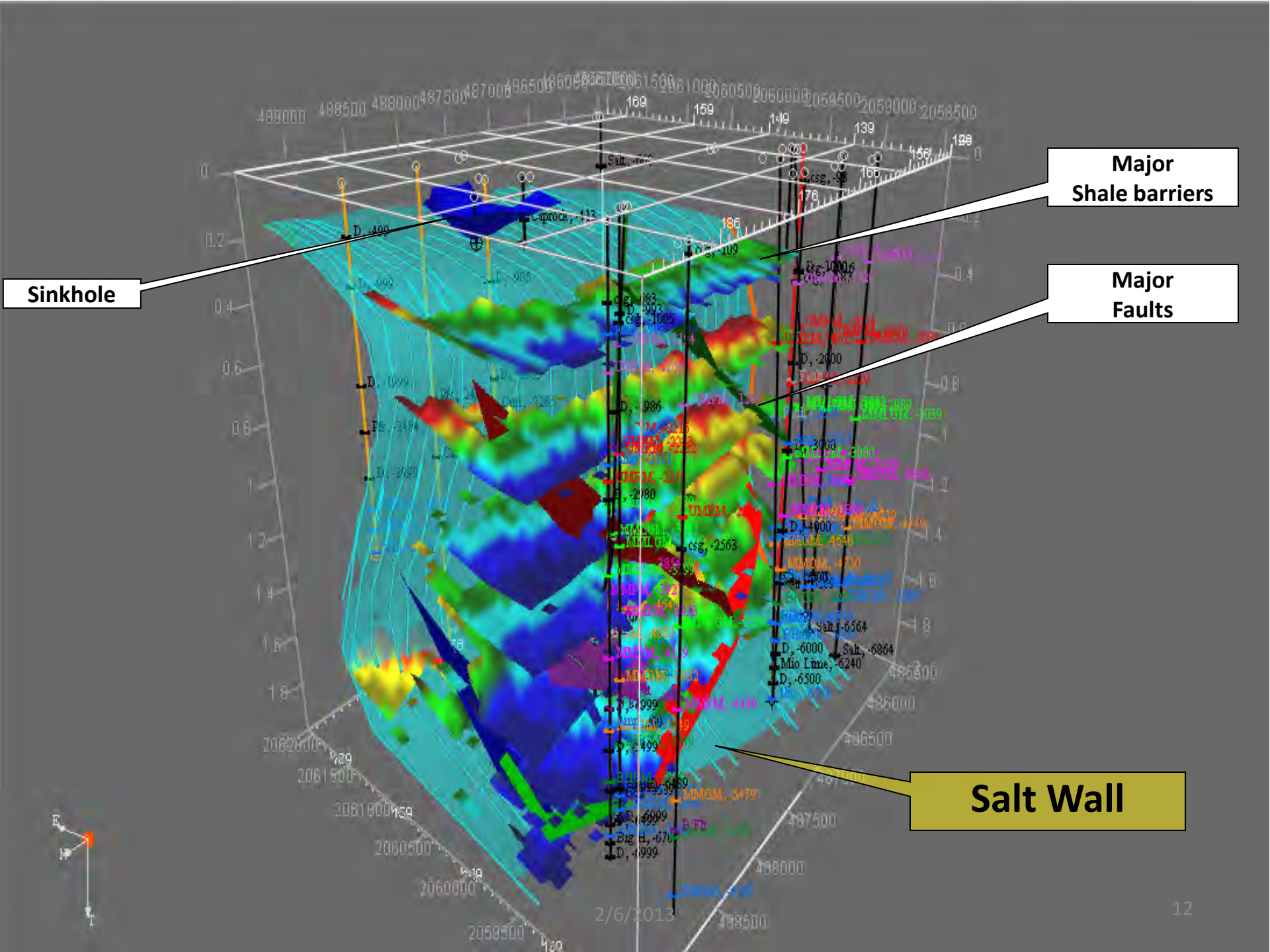


U:\3082 10/6/2007 133W° 2846.0 N 113M° 3384.0 N
 Tilt position

Depth (Feet)	Time	Abbrev.	Formation Top
1000.00	0.30280	D	Depth (Administrator)
2000.00	0.61016	D	Depth (Administrator)
2060.00	0.61631	Csg Cut	Csg Cut (Administrator)
2300.00	0.70246	Cmt	Cement (Administrator)
2440.00	0.754	Csg Cut	Csg Cut (Administrator)
2546.00	0.77315	csg	csg (Administrator)
3000.00	0.91795	D	Depth (Administrator)
3415.00	1.076	Top Cavern	Top of Cavern (Administrator)
3815.00	1.16806	Base Brine	Base Brine (Administrator)
4000.00	1.22235	D	Depth (Administrator)
4012.00	1.22600	Cavern Fill	Cavern Fill (Administrator)

Salt
Wall

Depth (Feet)	Time	Abbrev.	Formation Top
1000.00	0.30513	D	Depth (Administrator)
2000.00	0.61052	D	Depth (Administrator)



Sinkhole

Major Shale barriers

Major Faults

Salt Wall

Path Forward

- Obtain new April 2013 data for independent study.
- Integrate and revise January 2013 study data.
- Assess differences in the volumes to look for changes.
- Identify O&G reservoirs that could source the sinkhole.
- Quantify O&G reservoirs.
- Estimate time to depletion of reservoirs.
- ASSIST WITH ROADMAP TO RECOVERY FOR AREA



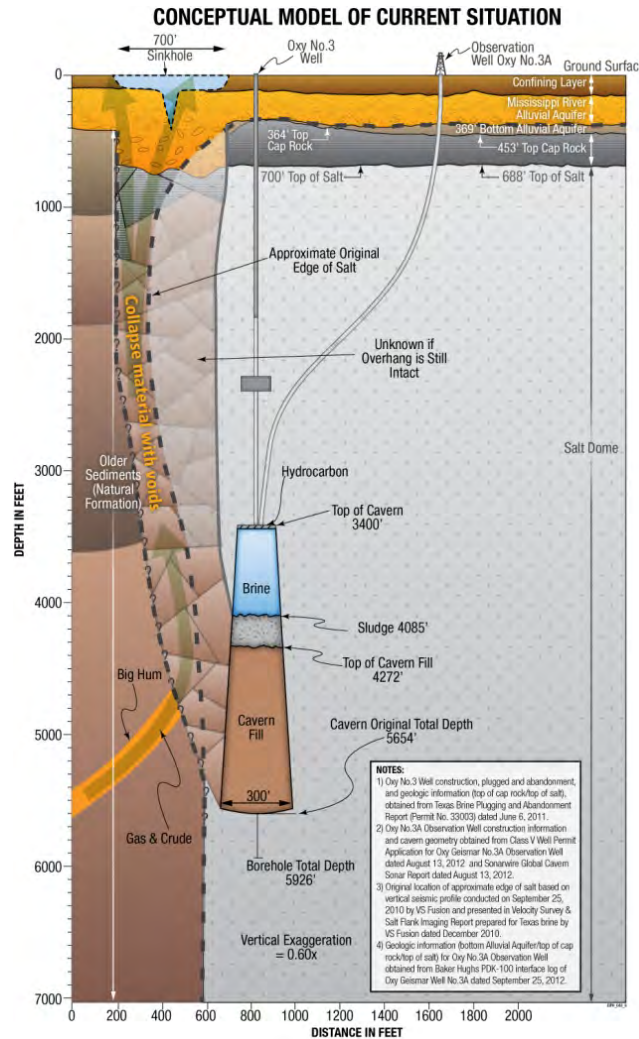
ITASCA™

Dr. Will Pettitt

ROCK MECHANICS MODELING AND PASSIVE SEISMIC MONITORING

Current Situation

- What do we know?
 - Sinkhole size and shape.
 - Amount of debris filling the cavern.
 - Size and shape of the cavern.
 - Gas behavior in the near surface.
 - Some information on site geometry and rock properties.



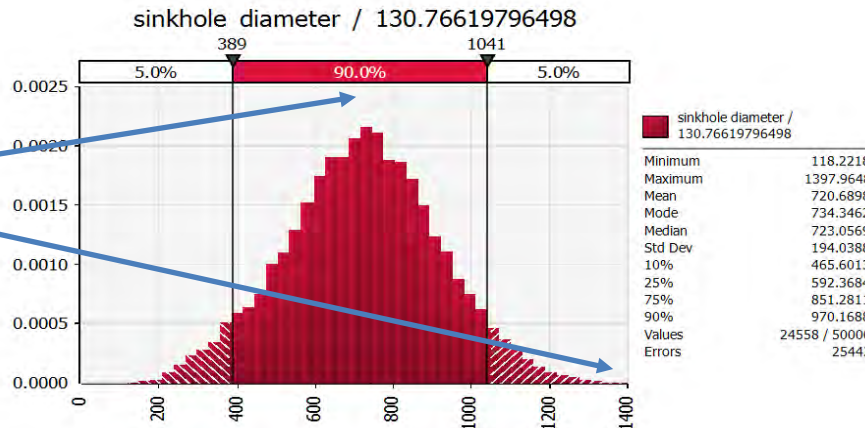
- What do we NOT know?
 - Size and shape of the Disturbed Rock Zone (DRZ).
 - Behavior of the DRZ at depth.
 - Good geometry of the salt dome wall.
 - Effect of DRZ on western edge of the salt dome.
 - Rock properties through the sedimentary layers.

Statistical Analysis for Final Sinkhole Size

Sinkhole Diameter

Most Likely = 734 ft

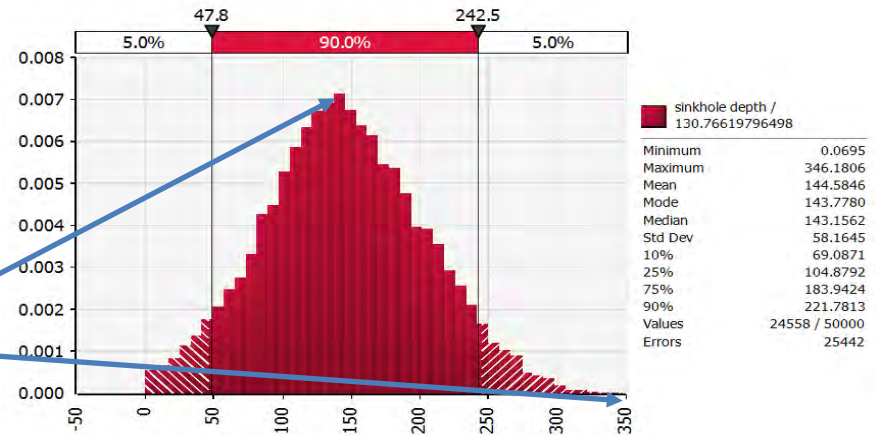
Worst Case = 1398 ft



Sinkhole Depth

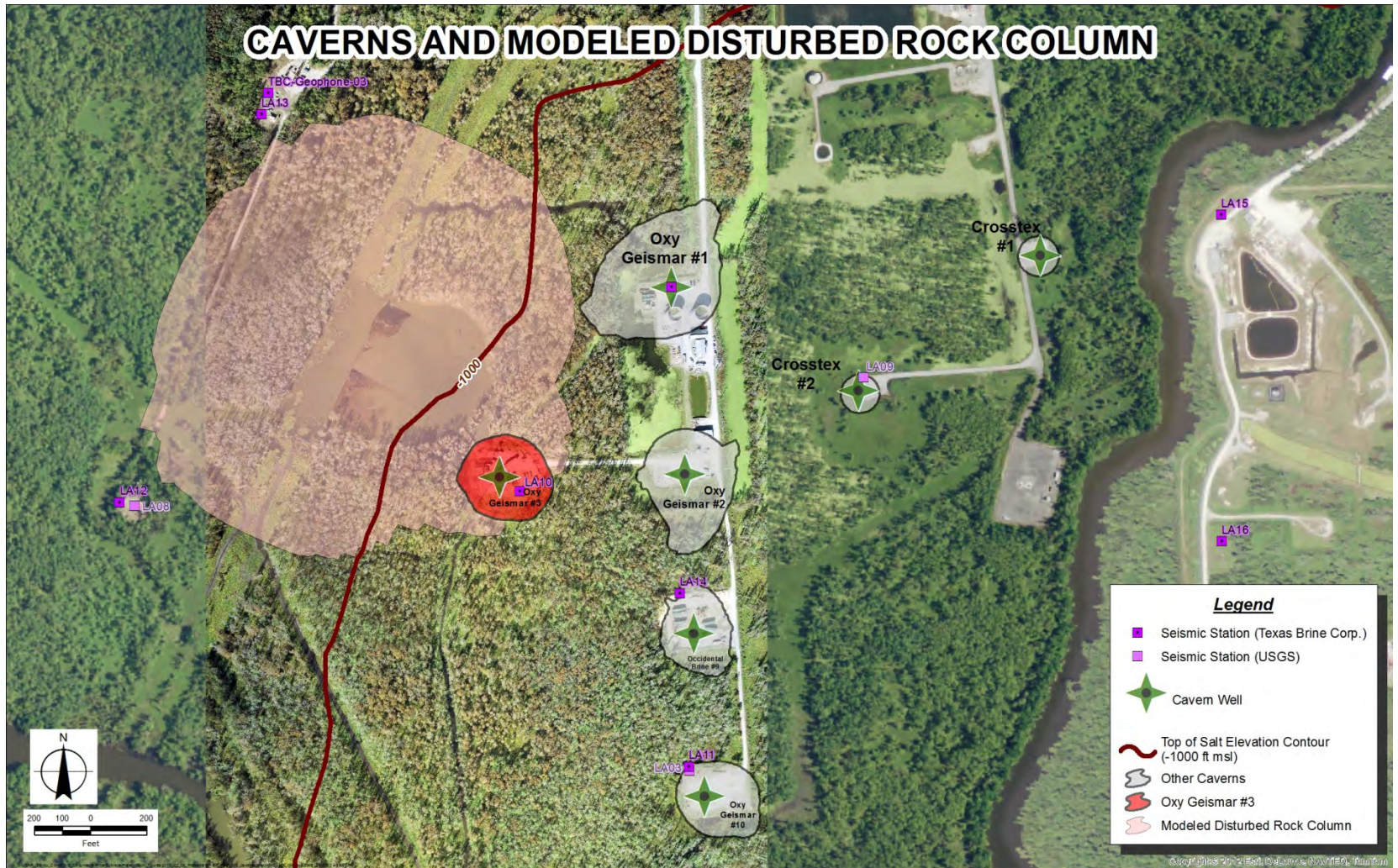
Most Likely = 144 ft

Worst Case = 346 ft



Sophisticated computer modeling is examining all this in greater detail....

