



Must See TV: A Post-Treatment Study Like None Other

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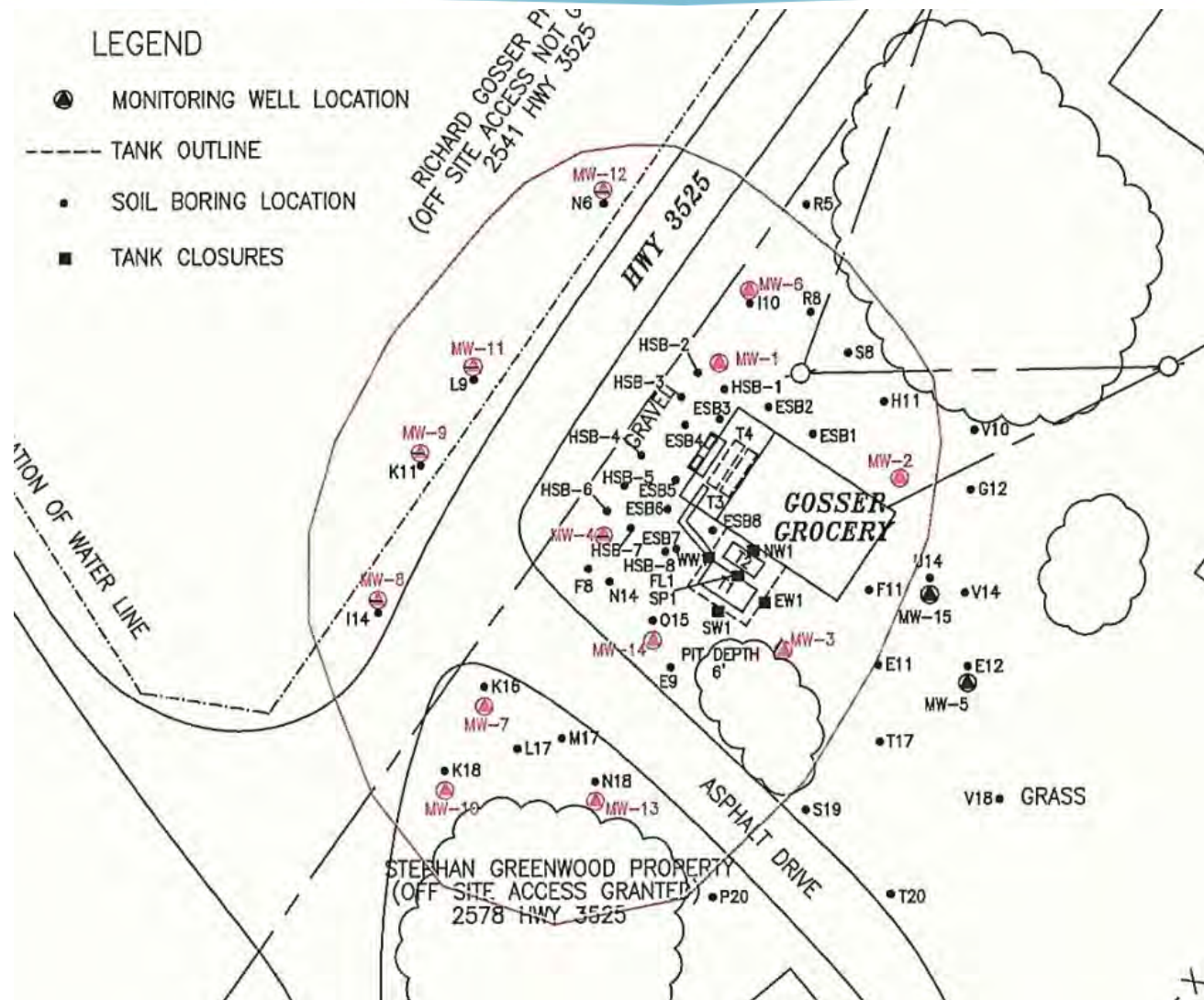
Proof of Concept Project

- Prove Contaminant Destruction in all Media
 - Field vs. Bench verification
 - Quality of Data → post-injection GW data from monitoring wells in direct contact with carbon
 - Guidance for RDC sampling and verification
 - Use data generated to estimate kinetic rates of degradation
 - Improve injection design and delivery

Proof of Concept Project (cont.)

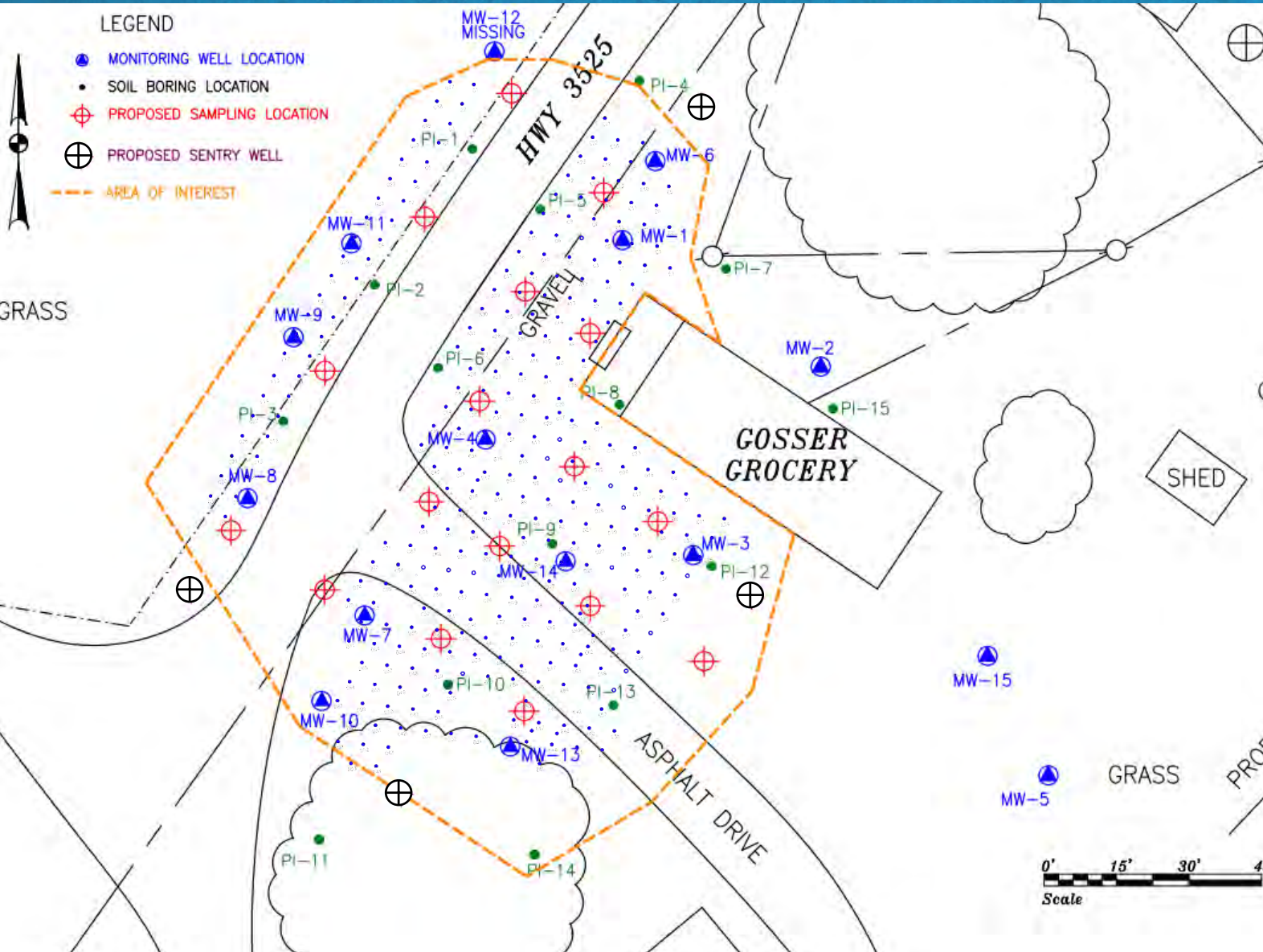
- 2014 evaluation for sites that fit qualifications
 - Source of release removed (UST System)
 - Minimal investigation and remediation
 - Isolated – no adjacent facilities to co-mingle
 - Vacant and accessible, potential for modification is very low
 - Significant mass present to provide measurable change