Disturbed Rock Column



Passive Seismic – Map

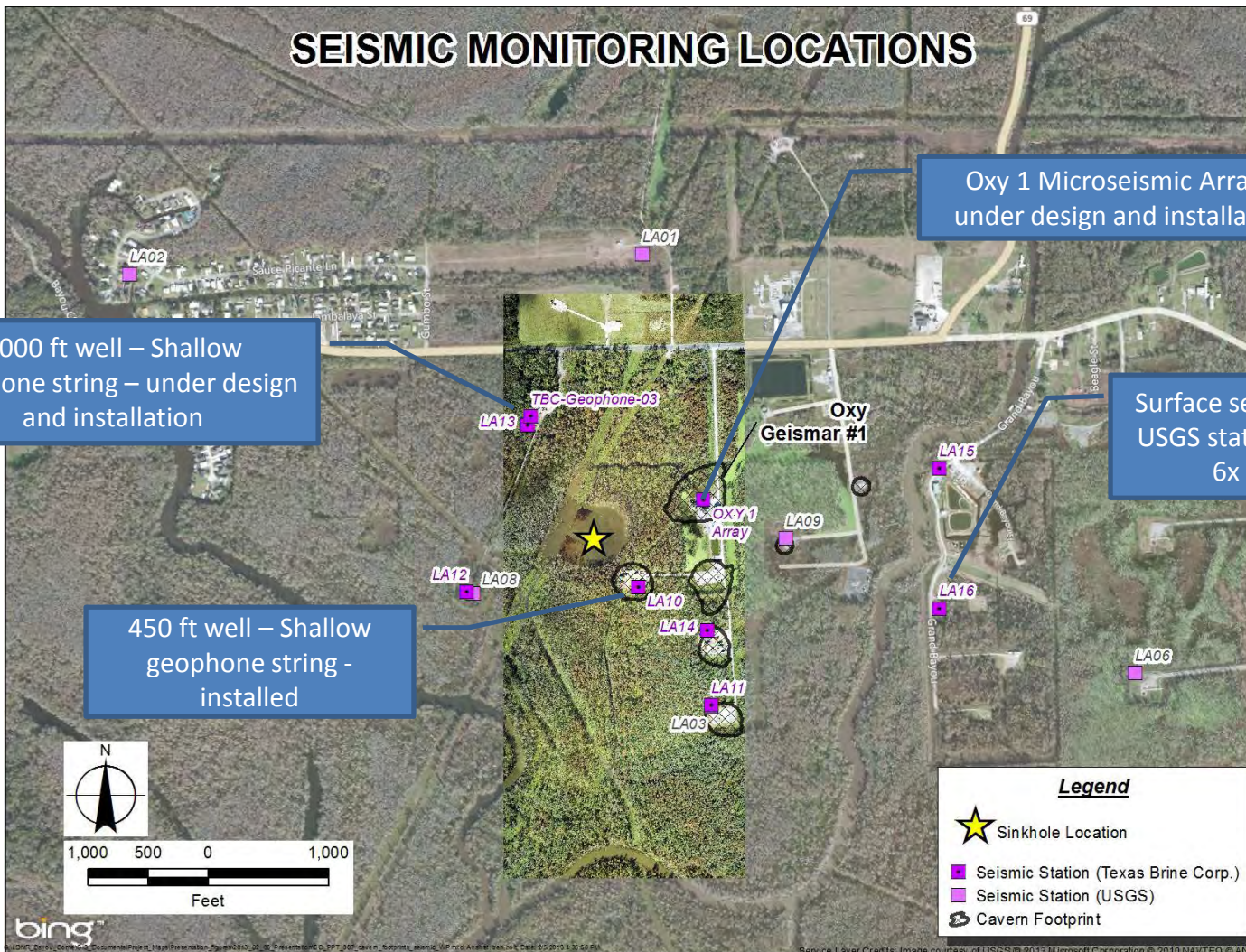
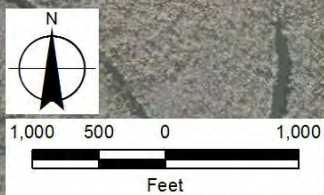
SEISMIC MONITORING LOCATIONS

Oxy 1 Microseismic Array – under design and installation

1000 ft well – Shallow geophone string – under design and installation

Surface seismic stations – 6x USGS stations replaced with 6x TBC stations

450 ft well – Shallow geophone string – installed



New Seismic Stations

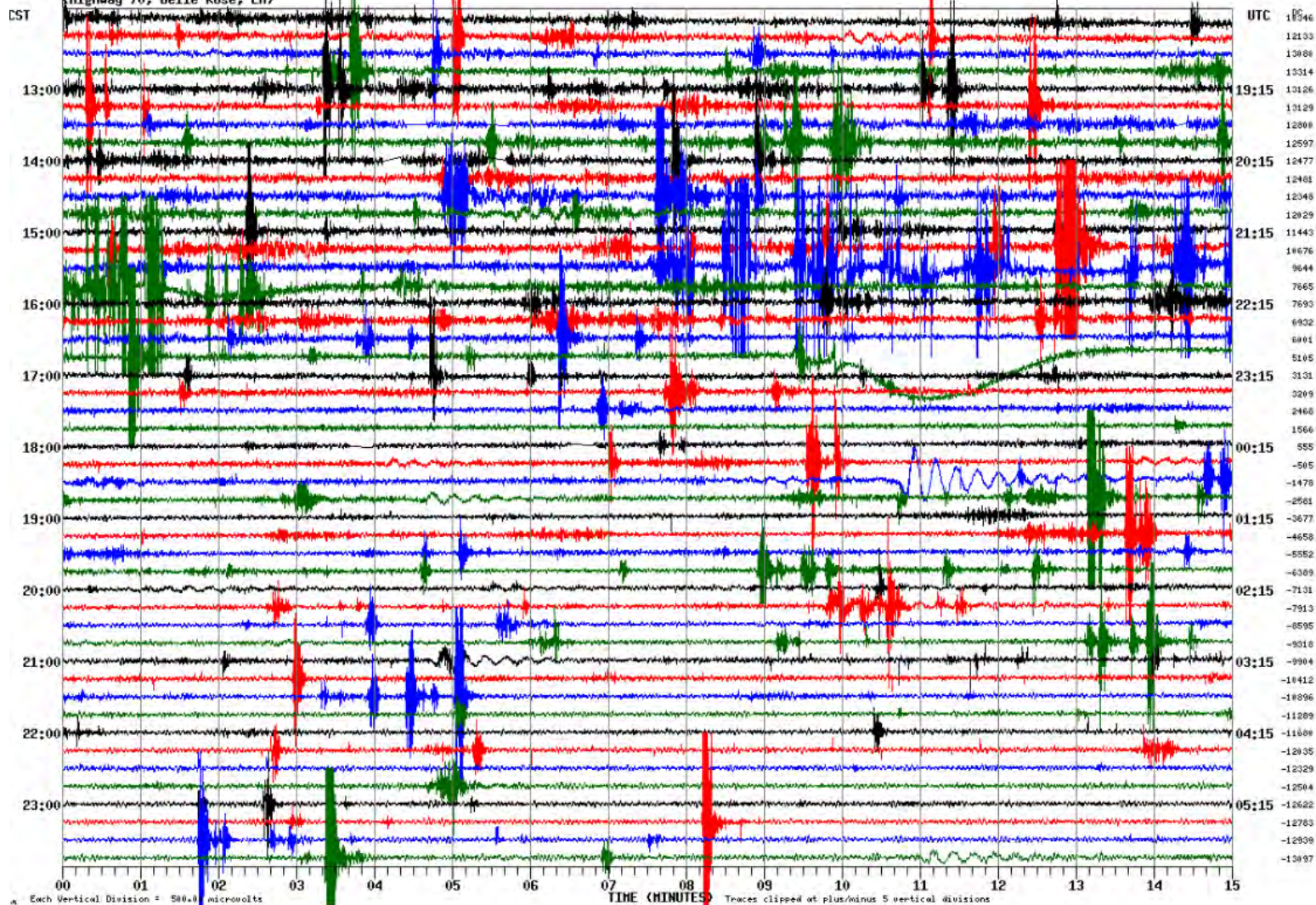


Photograph
courtesy of Dario
Baturan,
Nanometrics Inc.

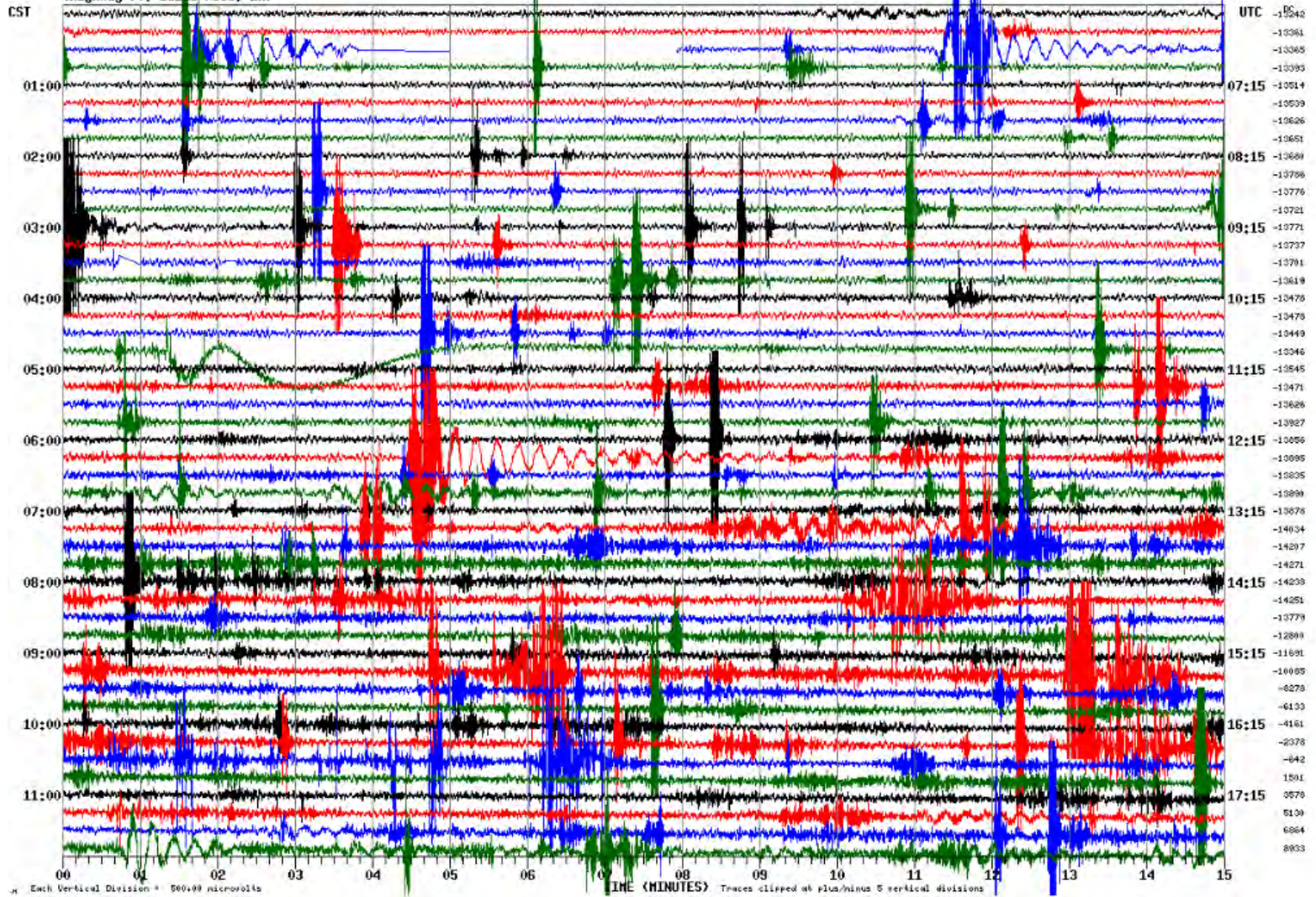
Seismic Activity at Bayou Corne

- Active vs Passive – active seismic uses a “man-made” source (e.g. 3D seismic survey, VSP) whereas passive seismic listens to “natural” sounds from the sub surface.
- MEQs – Micro-earthquakes are associated with small scale rock movements, usually on fractures and joints.
- VLPs – Very Long Period events are associated with gas and/or fluid movements through voids and fissures.
- January 19th sink hole event provides an example. Current helicorders at [http://folkworm.ceri.memphis.edu/heli temp/](http://folkworm.ceri.memphis.edu/heli_temp/)

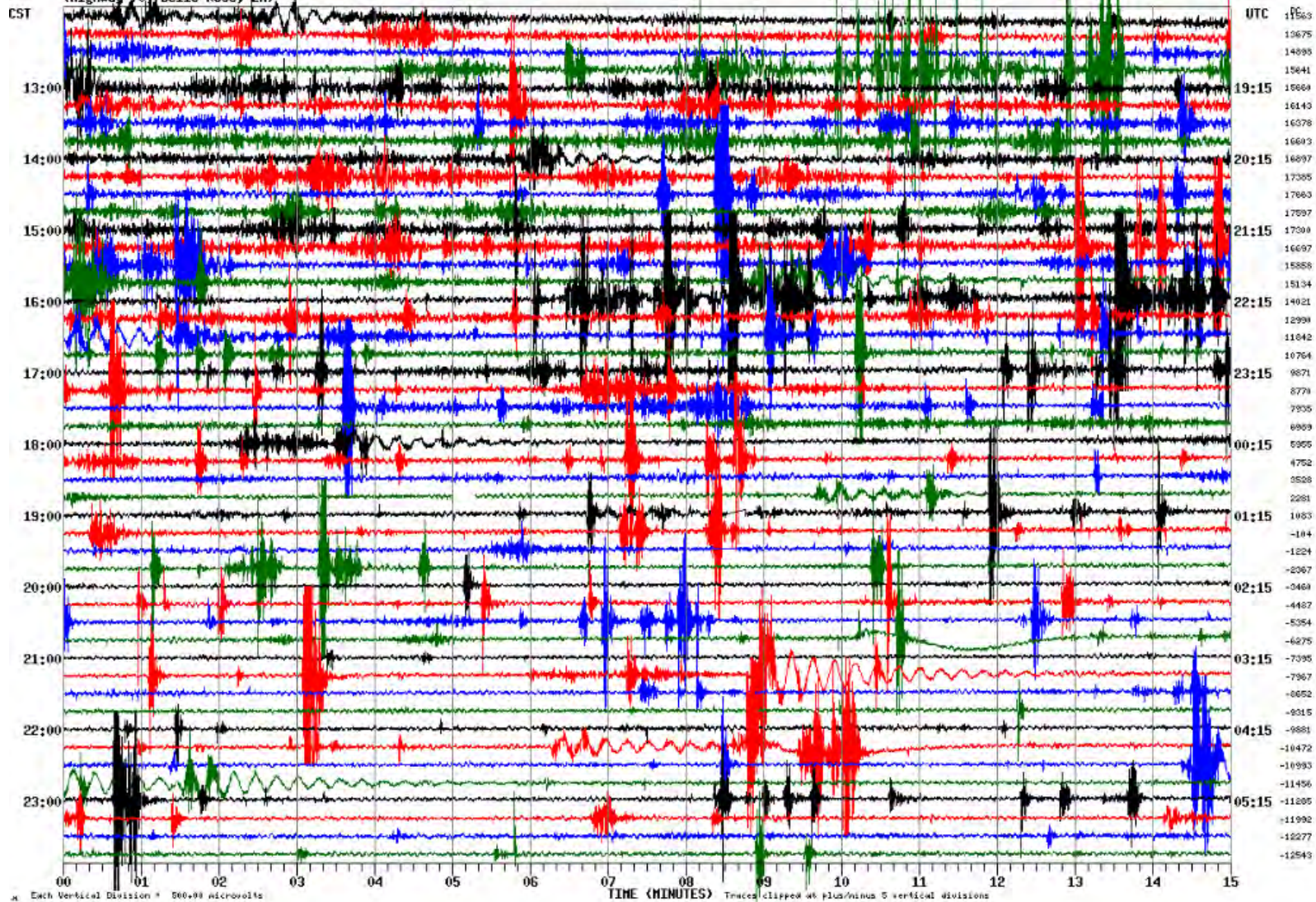
Jan17,2013
LA08 BHZ GS 00
(Highway 70, Belle Rose, LA)



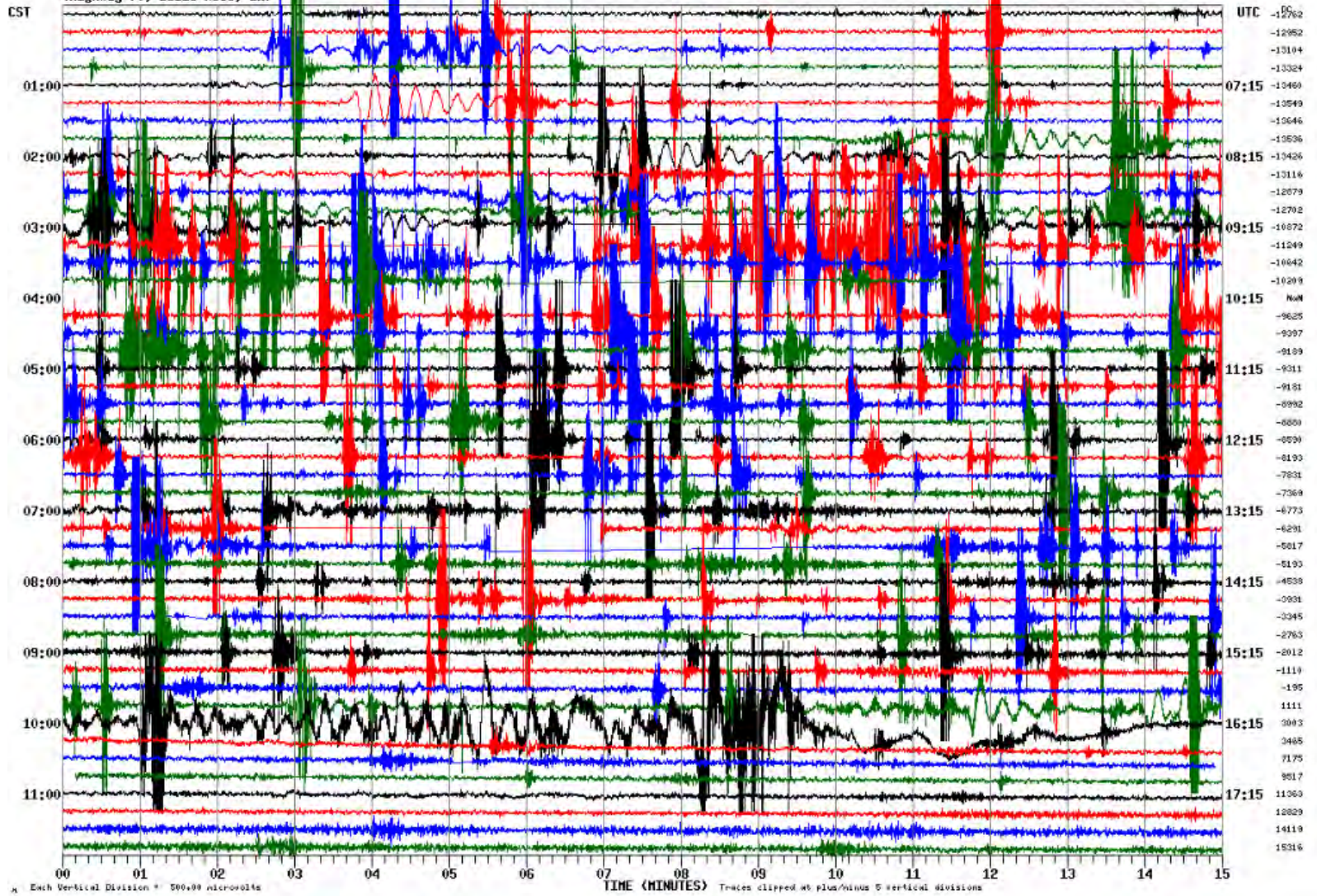
Jan18, 2013
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(Highway 70, Belle Rose, LA)