Site Background 2014



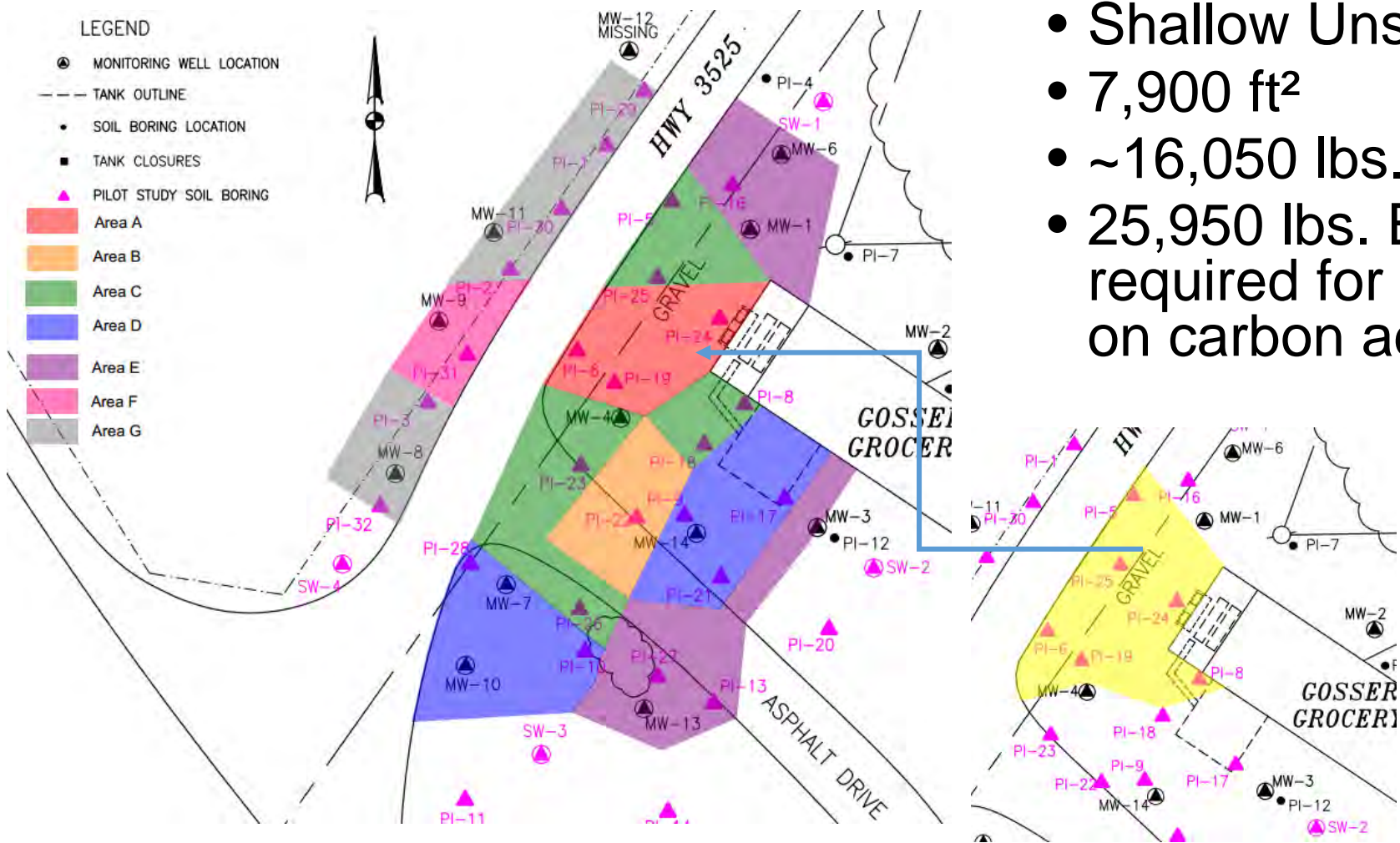
- Former UST Facility – Russell County, KY
 - UST Closure 2000 and 2001 (in-place)
 - Site Investigations 2002 thru 2013
 - GW Benzene Plume shown $> 7 \mu\text{g/L}$

Soil and Groundwater Evaluation



- **November 2016 Soil Sampling Work**
 - 32 total sampling locations
 - Installation of sentry wells (SW) (4)
- **June 2017 Groundwater (GW) sampling event**
 - Baseline GW values established for 14 monitor wells (MW) & 4 SWs
- **June-July 2017 BOS 200® Injections**
- **July and August 2017 Post-injection GW sampling events**
 - MWs & SWs sampled
- **September 2017 BOS 200® injection analysis**
 - Soil cores collected and inspected for carbon distribution
 - Replace C-Impacted MW's (12) and Installation of PI nested wells (28)
- **9/2017, 1/2018, 4/2018, 6/2018, 10/2018 Post-injection GW sampling events**
 - MWs, SWs & PIs sampled

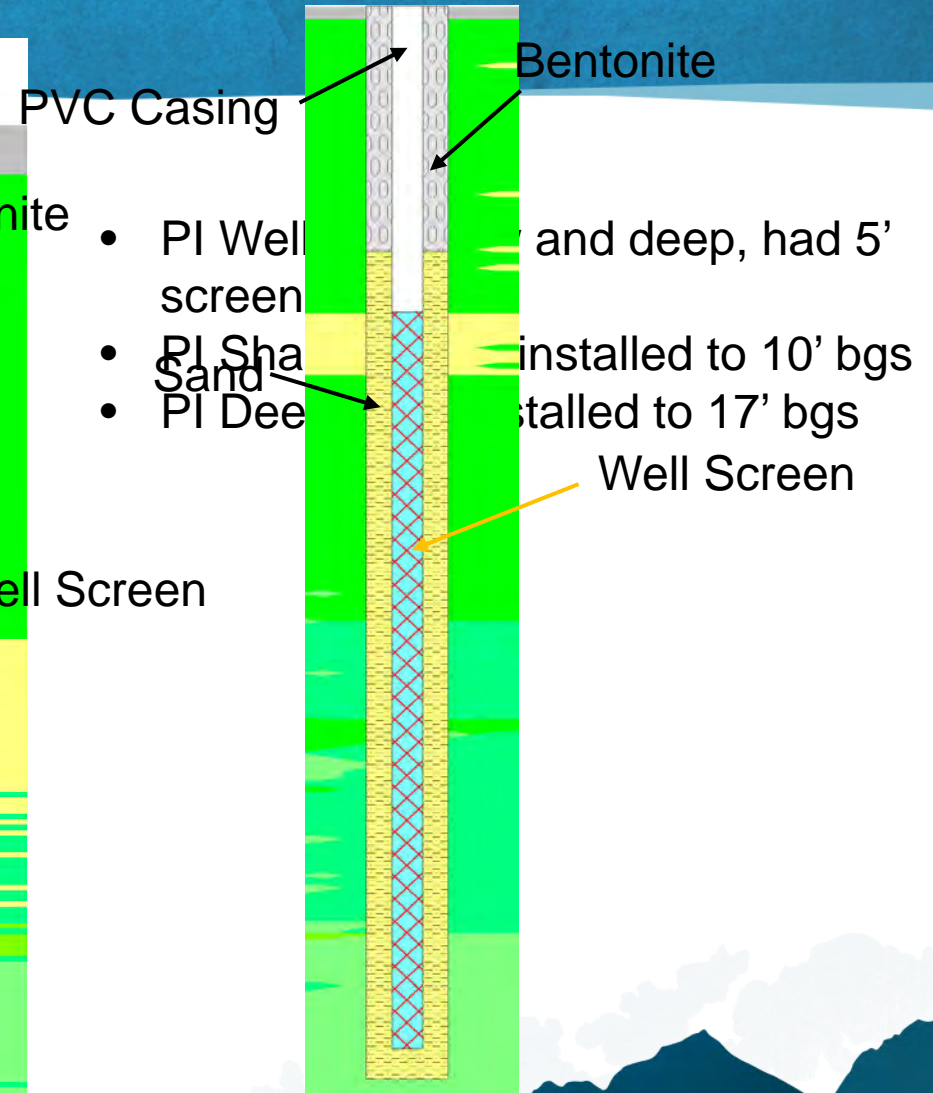
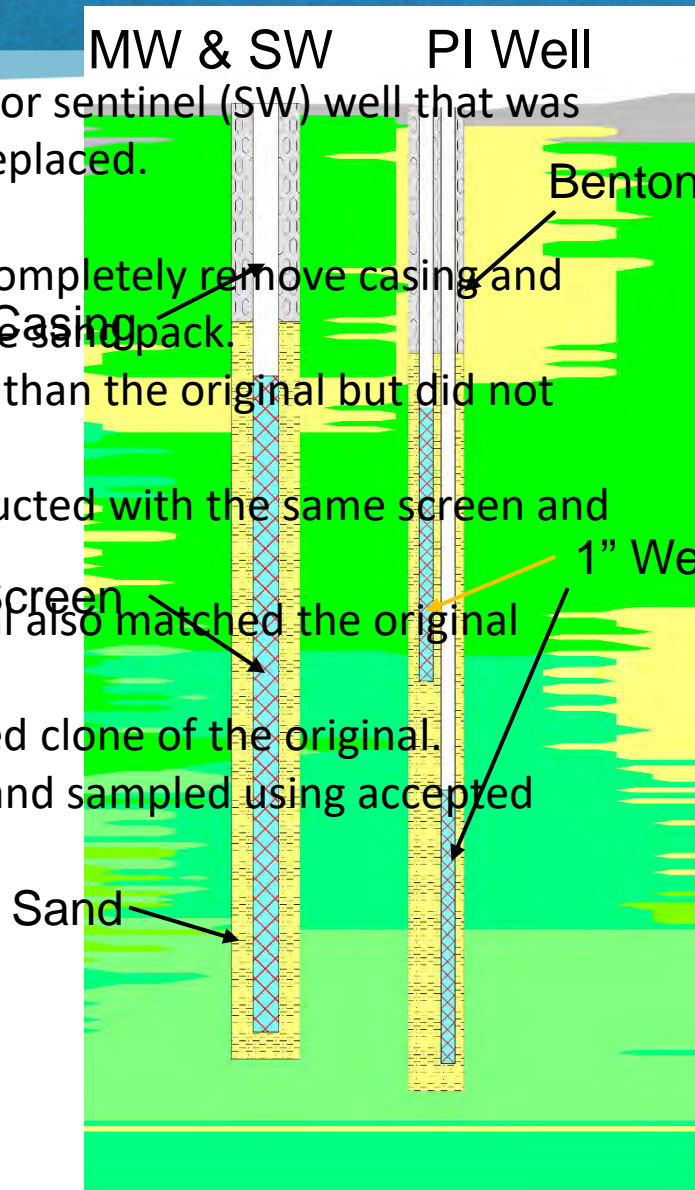
AST Design 2016



- Shallow Unsaturated source identified
- 7,900 ft²
- ~16,050 lbs. hydrocarbon mass
- 25,950 lbs. BOS 200®, less than required for total mass removal based on carbon adsorption alone

Well Construction

- For this project, any monitoring (MW) or sentinel (SW) well that was impacted by BOS 200® injectate was replaced.
- 2" Monitoring Wells (MW) had 10' screens with wells installed to 18' bgs
- 2" Sentry Wells (SW) had 10' screens with wells installed to 19' bgs
- Existing well was over-drilled to completely remove casing and screen materials and clean but the sand pack.
- New bore hole was slightly larger than the original but did not extend below the original depth.
- The replacement well was constructed with the same screen and riser lengths.
- New sand pack and bentonite seal also matched the original construction.
- The replacement well is a intended clone of the original.
- The clone wells were developed and sampled using accepted procedures.



Vocabulary & Method Defined for Characterization

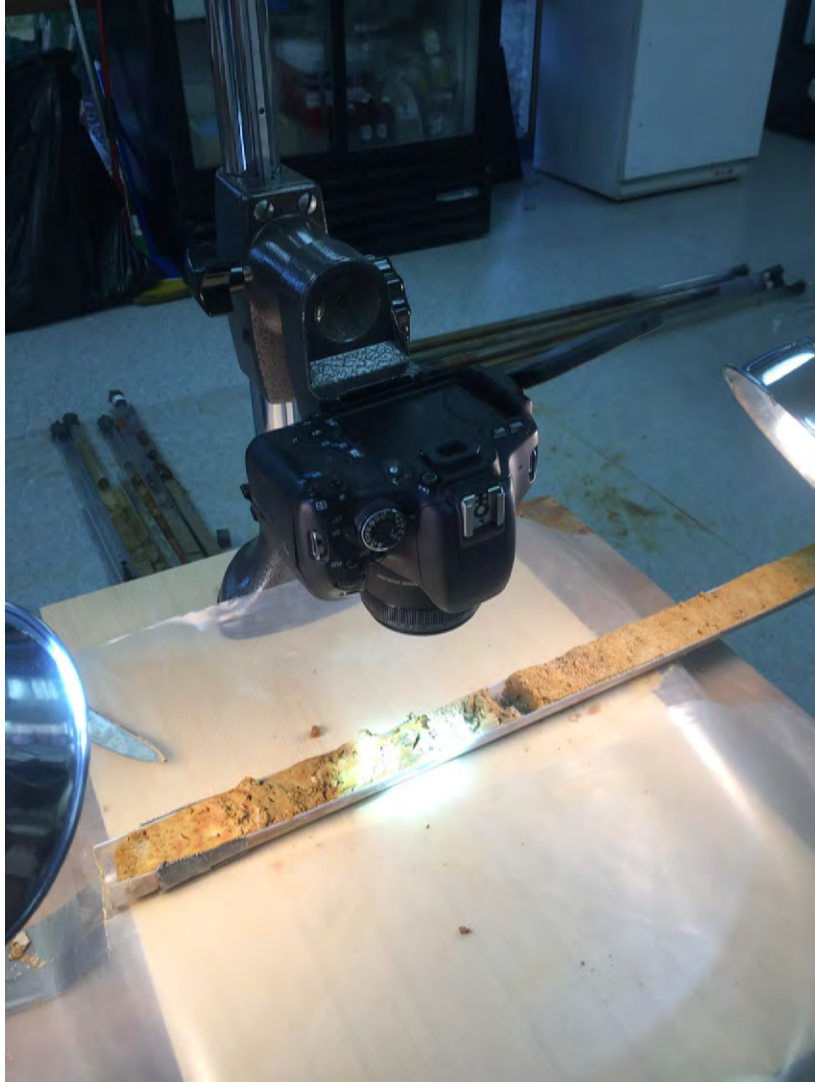
Vocabulary

- Horizontal Seams
- Vertical seams
- Smear
- Spot
- Specs
- Evenly Distributed
- Heavy Seams
- Feathers

Method

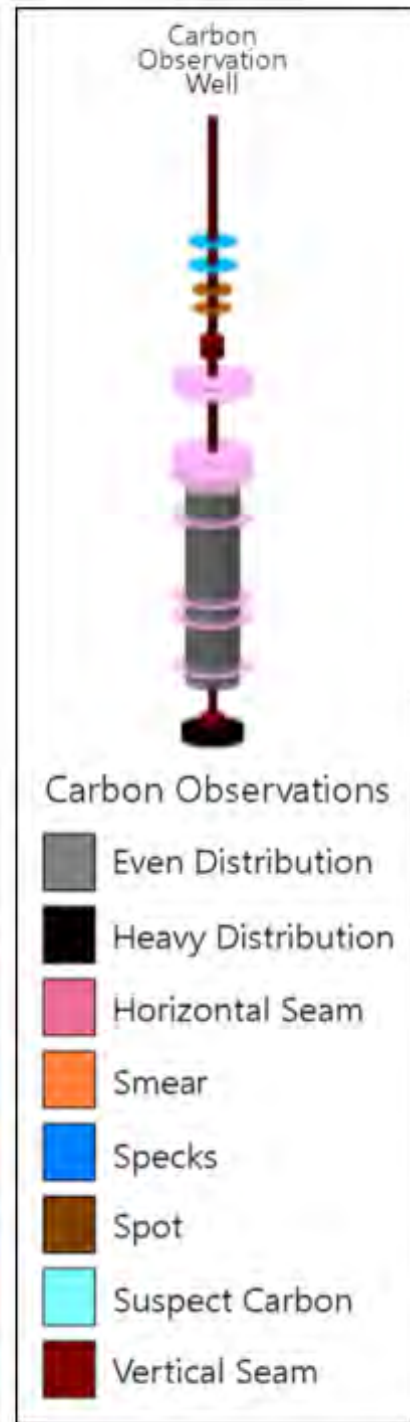
- Open Liner
- Cut and Split Long Axis (Top to Bottom)
- Cut Slices Short Axis (X-Sect)
- Light w/ no Magnification
- Light with Magnification
- Laboratory Analytical Fingerprint

Camera and Microscope Setup

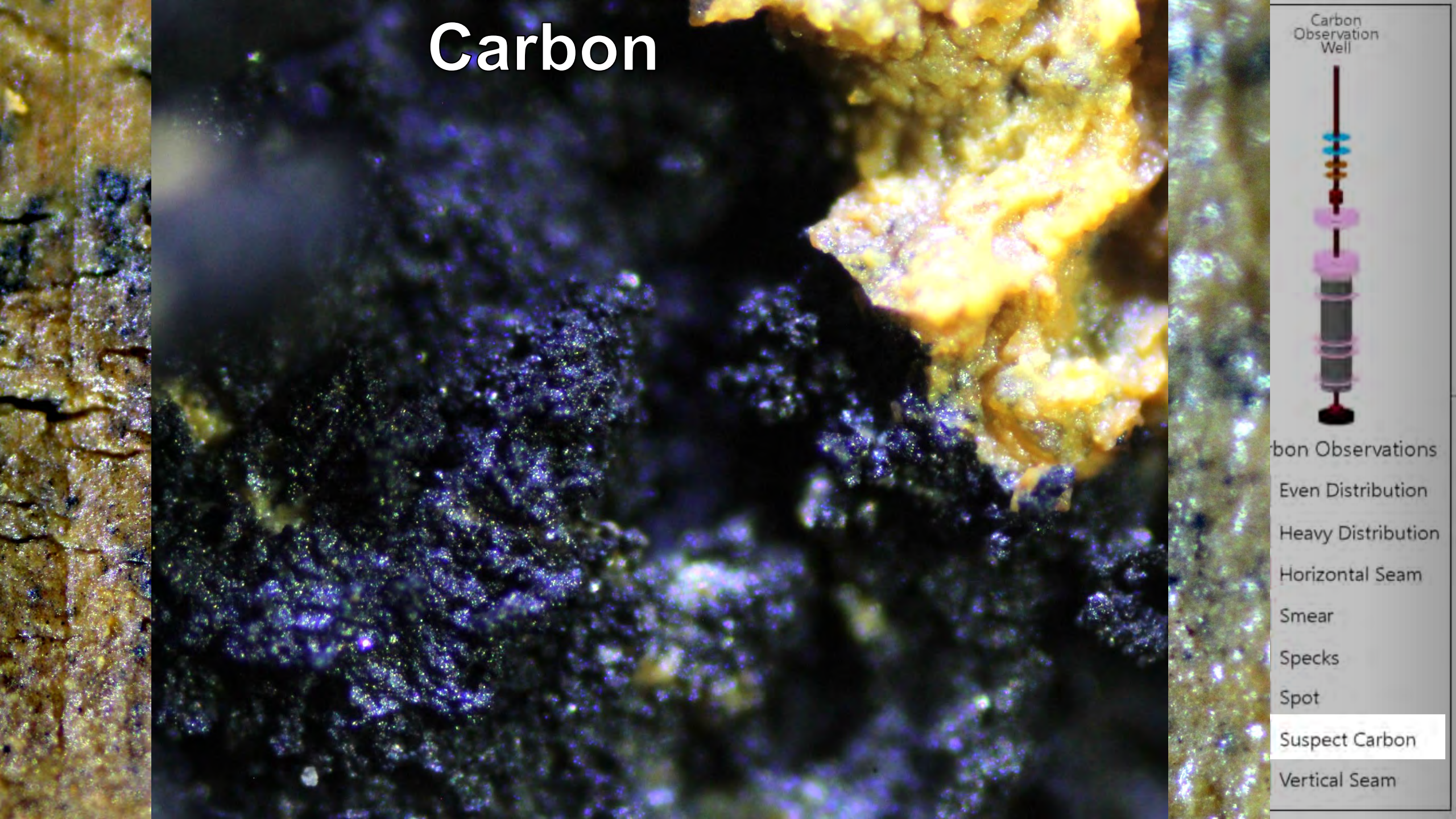


Observed Carbon Types

- Suspect Carbon
- Specks
- Spots
- Smears
- Even Distribution
- Heavy Distribution
- Vertical Seams
- Horizontal Seams