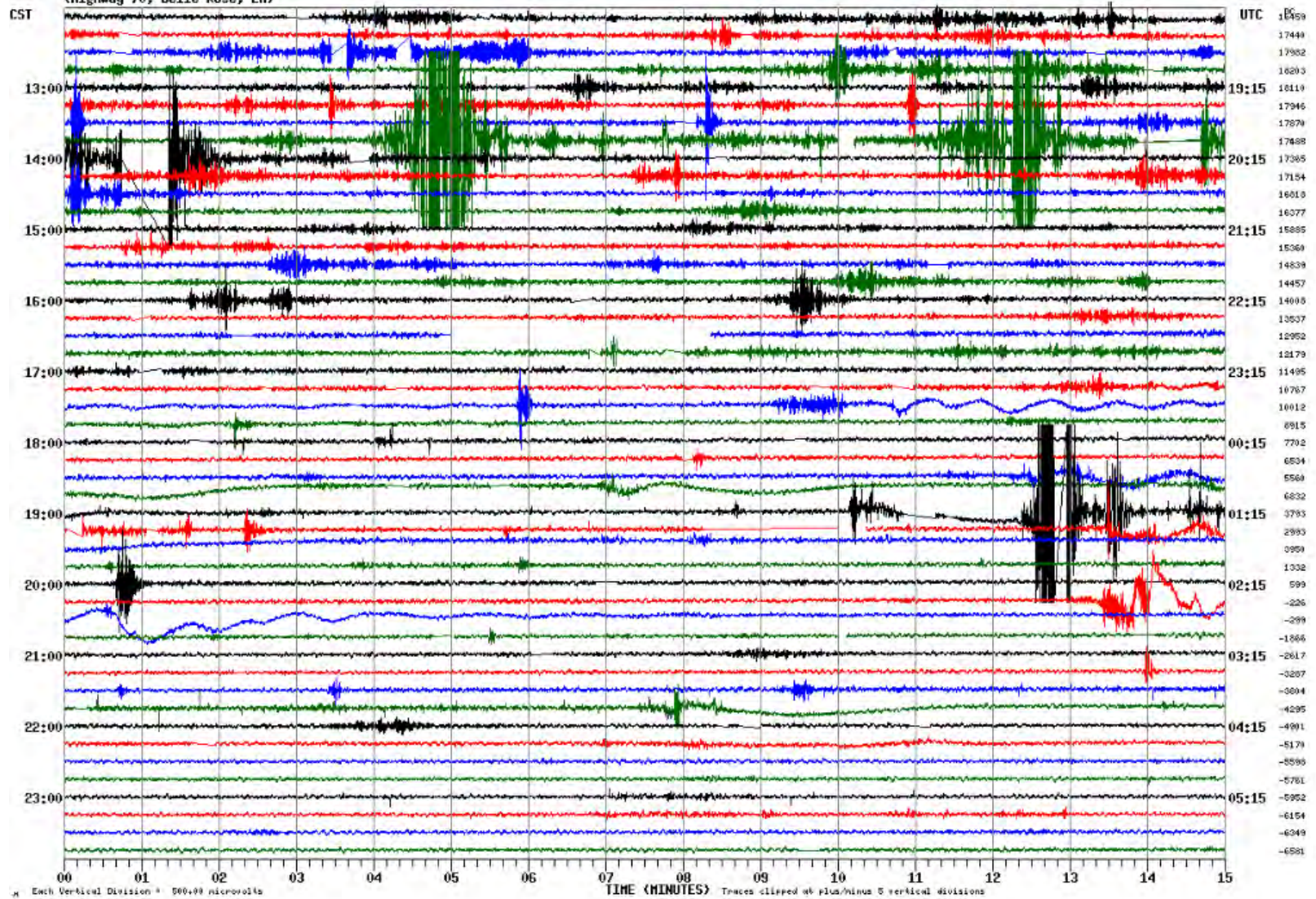
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(Highway 70, Belle Rose, LA)



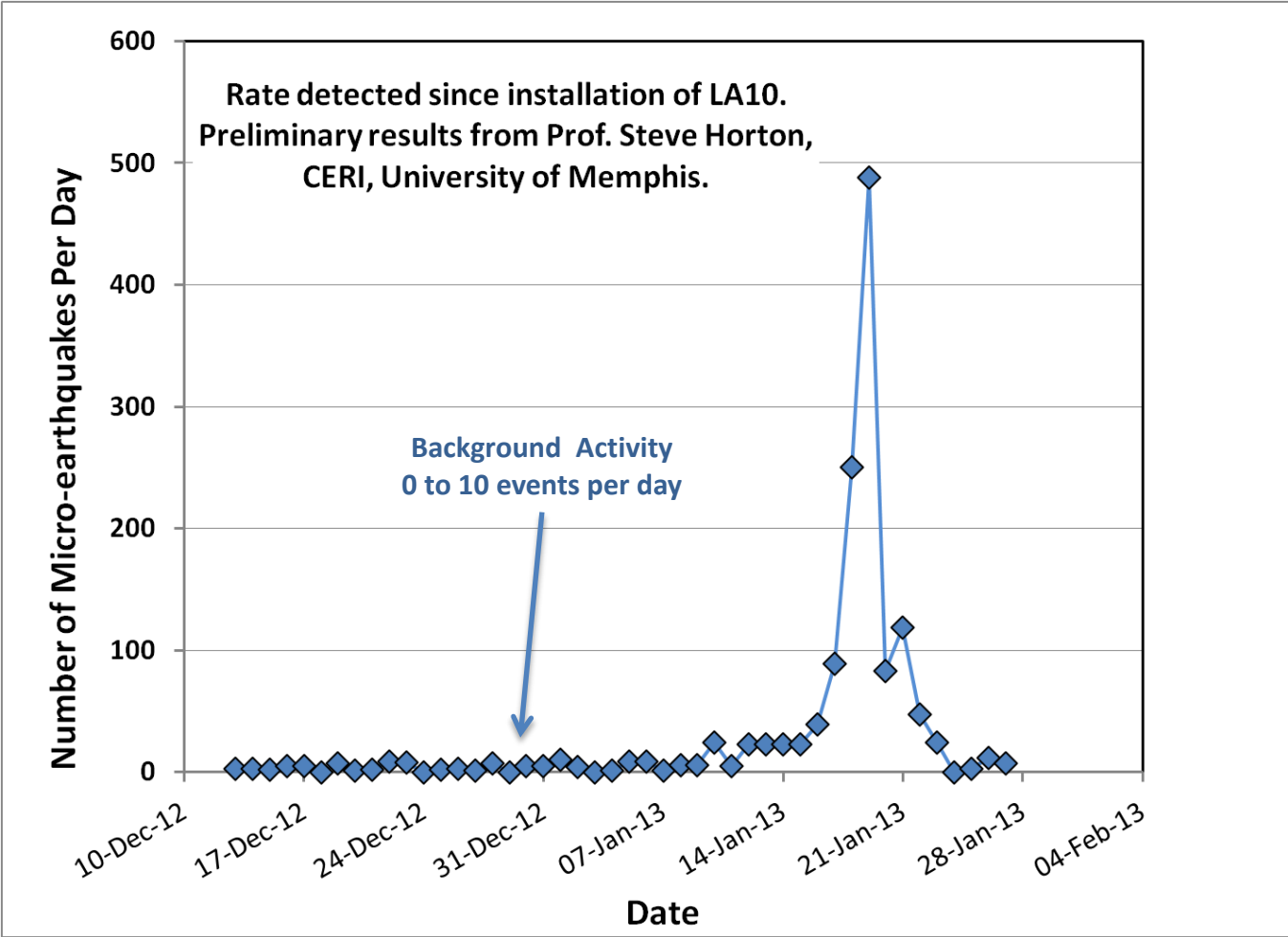
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LA08 BH2 GS 00
(Highway 70, Belle Rose, LA)



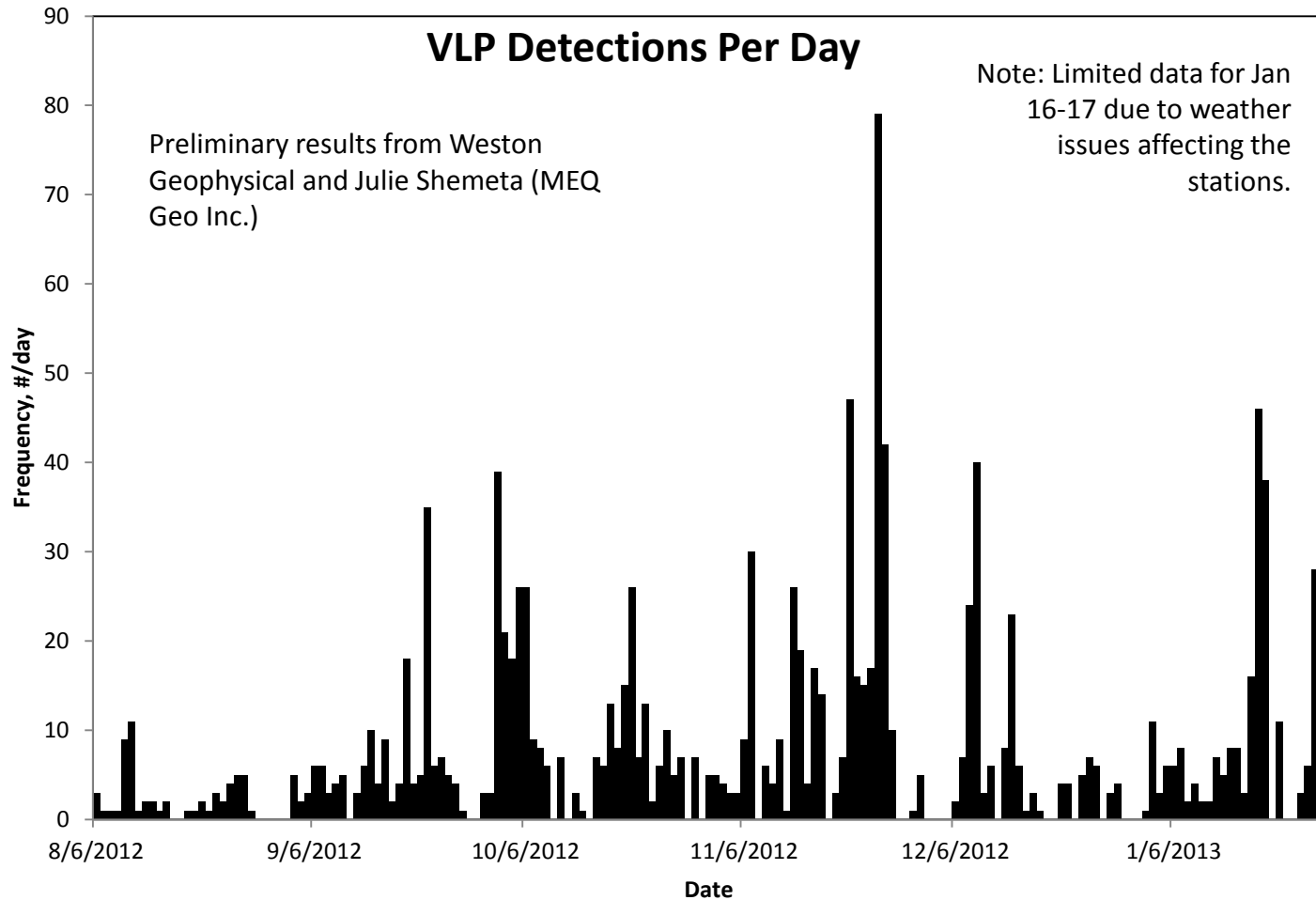
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LA00 BHZ GS 00
(Highway 70, Belle Rose, LA)



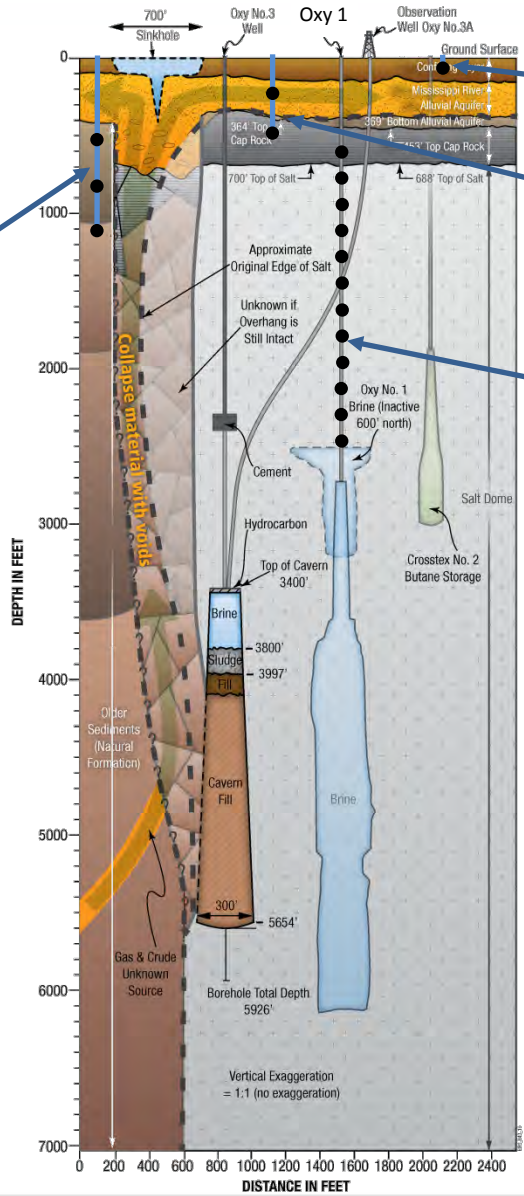
Micro-earthquake Event Rates



VLP Event Rates



CONCEPTUAL MODEL OF CURRENT SITUATION



1000 ft Shallow Array
(To Be Determined)

Buried Surface Array

450 ft Shallow Array

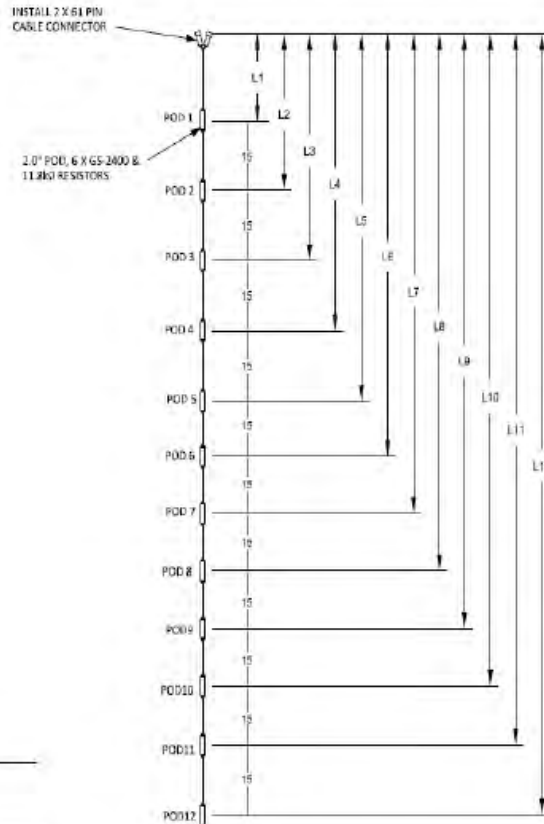
Oxy 1 Microseismic Array
Temporary and Permanent
Deployment
Positioned in salt between
approx. 800 – 2400 ft depth
(To Be Determined)



Oxy 1 Microseismic Objectives

- Objectives of microseismic (MS) monitoring (passive seismic) in well Oxy 1:
 - More accurately determine the positions of the observed micro-earthquakes and their relation to the rock disturbed zone;
 - Observe if micro-earthquakes are occurring at depths greater than 2500 ft depth, and, if so, image their relation to the Oxy 3 cavern.