Carbon



Carbon
Observation
Well



Carbon Observations

Even Distribution

Heavy Distribution

Horizontal Seam

Smear

Specks

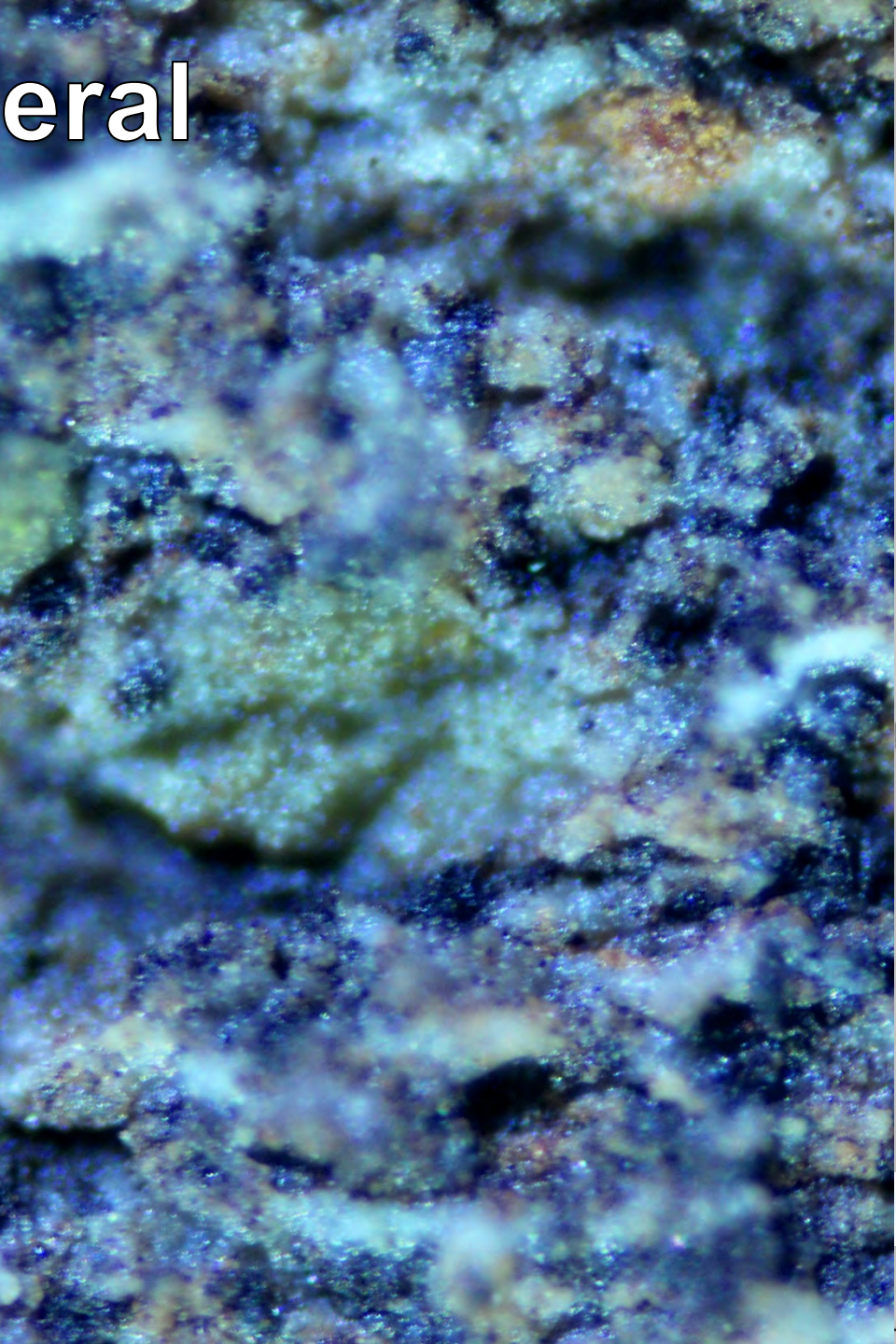
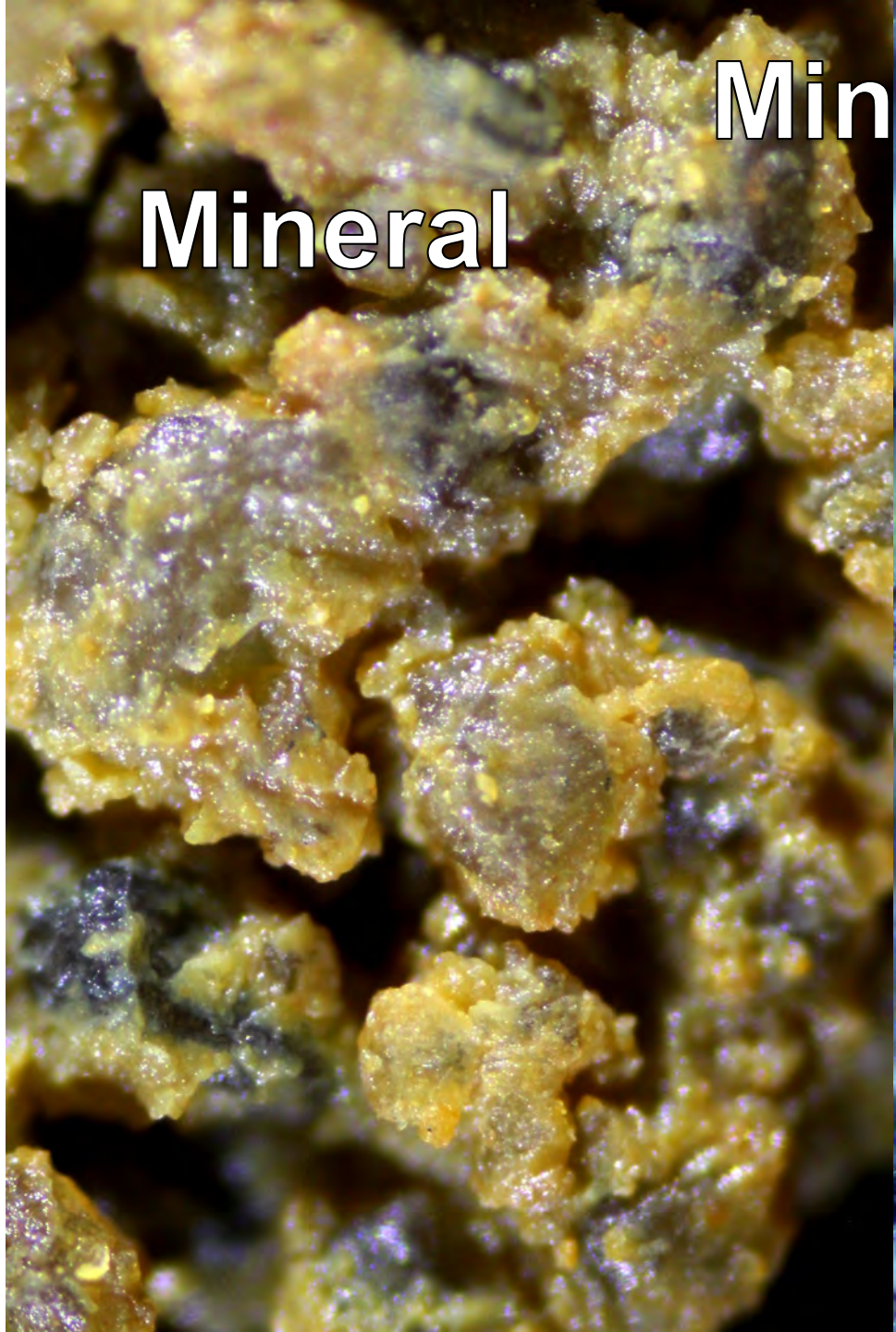
Spot

Suspect Carbon

Vertical Seam

Mineral

Mineral



- Carbon Observations
- Even Distribution
- Heavy Distribution
- Horizontal Seam
- Smear
- Specks
- Spot
- Suspect Carbon
- Vertical Seam

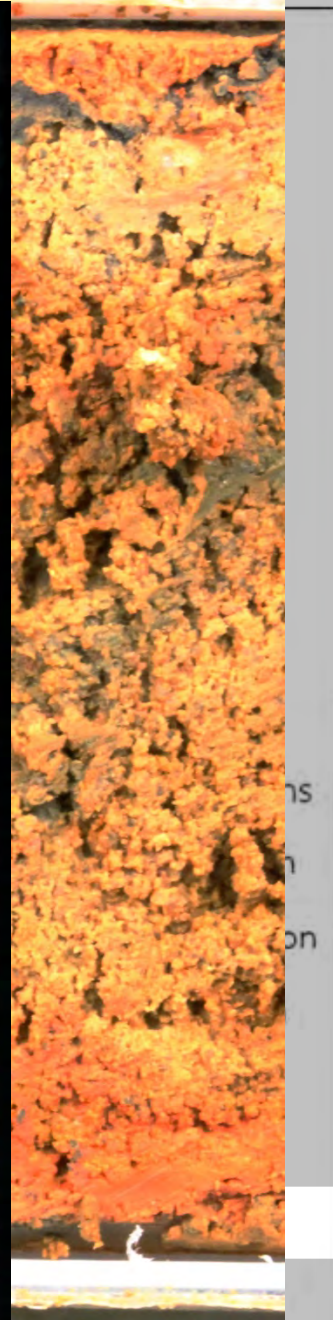
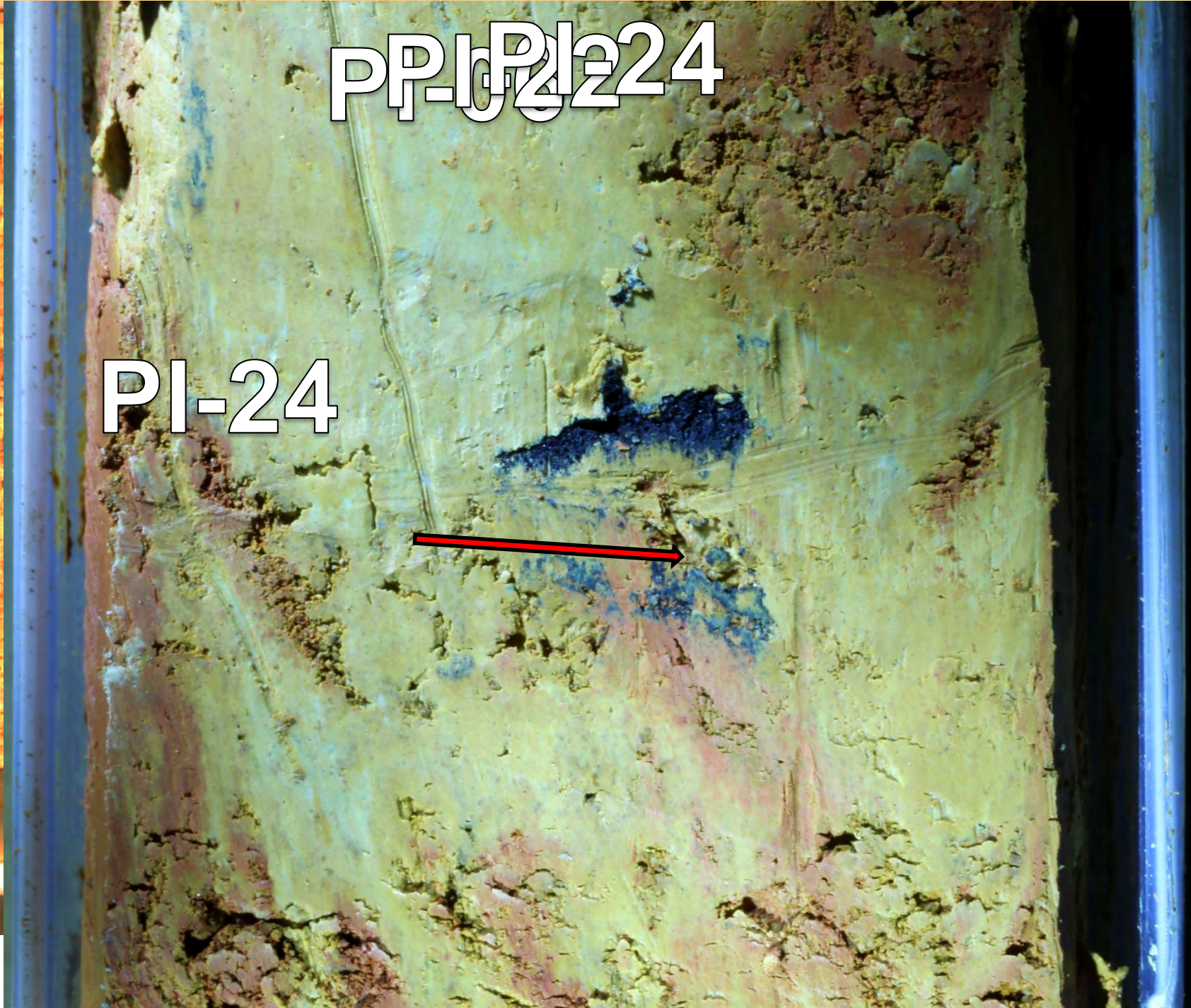
PI-

PI-19

PI-19

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Observations
Distribution
Distribution
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t Carbon
Seam