Temporary Microseismic Array



CLIENT NAME: _____

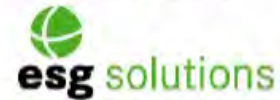
CLIENT SIGNOFF: _____

M	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	L11	L12
S1 (m)	595	610	625	640	655	670	685	700	715	730	745	760

Tool diagram



Diagram and photo from



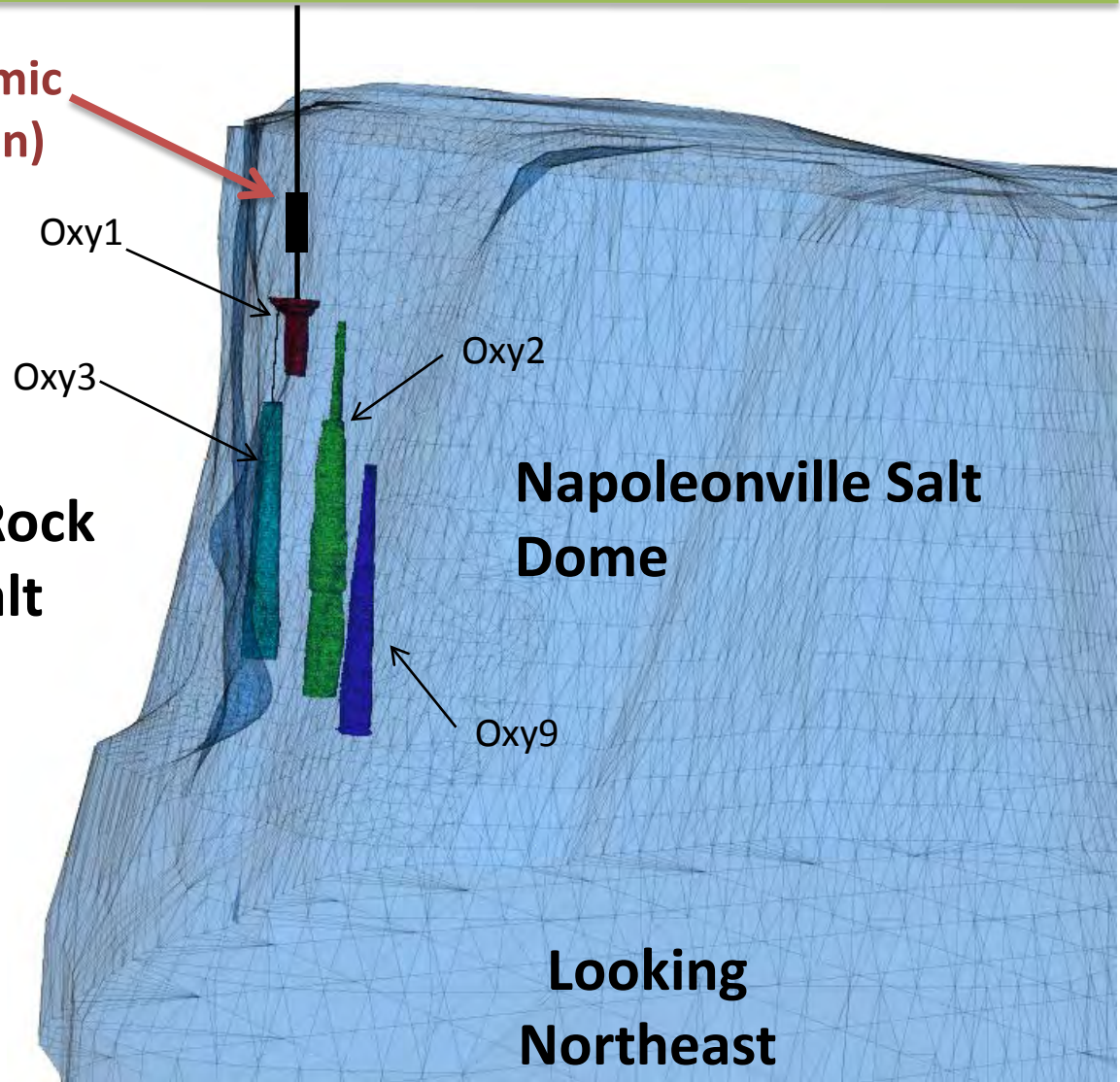
Ground Surface

Temporary microseismic array (approx. position)

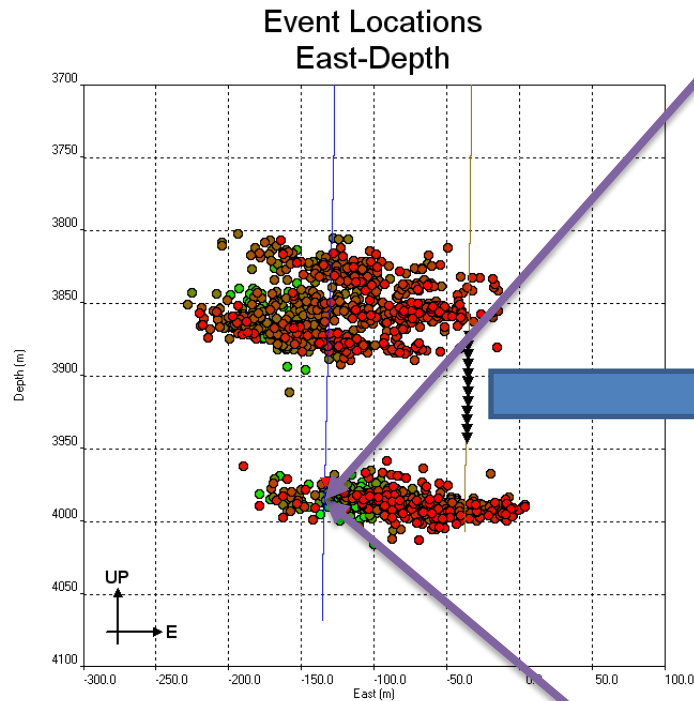
Sedimentary Rock Outside the Salt Dome

Napoleonville Salt Dome

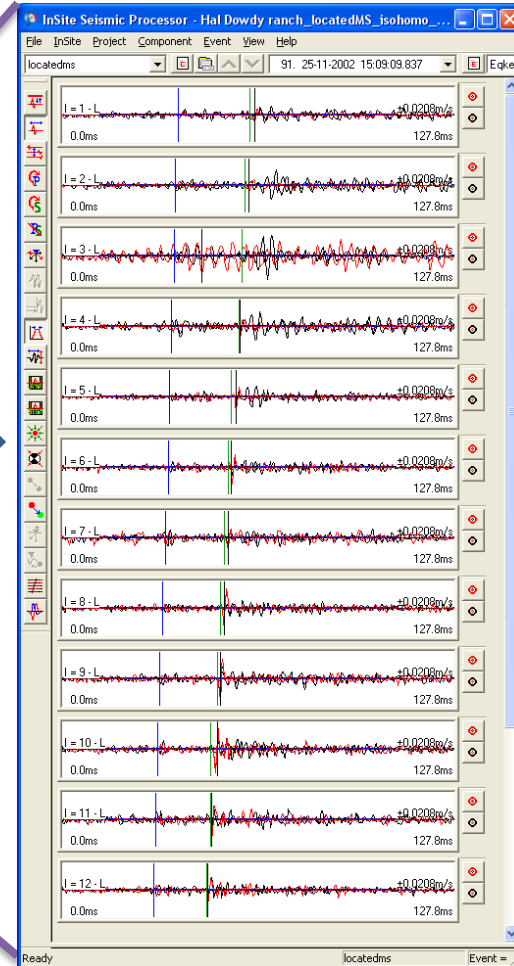
Looking Northeast



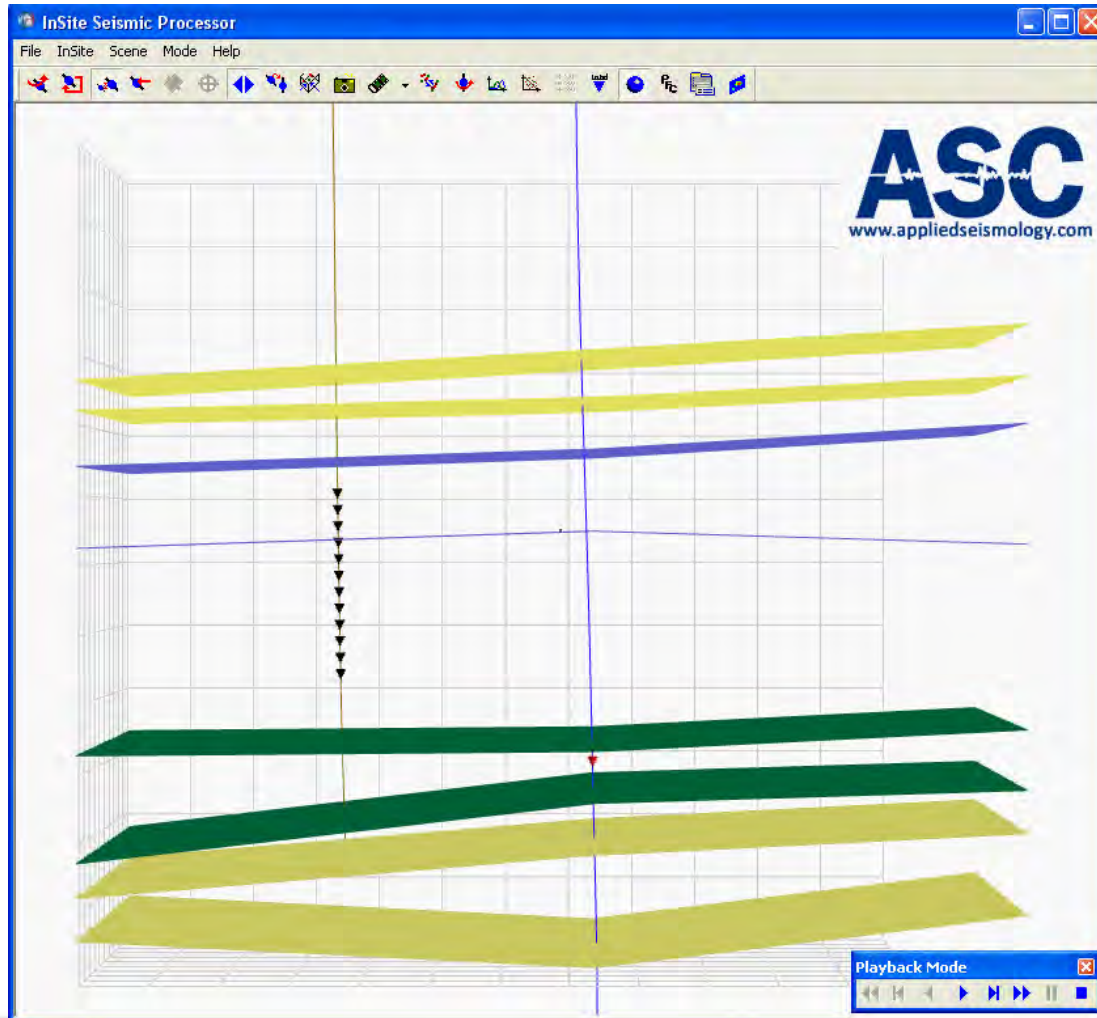
Example Location of Microseismicity



Example from an oil
field monitoring job in
east Texas

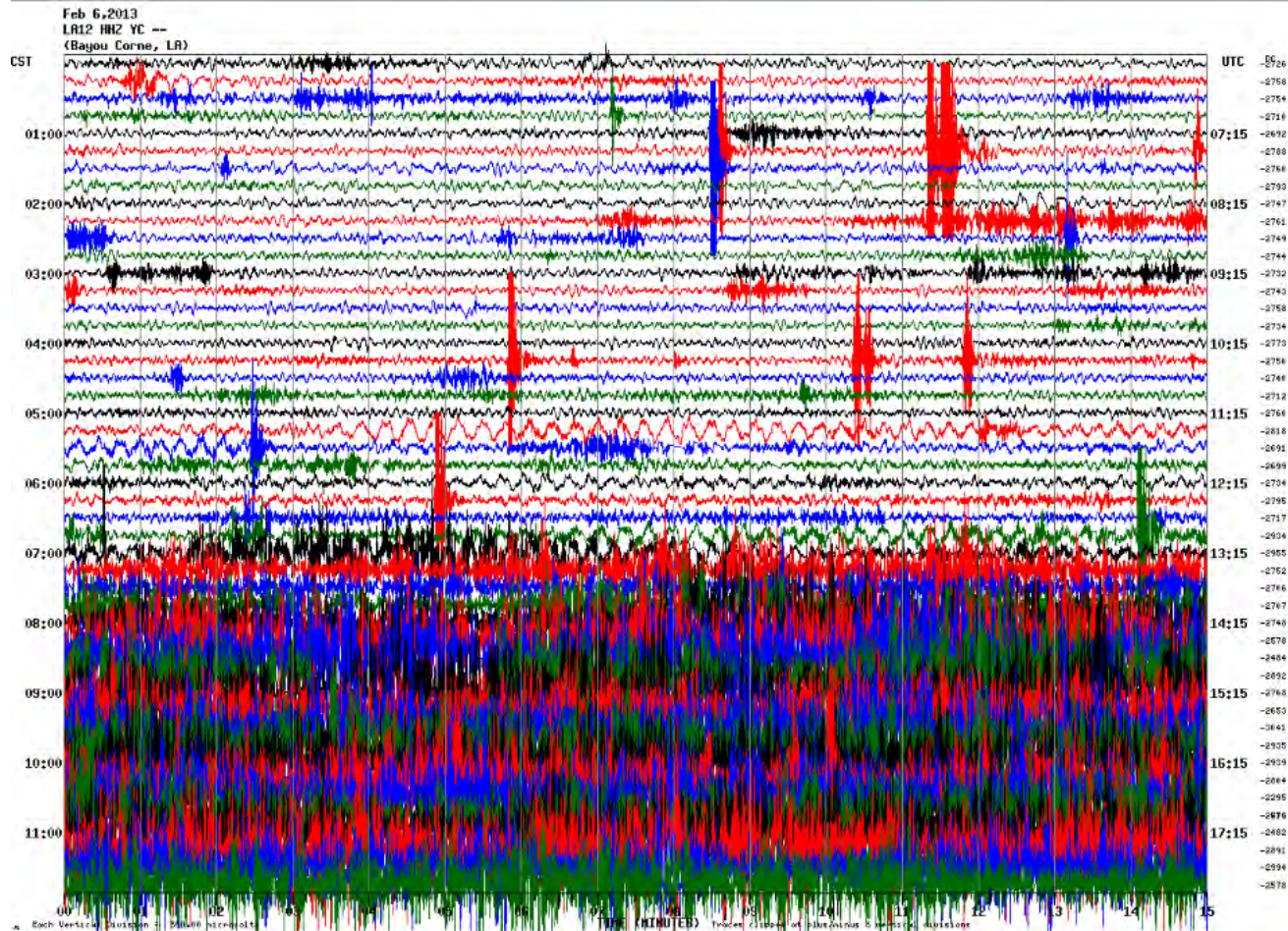


Example Microseismic Imaging



Example from an oil field monitoring job in east Texas

Helicorder Showing Truck Traffic



Technical Update

- Amendment 5 revised directives
- Gas venting
- Oxy 3 cavern data and cavern stability

Revised Amendment 5 Directives

- Original directives called for two 6000 foot wells
- Revised directive
 - 3D seismic survey by end of April to image collapse zone and ID gas horizons
 - Installation of seismic array in Oxy 1 cavern well to listen in salt
 - Drilling and sampling 1000 foot core well west of sinkhole for rock mechanics testing for model inputs

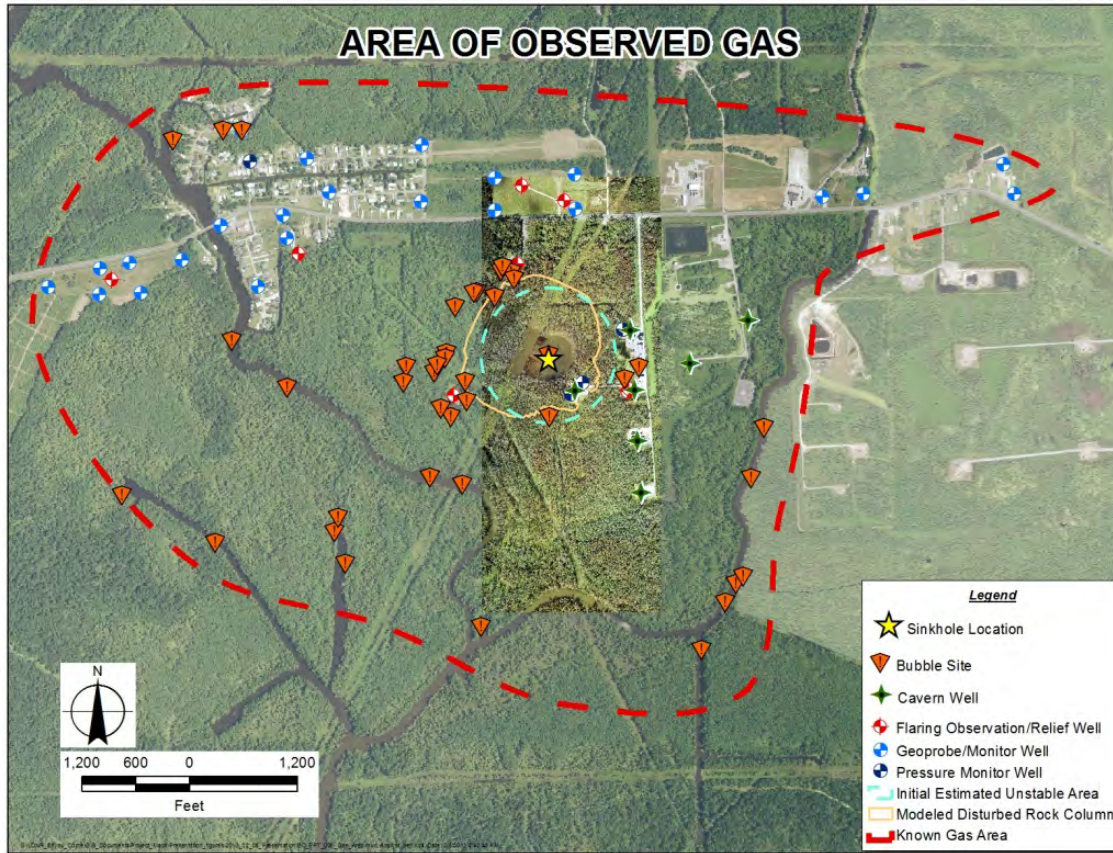
Why Revisions?