Vertical Seam

PI

PI-08

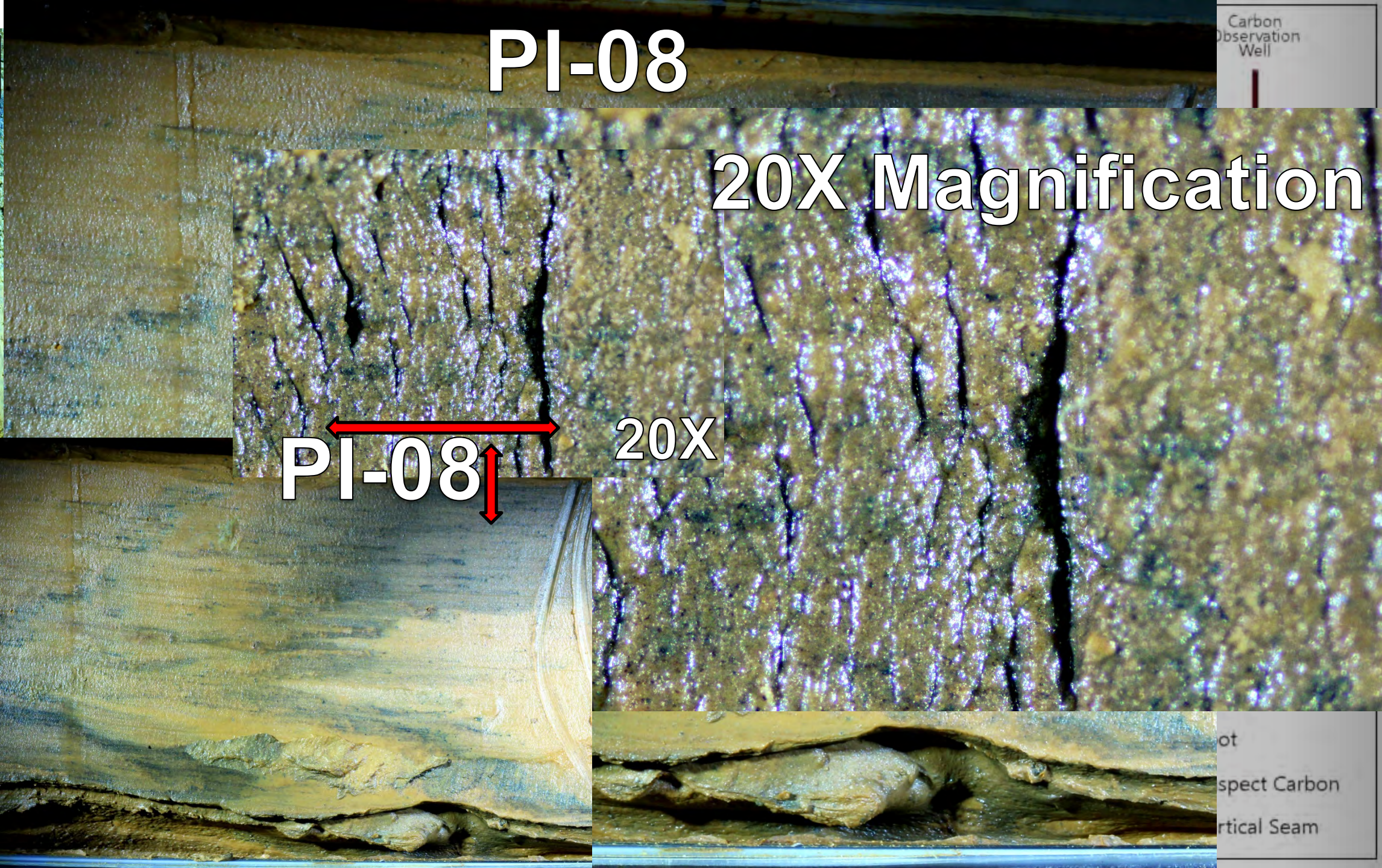
Carbon
Observation
Well

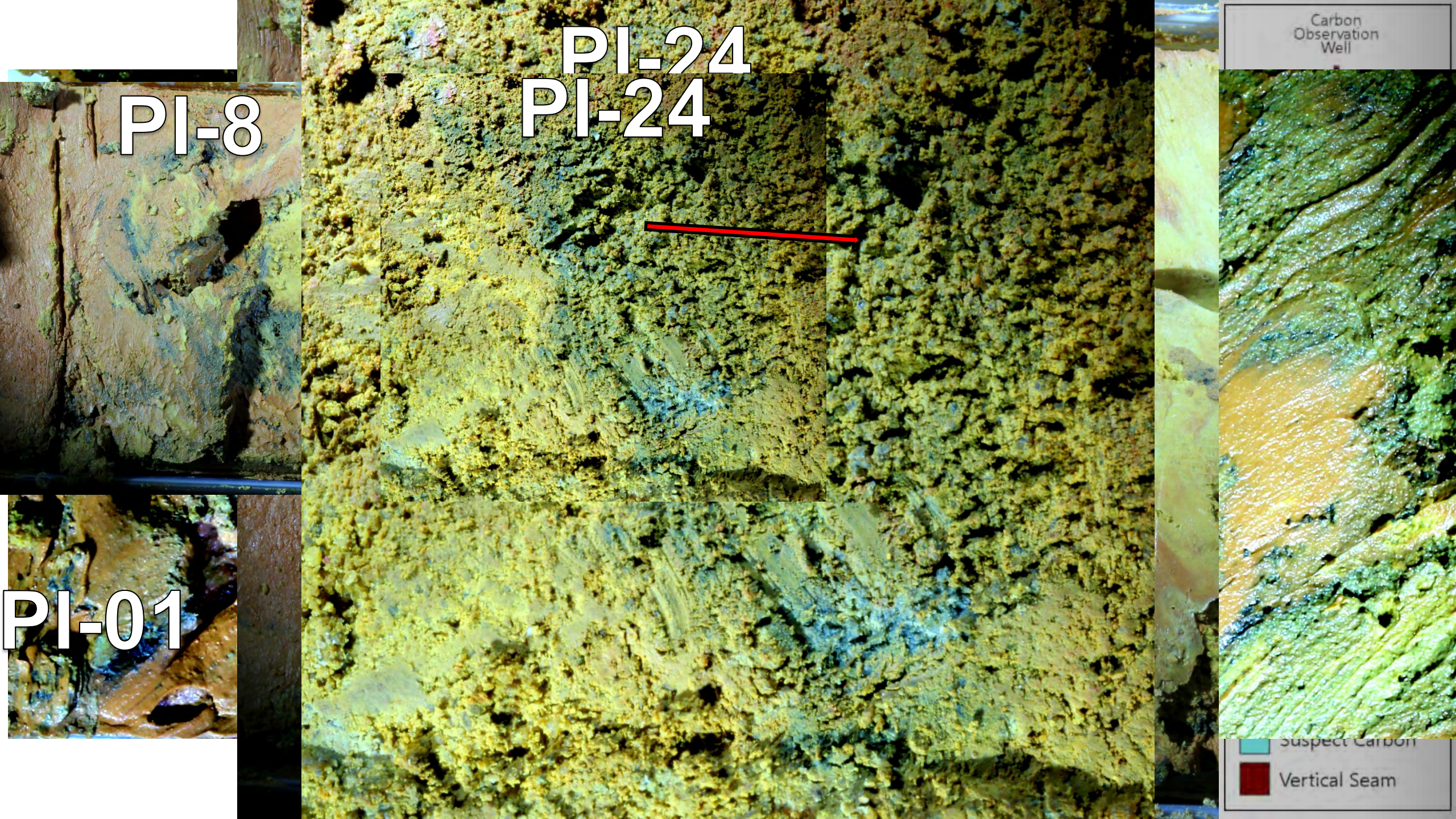
20X Magnification

PI-08

20X

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spect Carbon
rtical Seam





PI-8

PI-24
PI-24

Carbon
Observation
Well

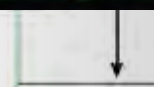
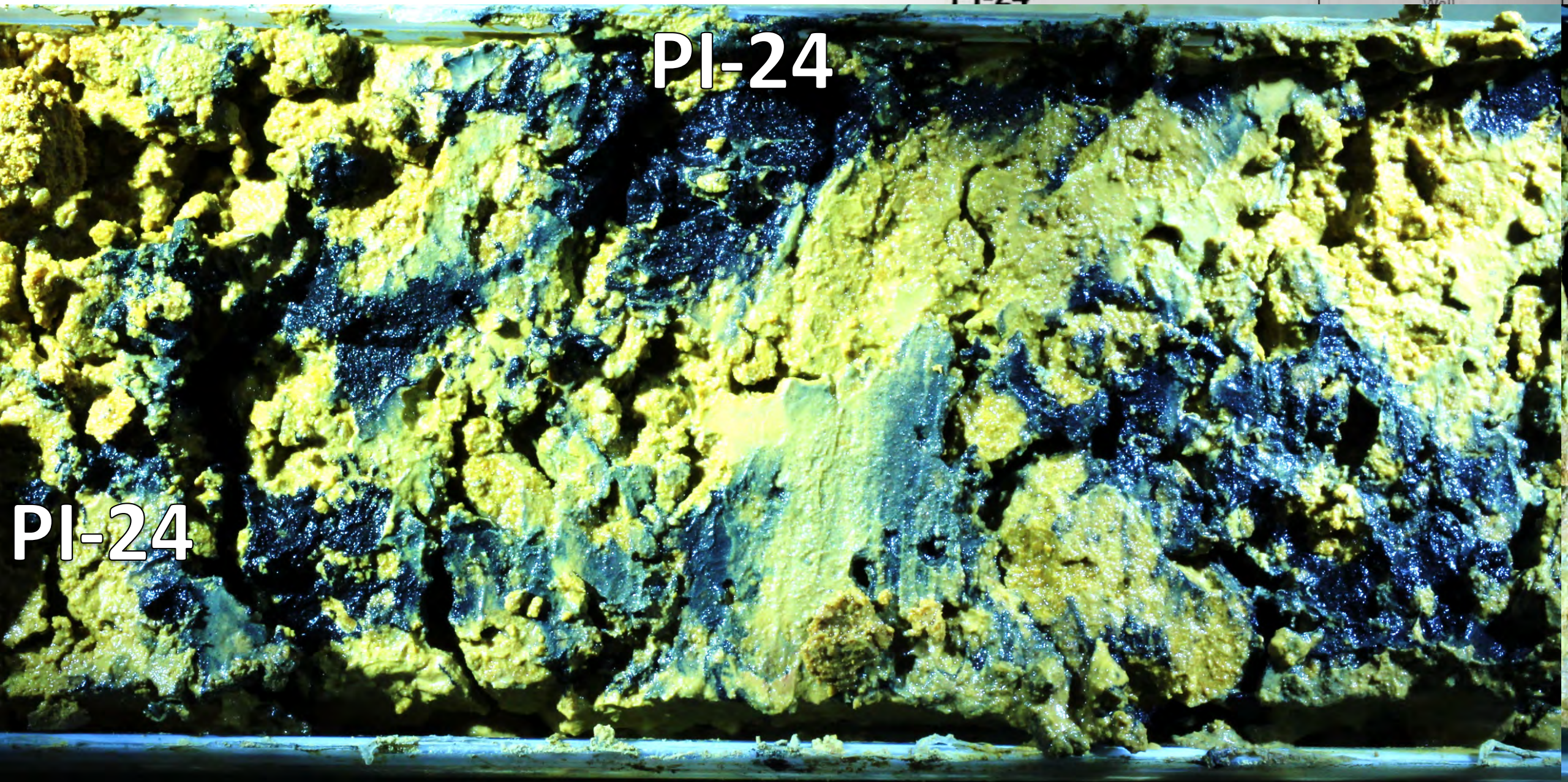
PI-01