- Get data we need sooner
- Get 3D seismic data for comprehensive evaluation of collapse zone
- Get answers faster to ongoing gas and stability questions and issues
- Evaluate data obtained and make recommendations as needed

Gas in Aquifer and Venting

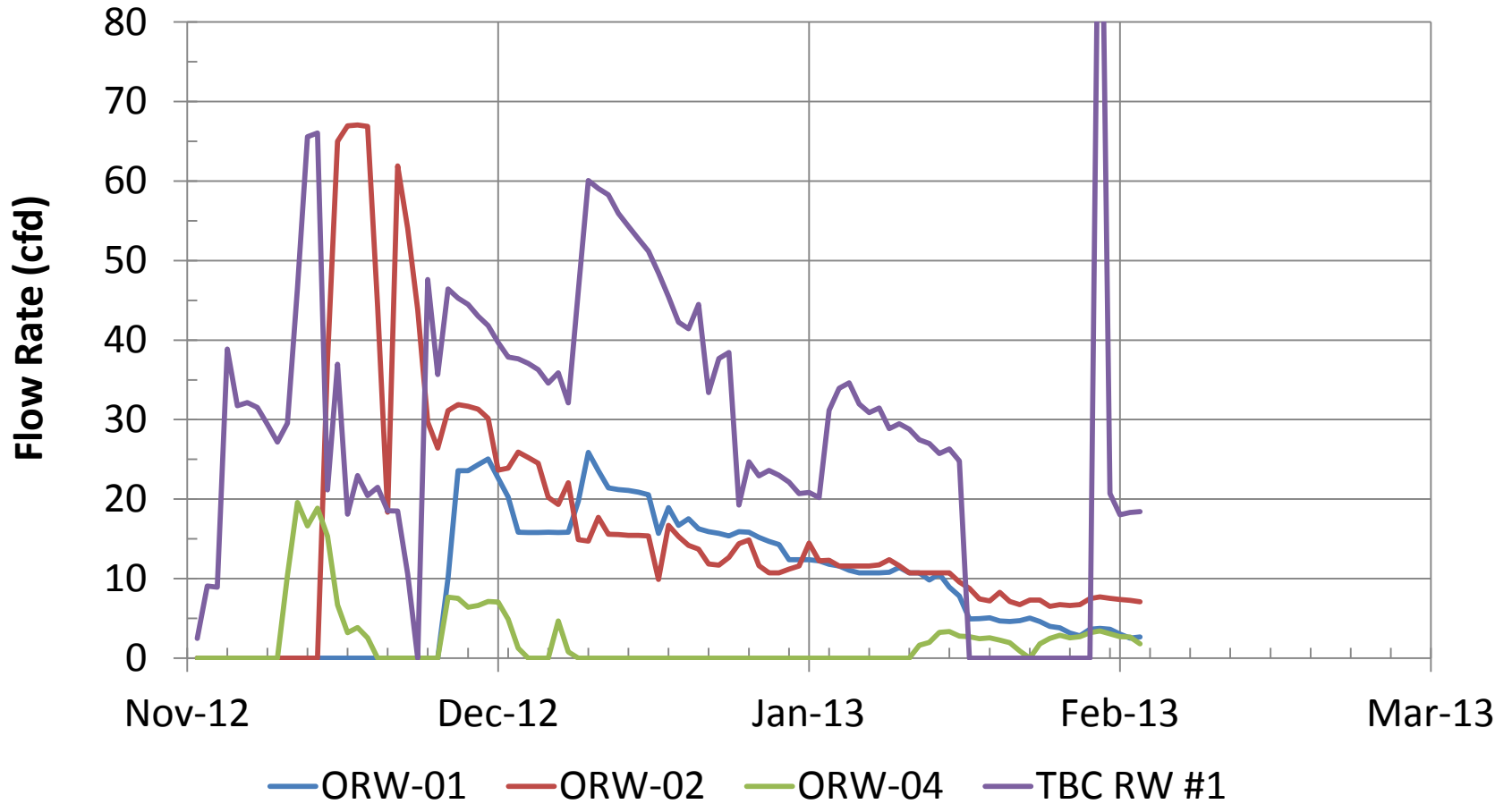
- Venting since mid-November with ~6.4 million cubic feet flared
- Obvious pressure and gas column reductions in vicinity of ORW-01/02 area
- Know how to install and operate wells to remove gas from Mississippi River Alluvial Aquifer (MRAA)
- Tetra-Tech implementing a large-area system
- Determined some limitations of PDK logs in defining gas in MRAA

Areas of Gas and Disturbed Rock

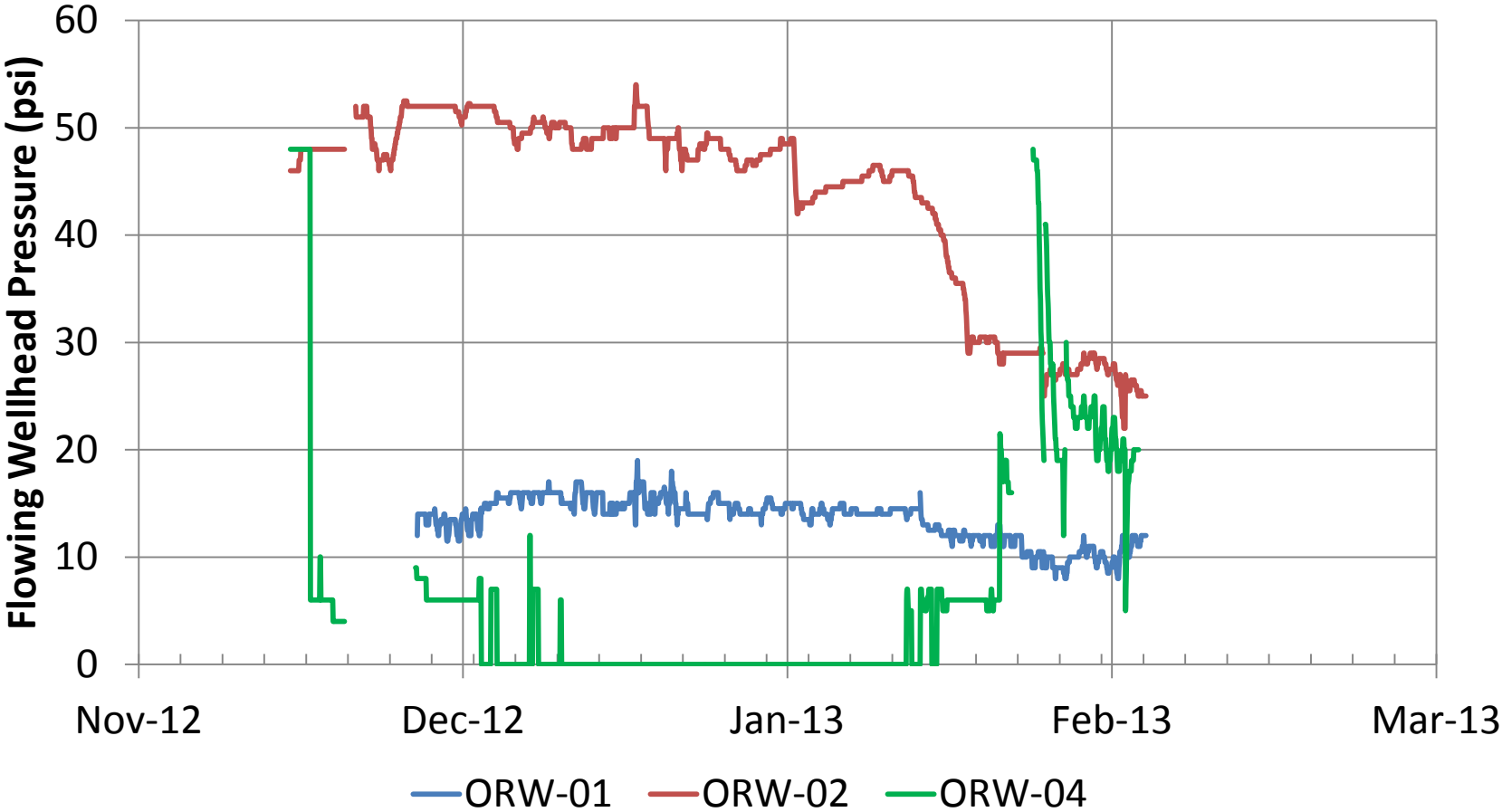


- Still seeing pressures in Geoprobe wells even where MRAA gas pressures have declined
- Observed about 20 new bubble sites—mostly on west side of sinkhole around perimeter of modeled disturbed rock column

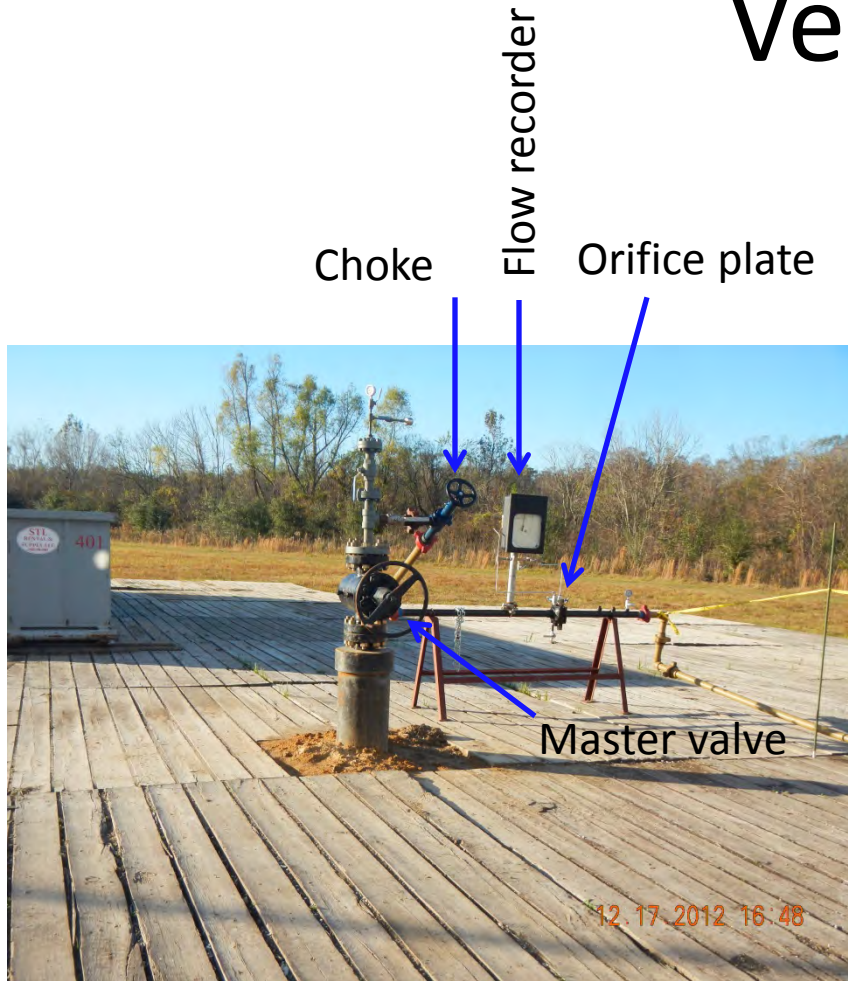
Vent Well Flow Rate



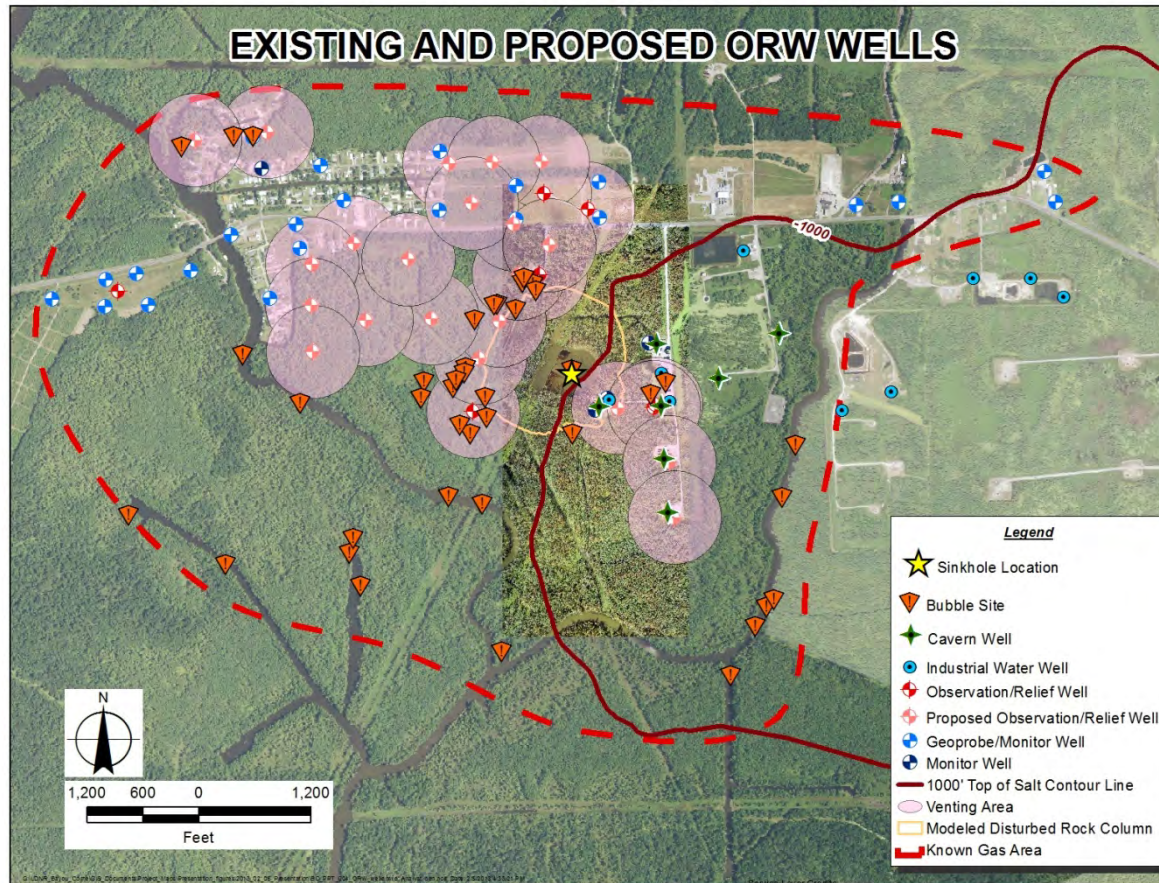
Vent Well Pressures



Venting Operations



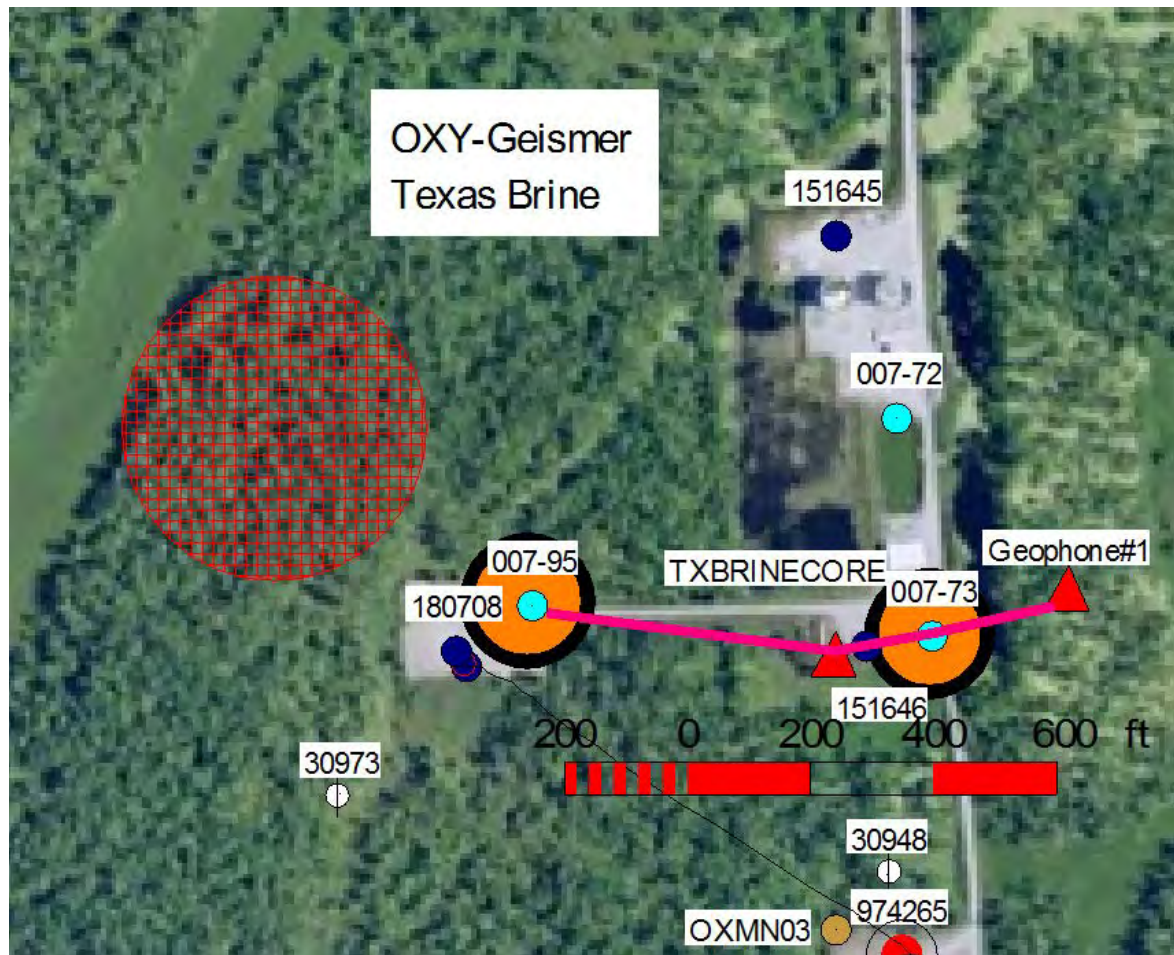
Proposed MRAA Vent Wells Areas of Gas Mitigation



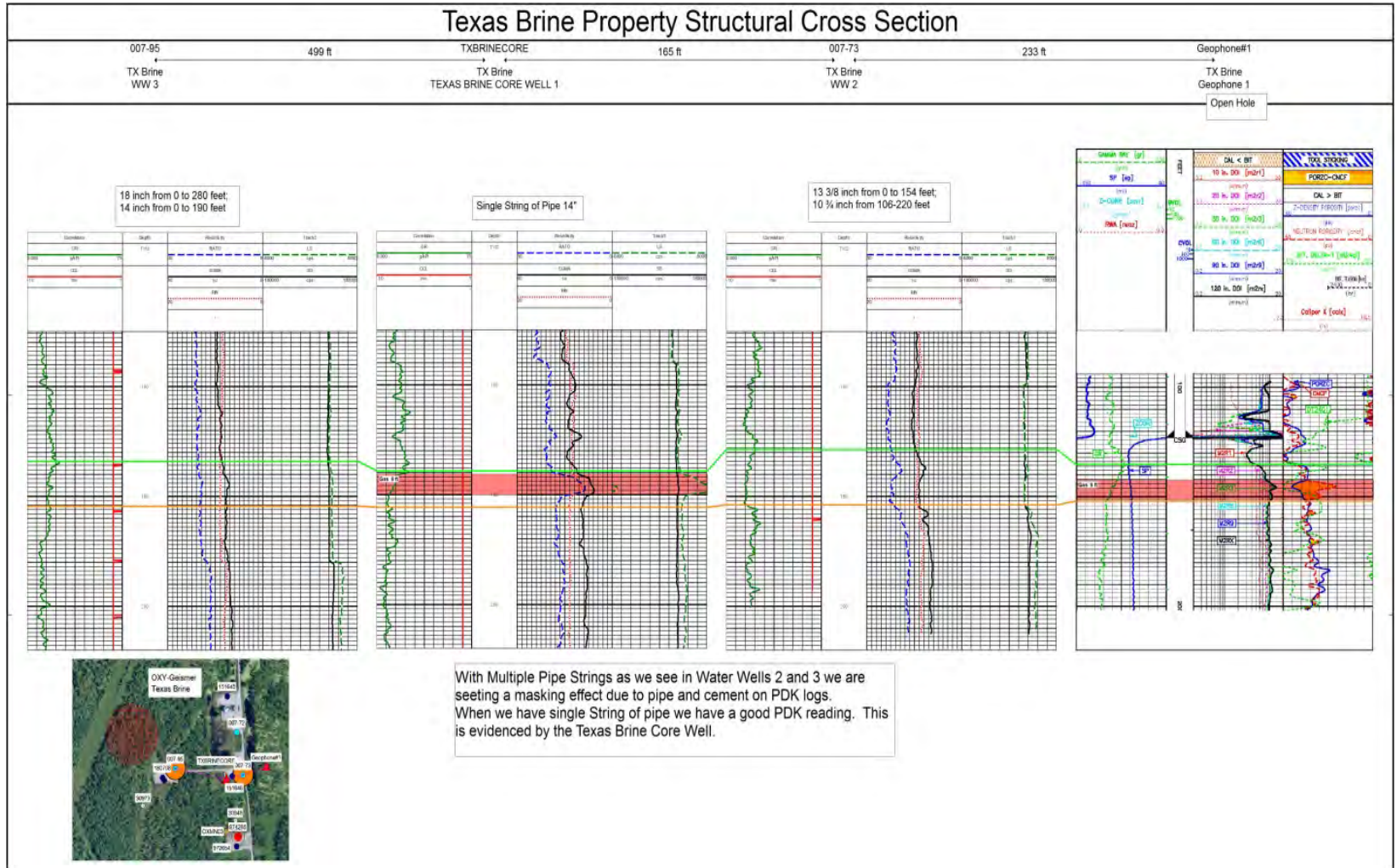
PDK Logs-Industrial Water Wells

- PDK logging technology may or may not be capable of identifying gas with a high degree of confidence in all wells surveyed (**False negative—gas there but don't see it**)
- Dependent on several factors:
 - Construction of the well – casing size, diameter, presence of cement, multiple strings
 - Insufficient gas saturations in the formation due to timing of logging and/or lithology (permeability)
 - Geometry of logging tool within the well casing (against casing so not reading fluid in casing instead of formation)
- PDK logs evaluated as having no gas in the wellbores with multiple strings of casing should not be interpreted as absolute as seen in the observations of the Oxy WW#2 and WW#3 as compared to TBC core hole and TBC-RW-1

Oxy WW#2 and WW#3



Oxy WW#2 and WW#3



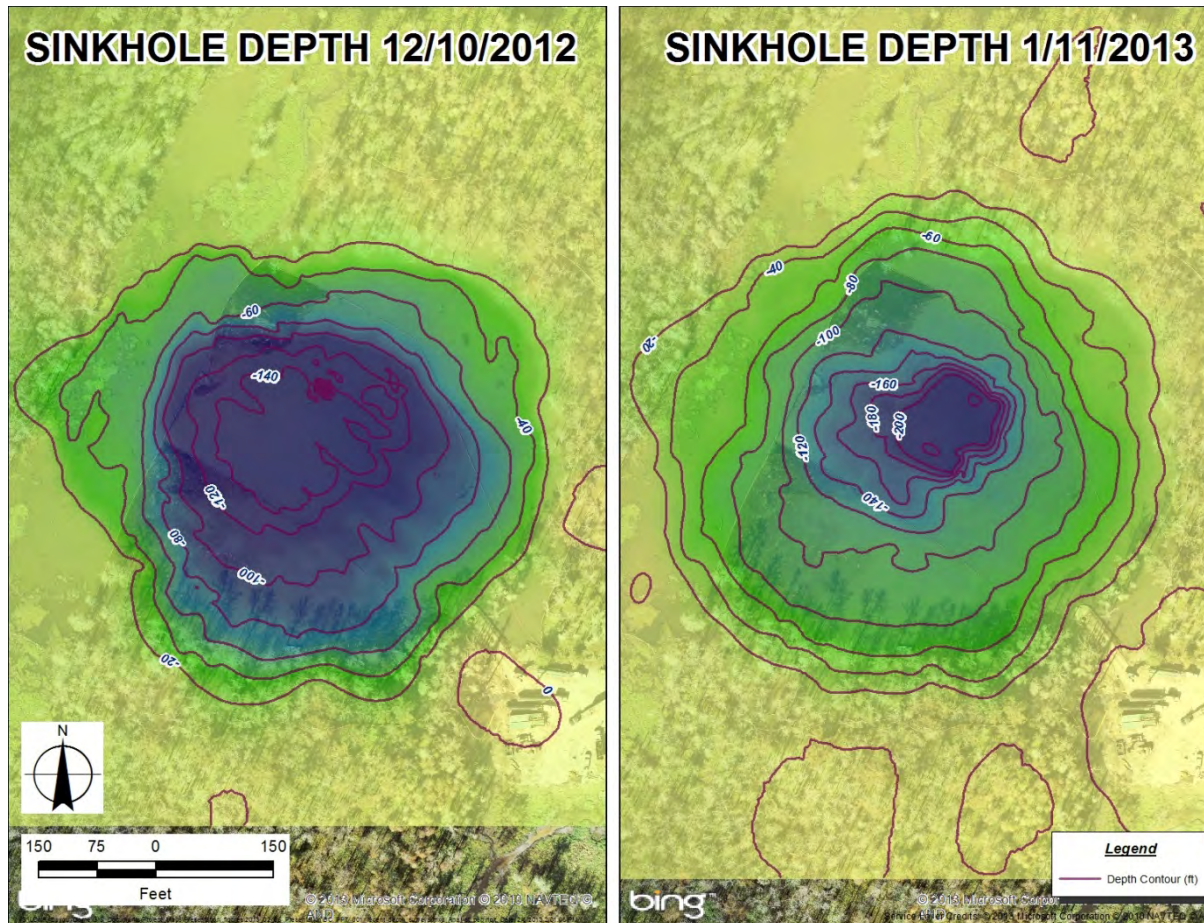
PDK Logs and Vent Well Performance

- Recent logs in ORW-01, ORW-02, and ORW-04 showed no obvious gas column in wells
- All 3 wells are still venting gas at 2 to 7 mcf/d with between 10 and 25 psi FWHP (flowing wellhead pressure)
- ***Conclusion:*** Below a certain gas saturation in pore space in aquifer, the PDK log cannot detect presence of gas

Path Forward on Vent Wells

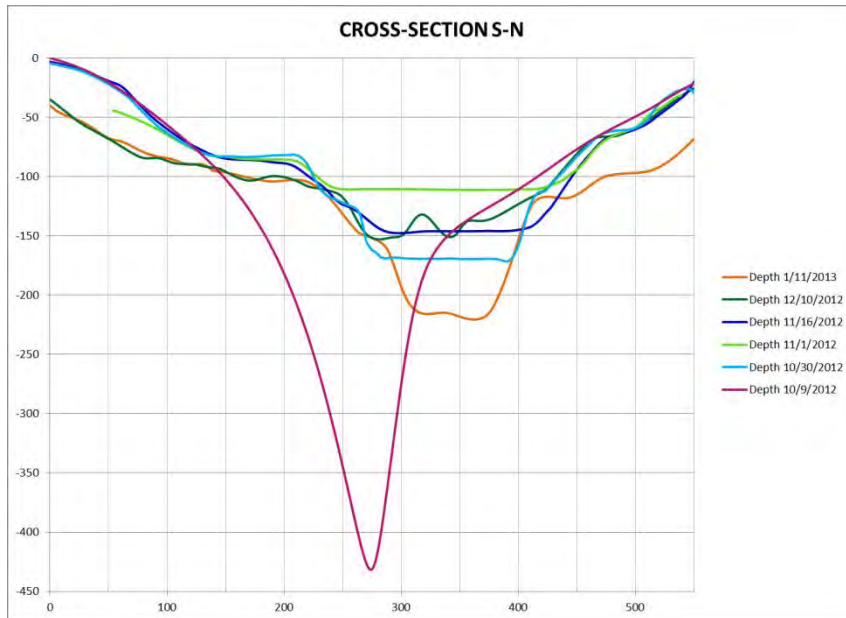
- **Need to install several vent wells in community**
- Making good progress on how to do it
- TBC installing many new vent wells
- Operate with standard chokes and flow meters
- Collecting data needed to evaluate performance
- Gas can be present even if not observed in PDK logs
- Dr. Charles Faust (Tetra-Tech) developing comprehensive overall gas mitigation model