■ suspect carbon
■ Vertical Seam

PI-24

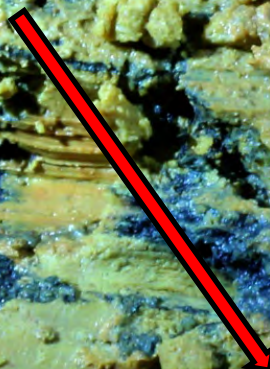
PI-24

PI-24



Vertical Seam

PI-24



PI-18

PI-18

PI-24

PI-26

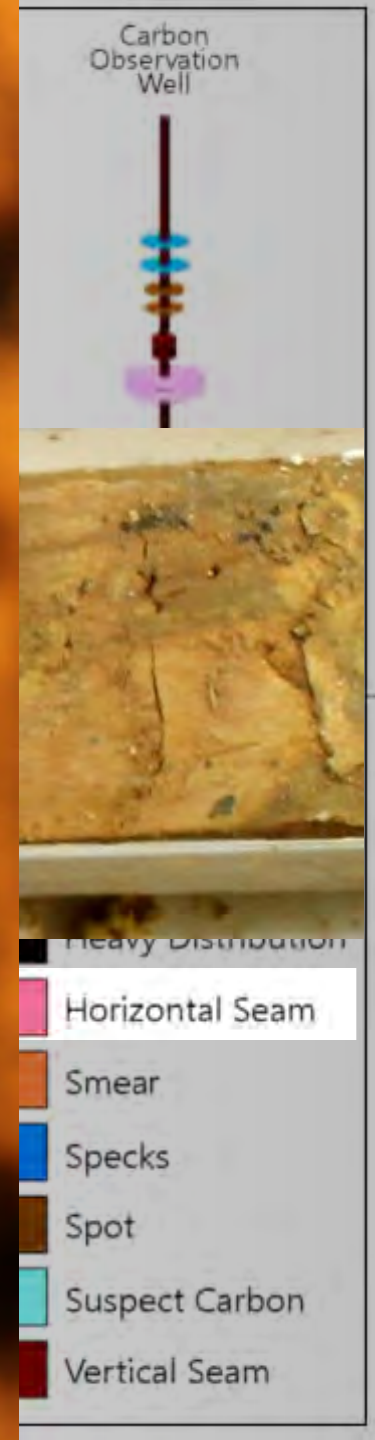
Carbon
bservation
Well

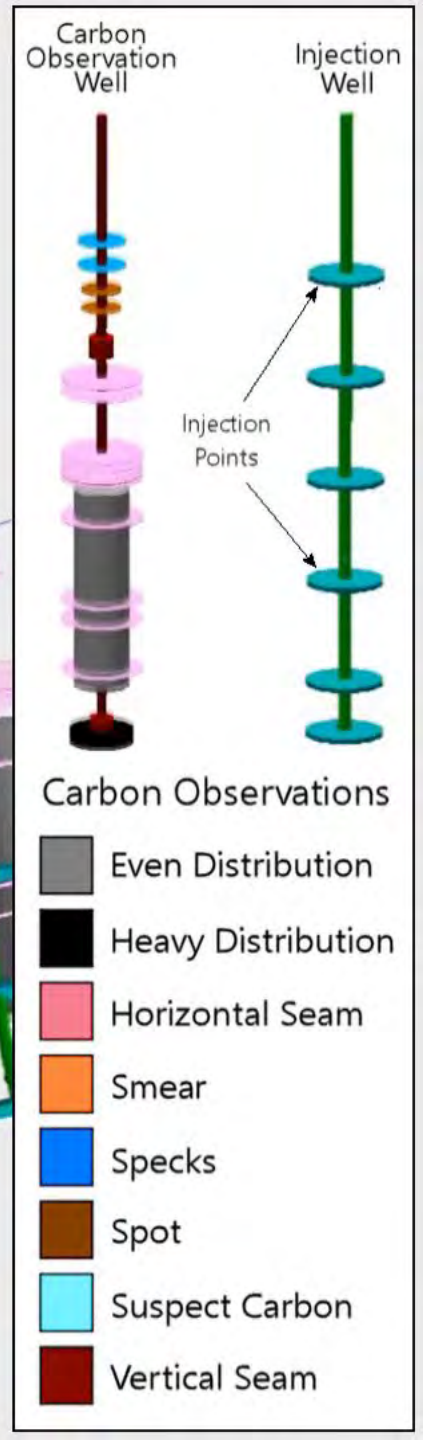
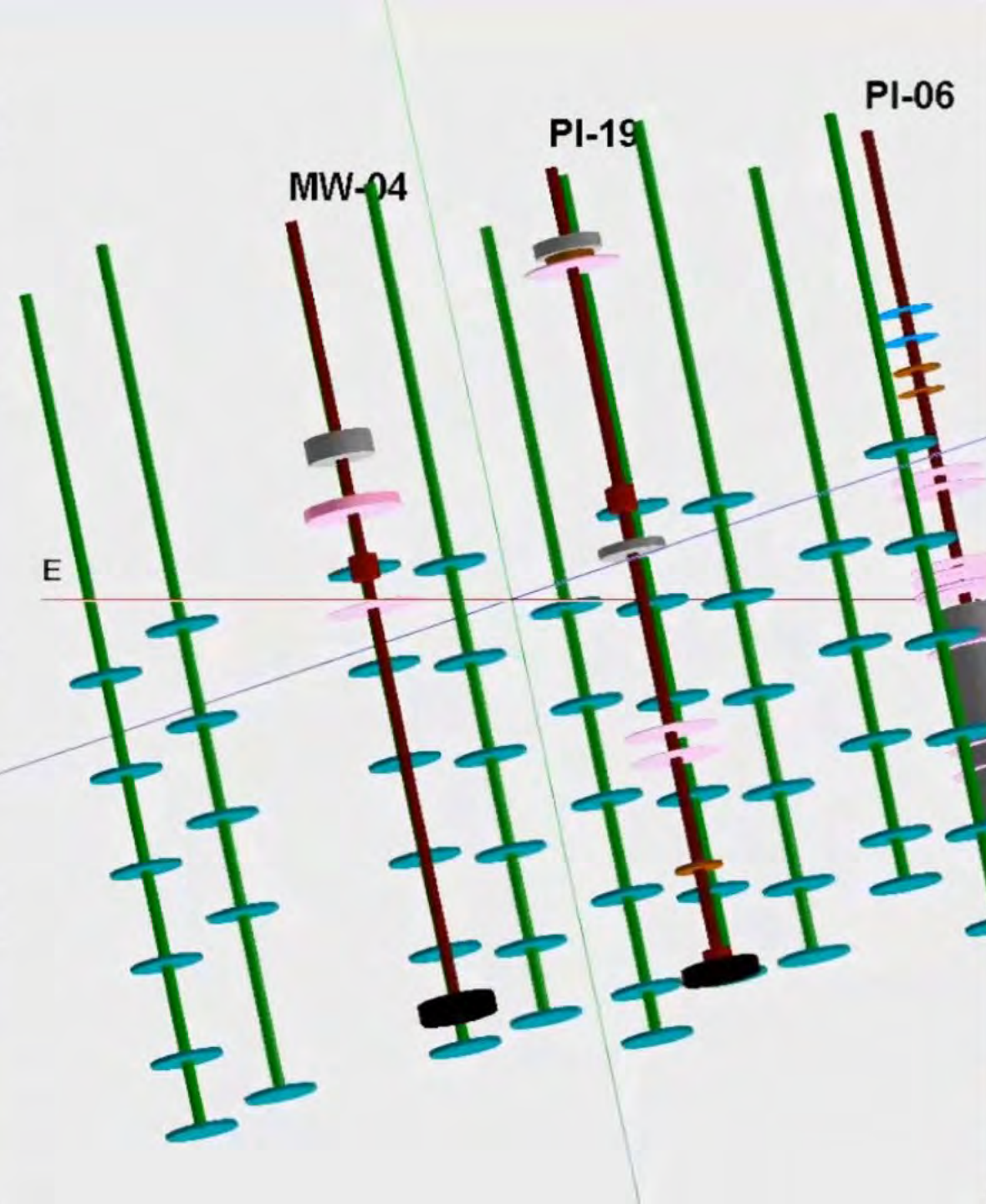
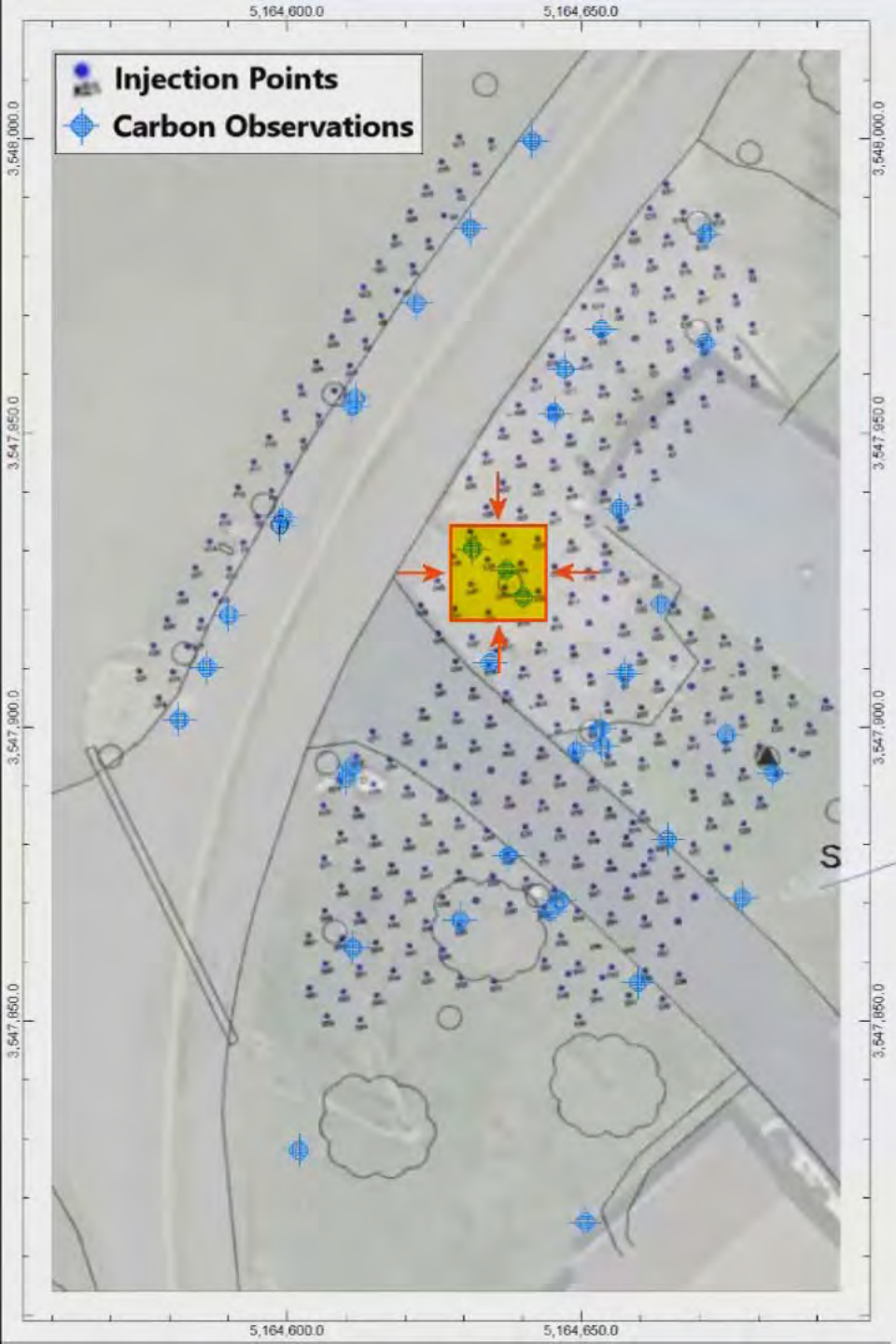


PI-20

MW-08

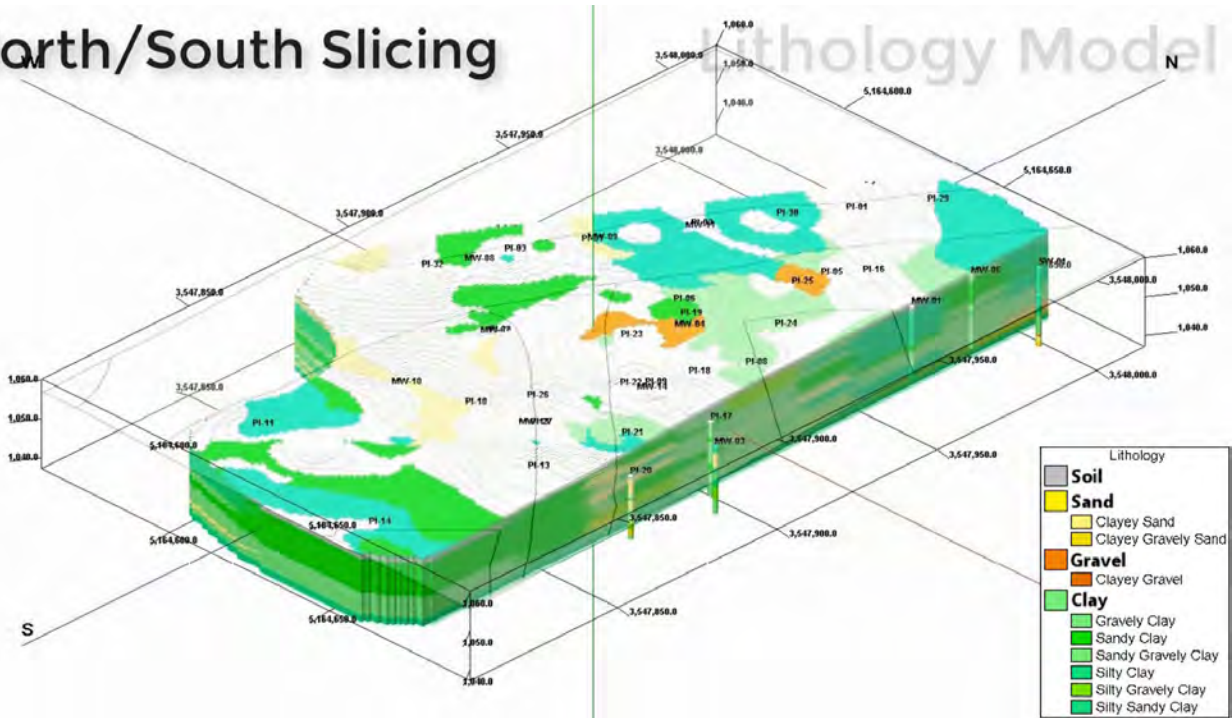
MW-08



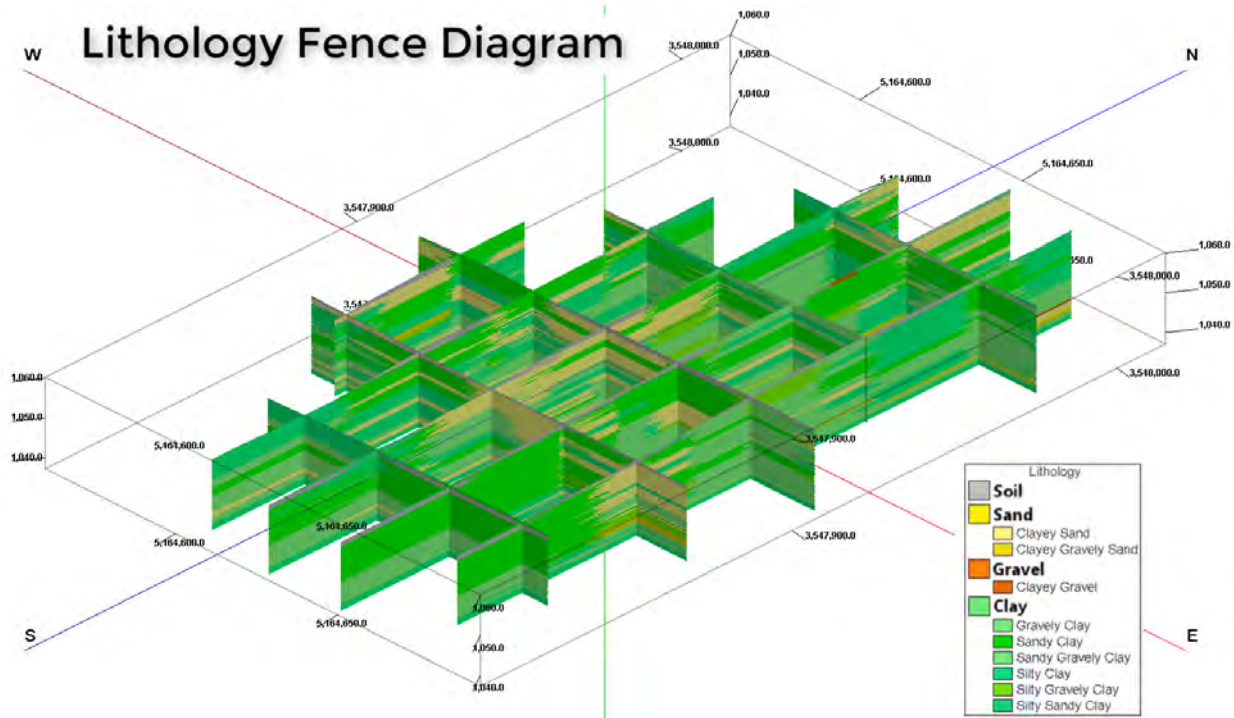


Additional Modeling Highlights - Geology

North/South Slicing

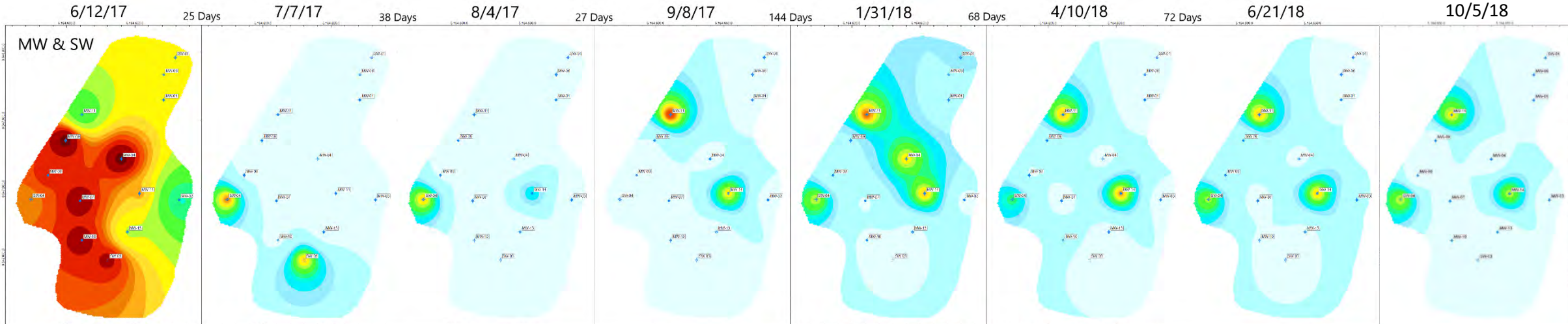


Lithology Fence Diagram



Distribution Statistics

Inj Interval (ft)	6 - 8	8 - 10	10 - 12	12 - 14	14 - 16	
(ft)						
Total Sightings	53	65	53	36	65	272
Percentage	19	24	19	13	24	19.8%
3% of the total sightings were within the 0 to 5' depth interval						

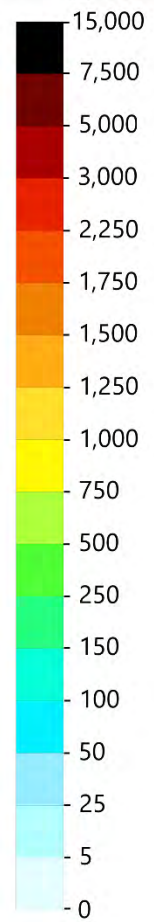


Benzene Levels

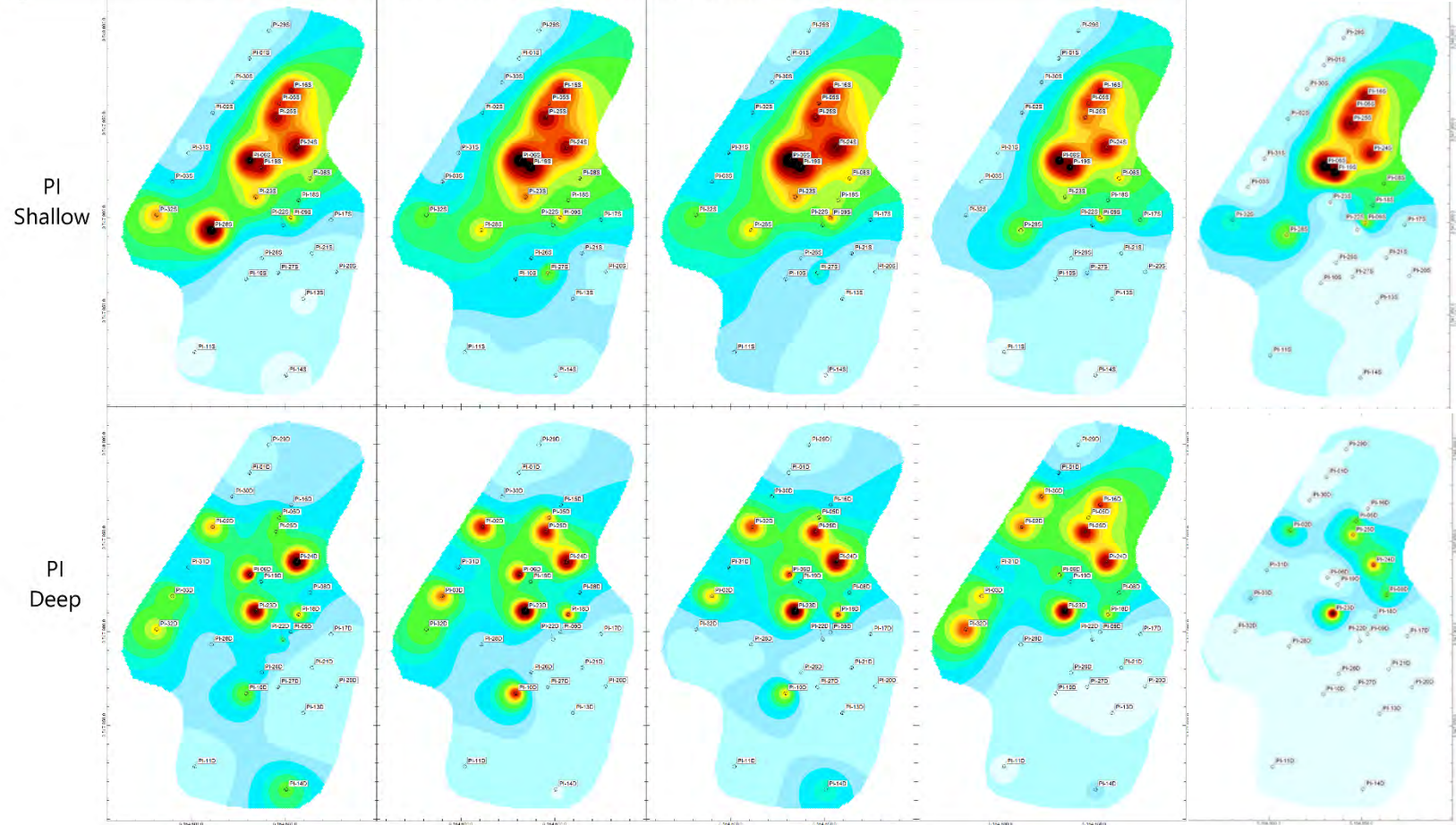
Top Row:
 MW-1,2,3,4,5,6,7,8,9,10,11,13,14,15 &
 SW-1,2,3,4

Middle Row:
 PI-1,2,3,5,6,8,9,10,11,13,14,15,16-32 Shallow

Bottom Row:
 PI-1,2,3,5,6,8,9,10,11,13,14,16-32 Deep



All Horizontal Units = Feet



Questions

I appreciate the work of those who contributed to this presentation either in its development or by executing the on the ground work at the Gosser Grocery site. Regardless of individual contributions, the ideas expressed are my own and may or may not be shared by those who contributed. I'd like to thank the following individuals or entities:

Alvin Campbell – Gosser Grocery Project Manager – KY DWM UST Branch



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