Sinkhole Depth December and January

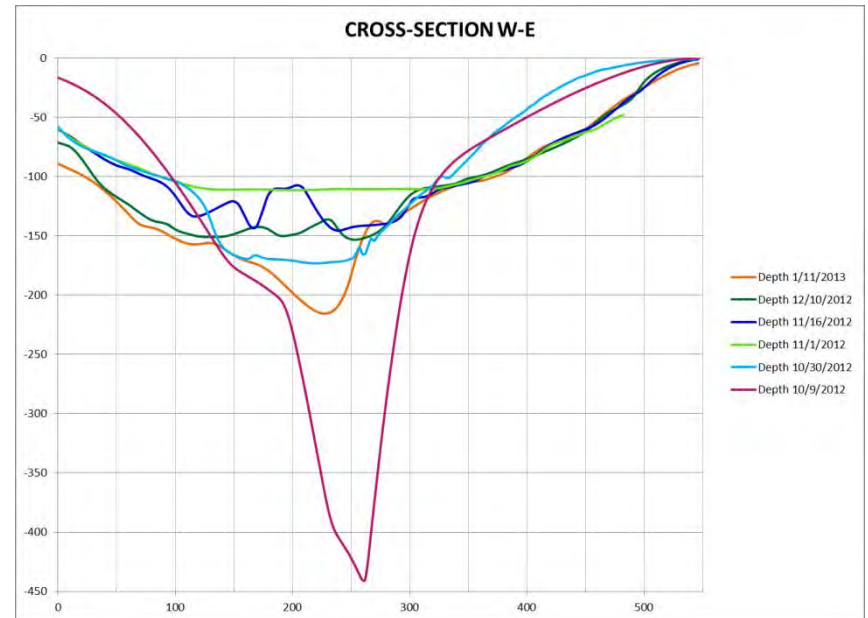


Sinkhole Cross-Sections

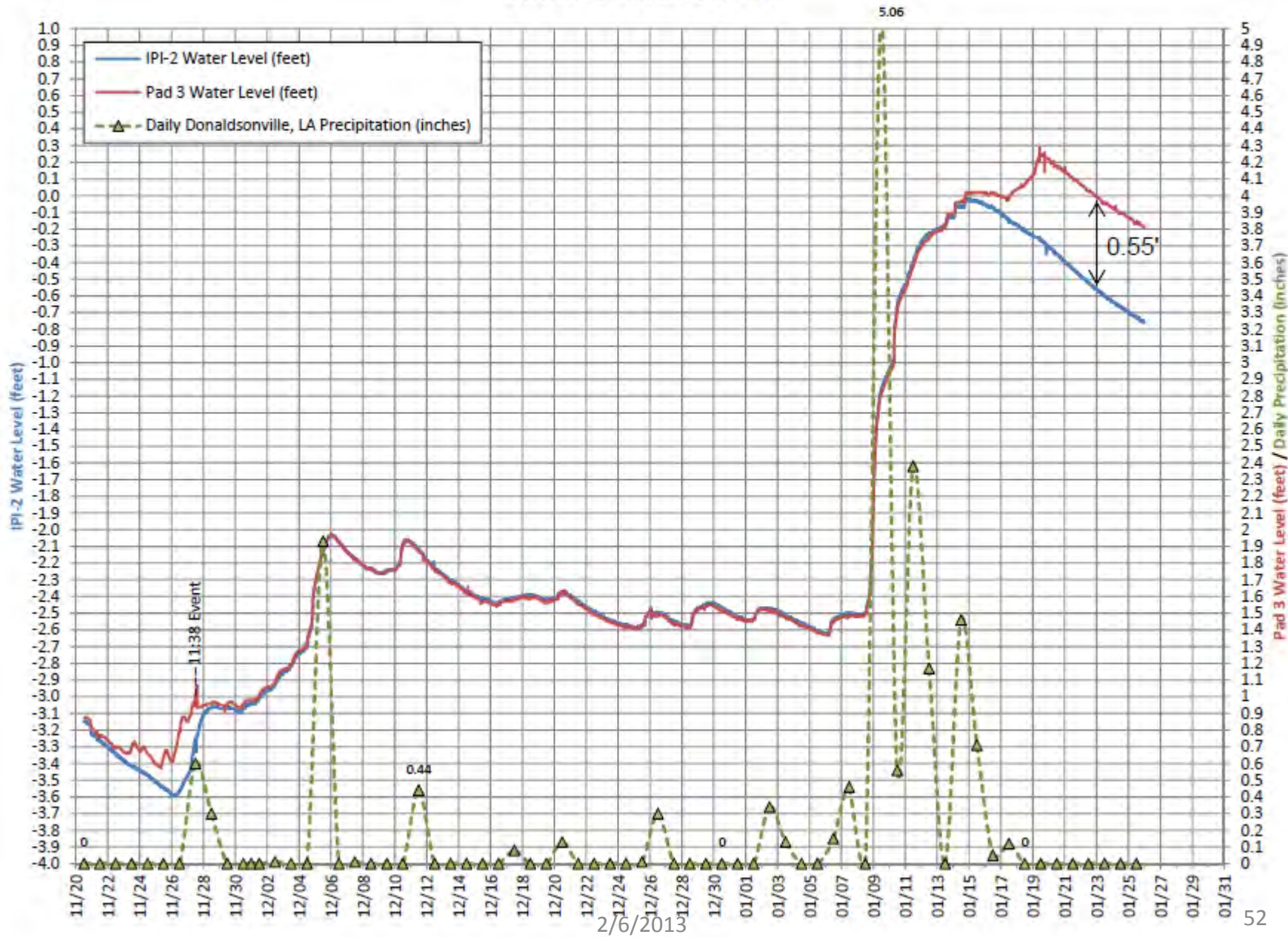
South to North



West to East

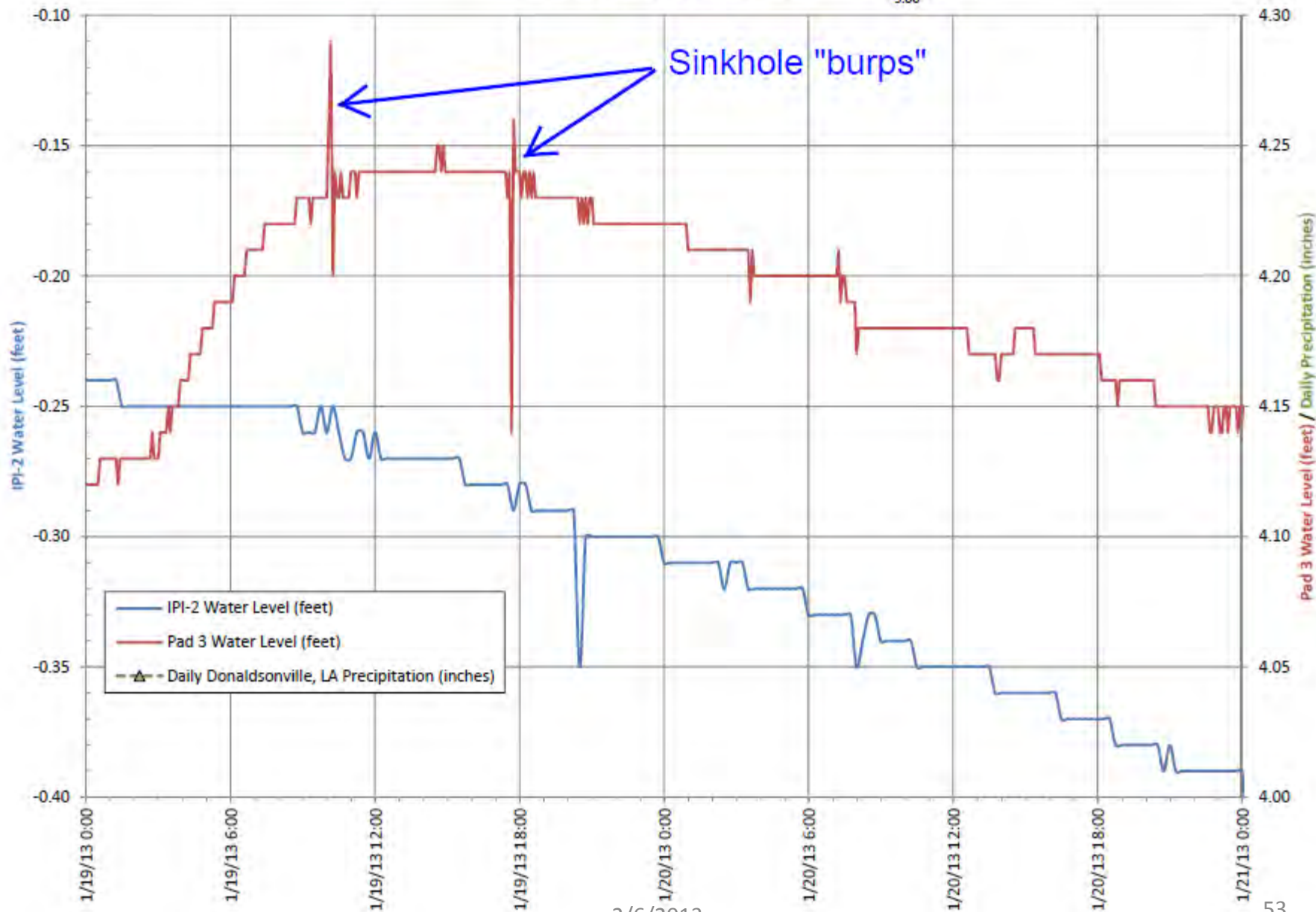


Sinkhole Water Level



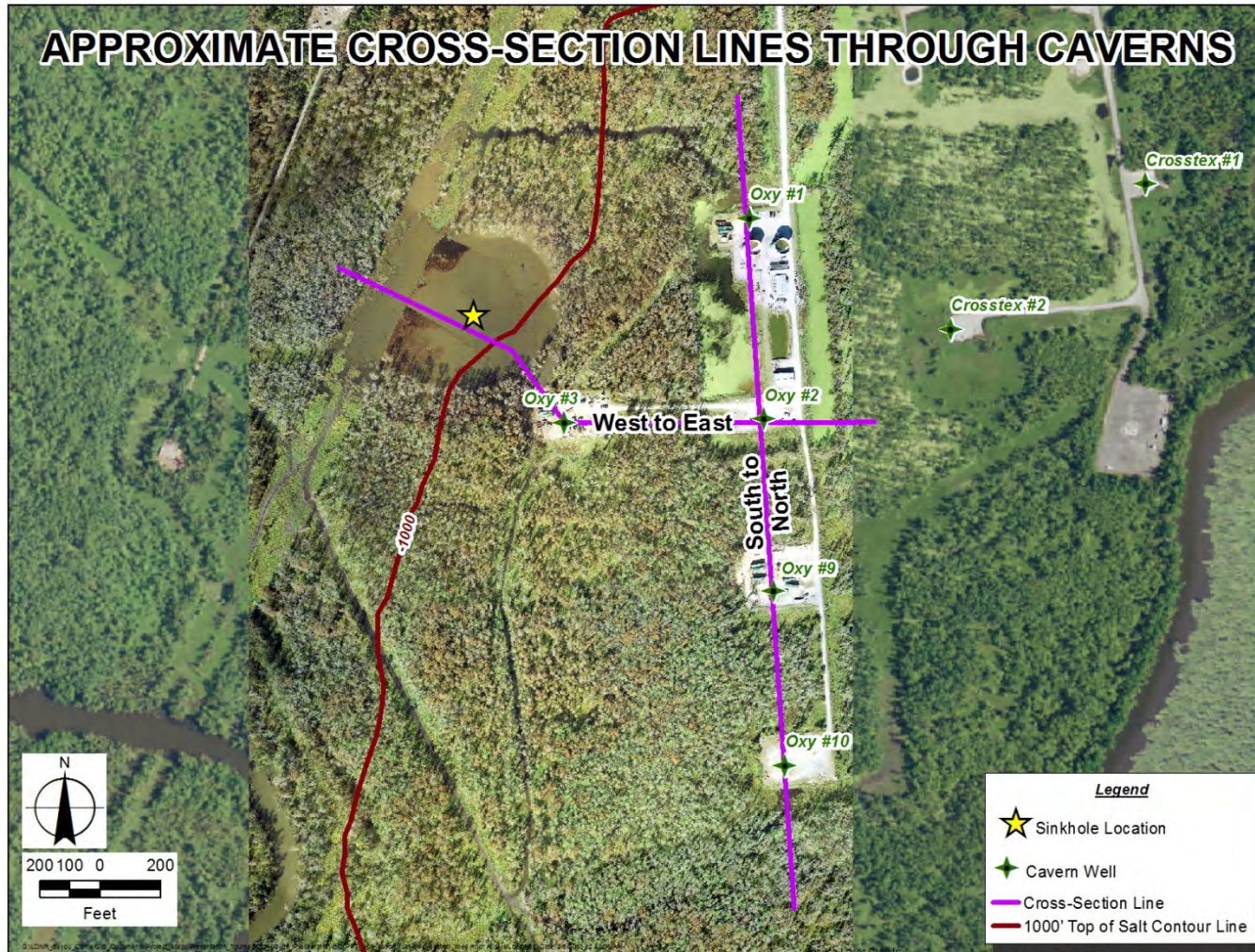
Sinkhole Water Level

5.06



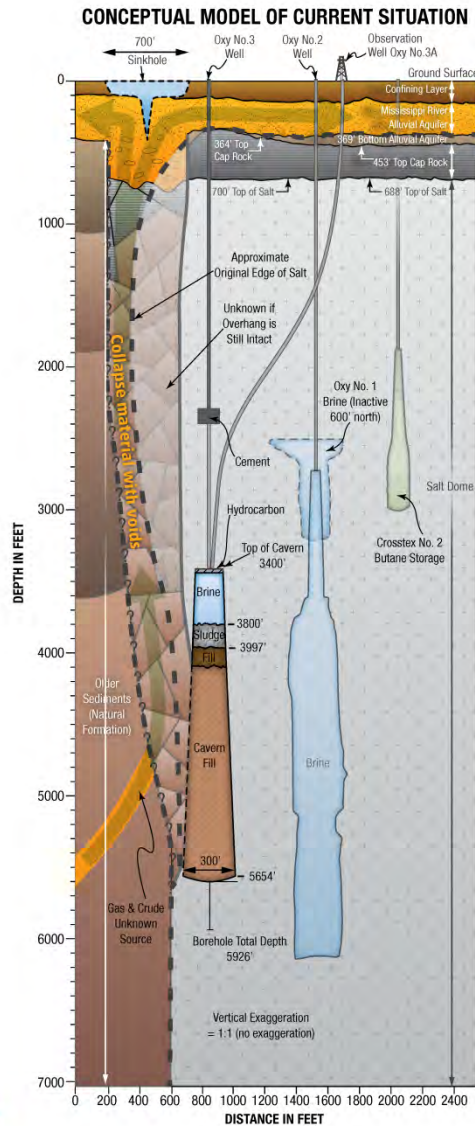
Cavern Stability

Caverns Included in Stability Assessment

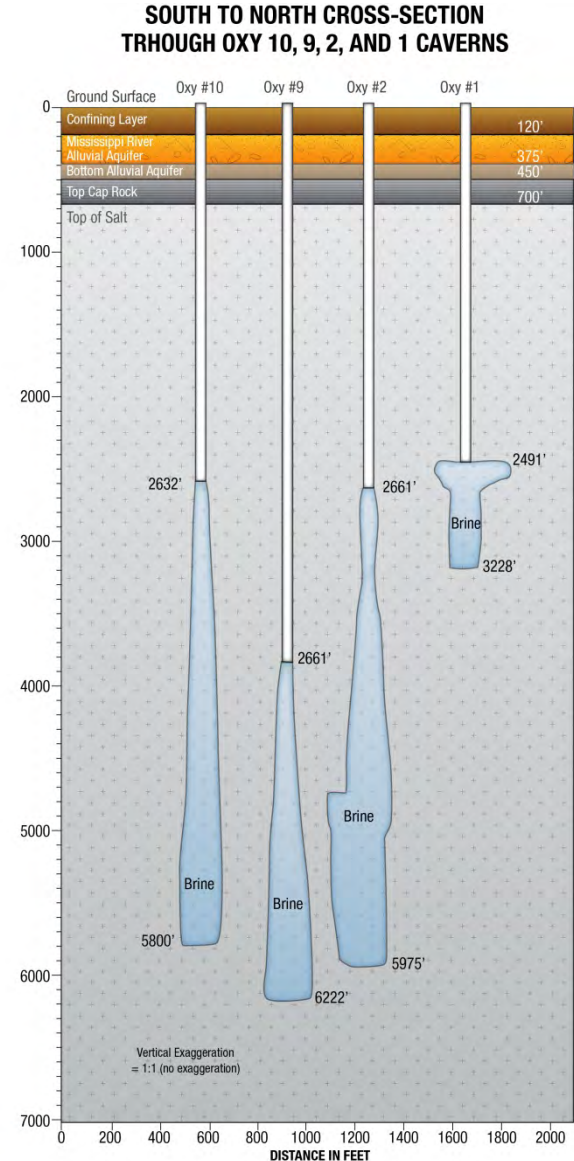


Cross-sections Through Caverns

West-East



South-North

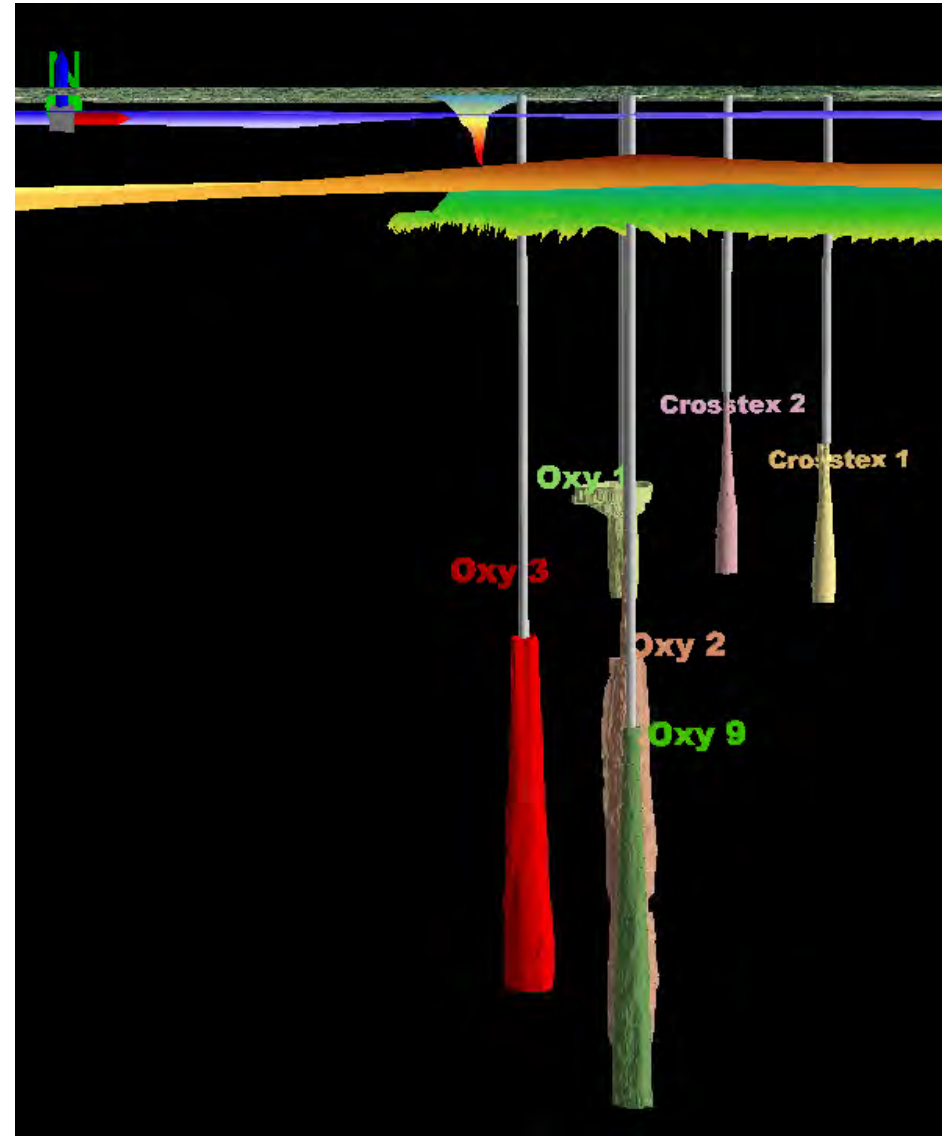


2/6/2013



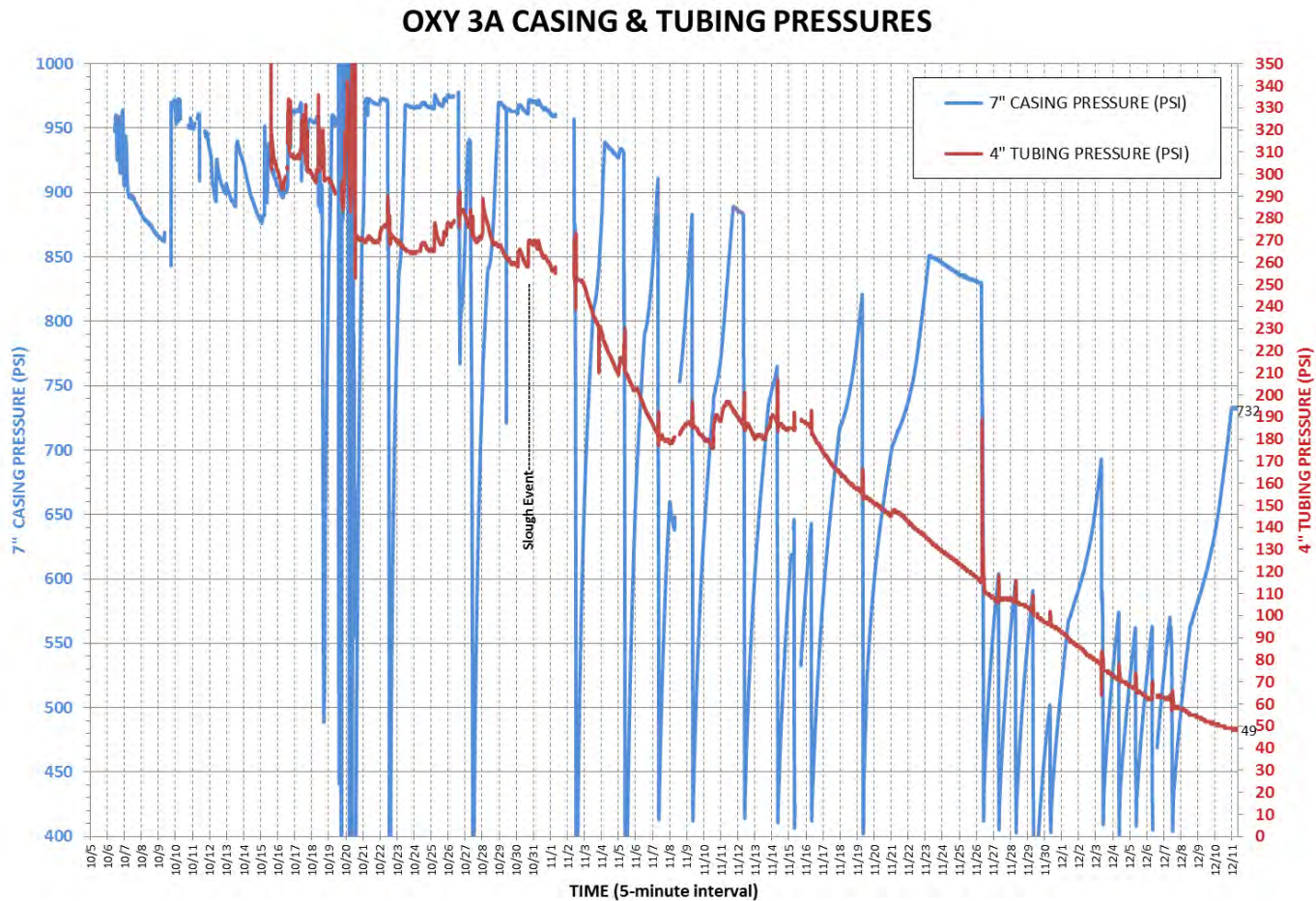
Conceptual Model Update

- Sinkhole “burps”
 - Strong indication of voids that fill with gas and then release
 - 1/19/13 burp event indicated that large gas bubble unlikely to reach surface as one bubble
- Sinkhole changes and Oxy 3 pressures reflect disturbed rock zone changes
- Seismic tremors—two types
 - Rock movement
 - Gas moving thru voids
- Vertical seismic profiles (VSP) completed in Oxy 1, 2, and 3A

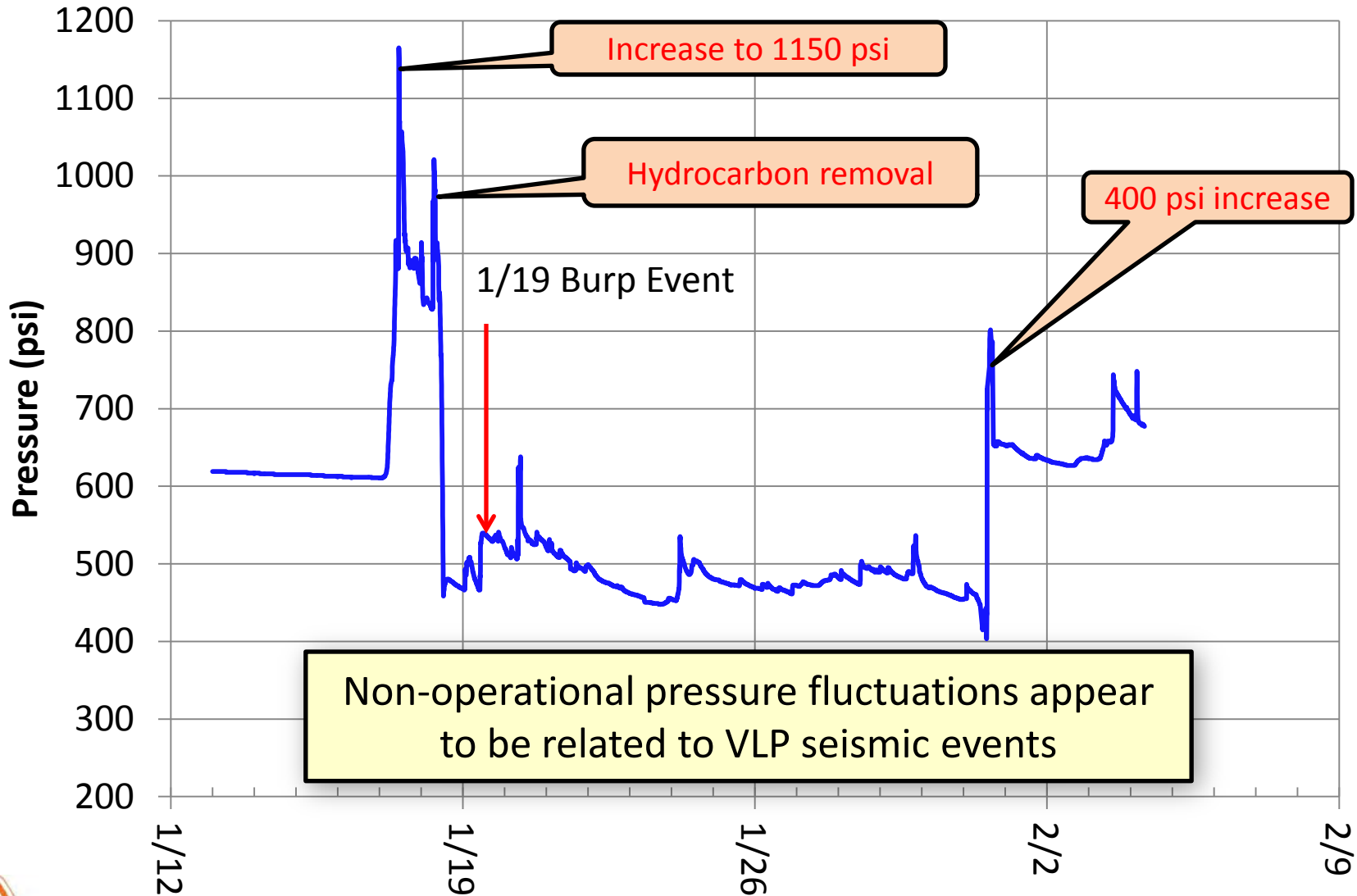


View looking North
From 3D Geologic Model 57

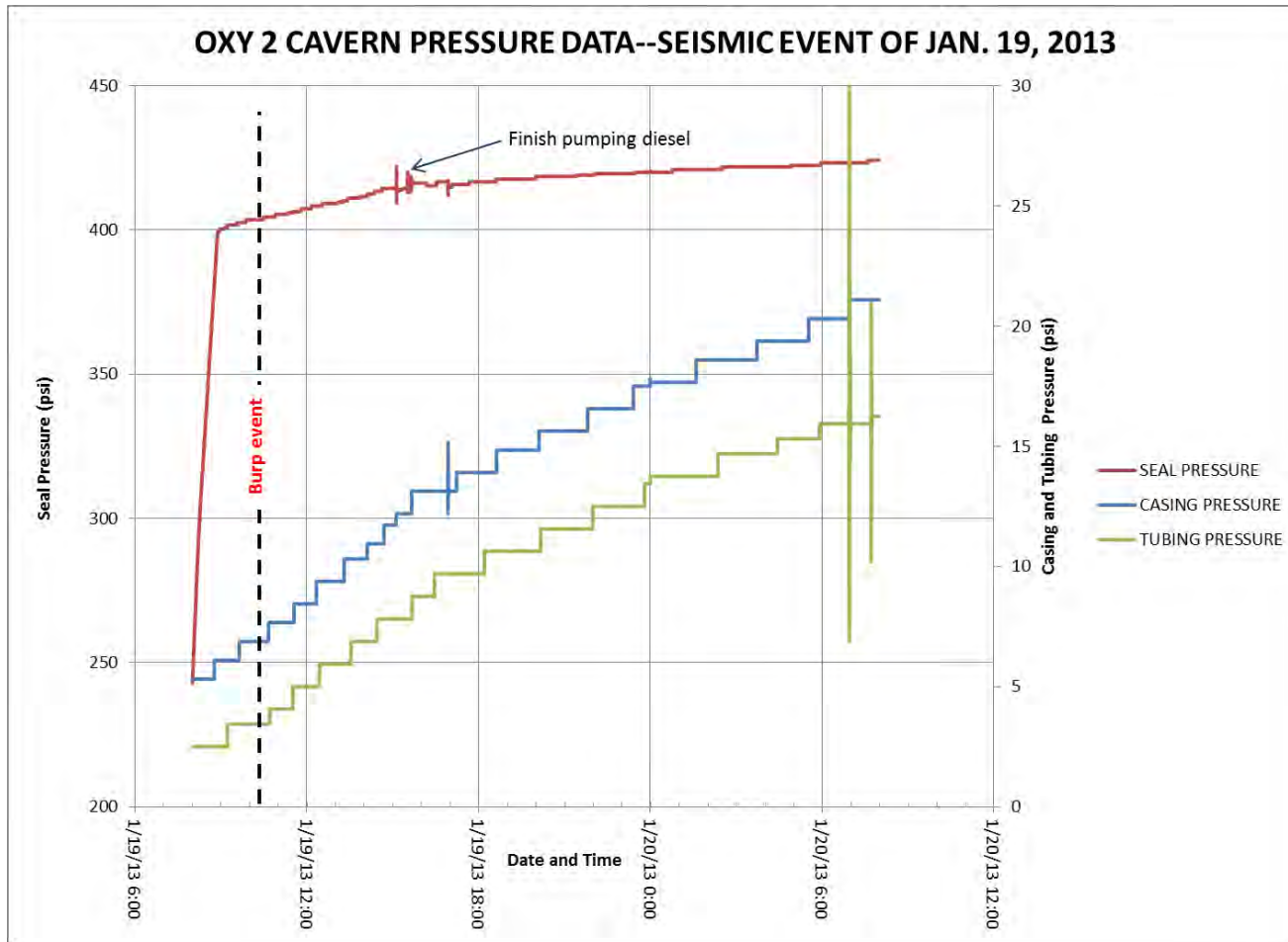
Dec. 2012 Cavern Pressure Declining



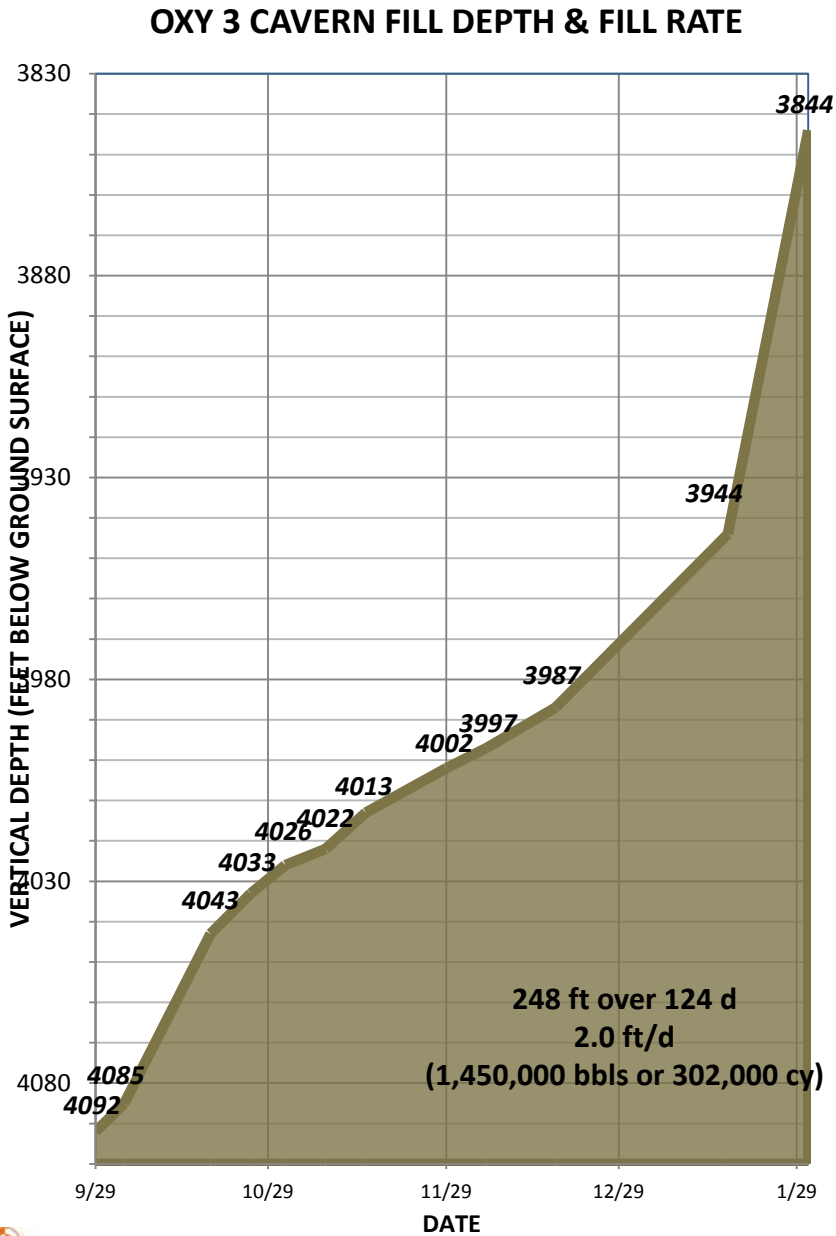
Oxy 3A Pressure 2013



Oxy 2 Pressures During 1/19/13 Seismic Event



Cavern In-Filling Rate



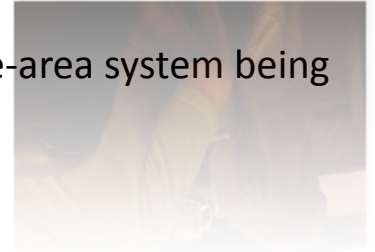
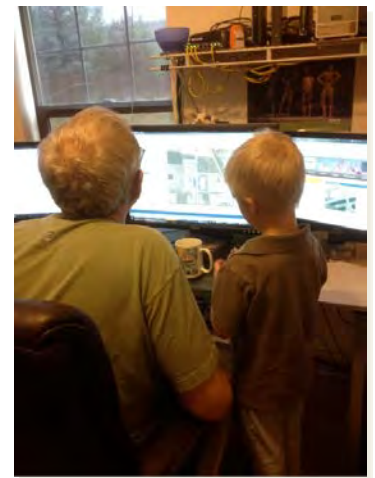
- Vertical depths plotted (not measured depths)
- Major fill event of 100' from 1/17/2013 to 1/31/2013—related to seismic activity
- Roof of cavern at 3400' vertical depth

Oxy 3 Cavern Summary

- Oxy 3 cavern is again in communication with disturbed rock column
- Not making much gas but still making liquid hydrocarbon
- Oxy 3 pad damaged in 1/13 to 1/19 seismic events—Respec doing stability evaluation
- Approximately 400 feet to fill in before cavern full
- Lack of observed seal pressure response in Oxy 2 during 1/19 seismic events positive indication of adjacent cavern stability at present

Path Forward

- Reduce methane in MRAA
 - Ventilation, indoor and sub-slab monitoring
 - Shallow Geoprobe wells to monitor shallow pressure
 - Know how to reduce gas volumes and pressures in MRAA and large-area system being installed
- Stability of the disturbed rock zone and void spaces
 - Passive seismic data show micro-earthquakes and fluid flow
 - Sinkhole changing with each survey
 - Active 3D seismic survey and VSP's of three caverns
 - Geomechanical modeling
- Evaluating stability of western side of dome
 - Analysis of ongoing seismic events with upgraded passive seismic array systems including salt seismic monitoring
 - Active 3D Seismic imaging of disturbed rock zone
 - Rock mechanics modeling with site data from core hole



Questions?