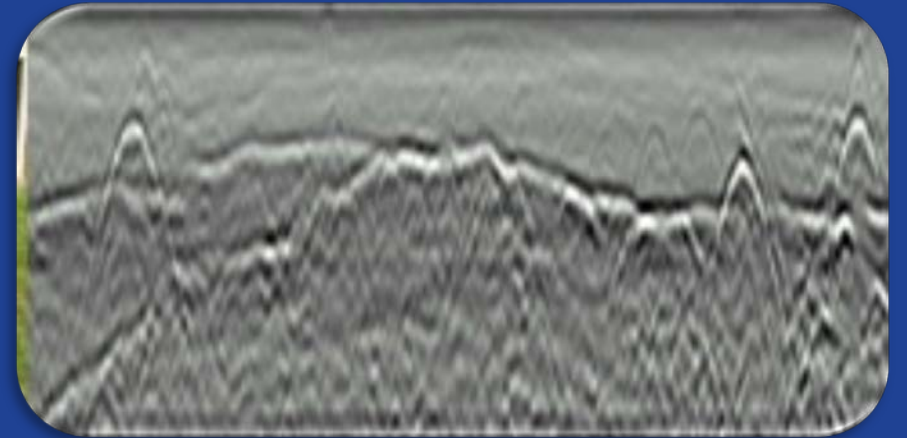
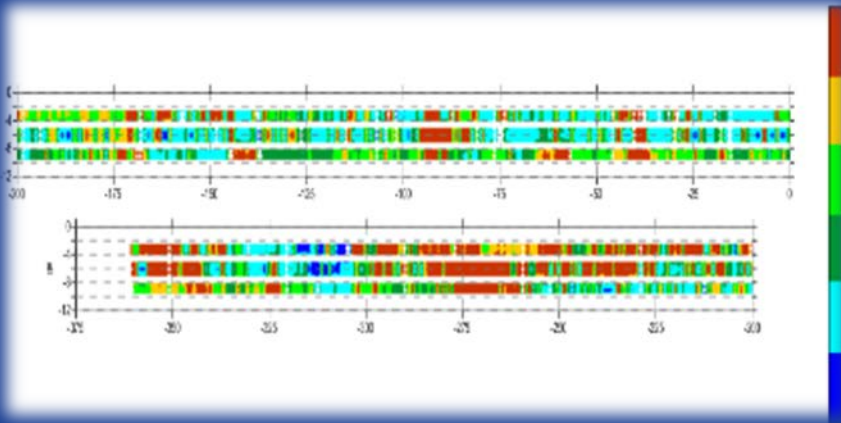


# Evaluation of 3D Radar and Sonic Surface Scanner (SSS) Technology for Pavement Forensics (a.k.a. pavement delamination RO6D)

## KENTUCKY

Brad Rister P.E.  
Brad Frazier P.E.  
Jamie Creech Eng. Tech.  
Joe Tucker P.E.  
Kate Kurgan  
Michael Heitzam P.E.



# Outline: Why - Where - What - How

Evaluation of 3D Radar and Sonic Surface Scanner (SSS) Technology  
for  
Pavement Forensics (a.k.a. pavement delamination RO6D)





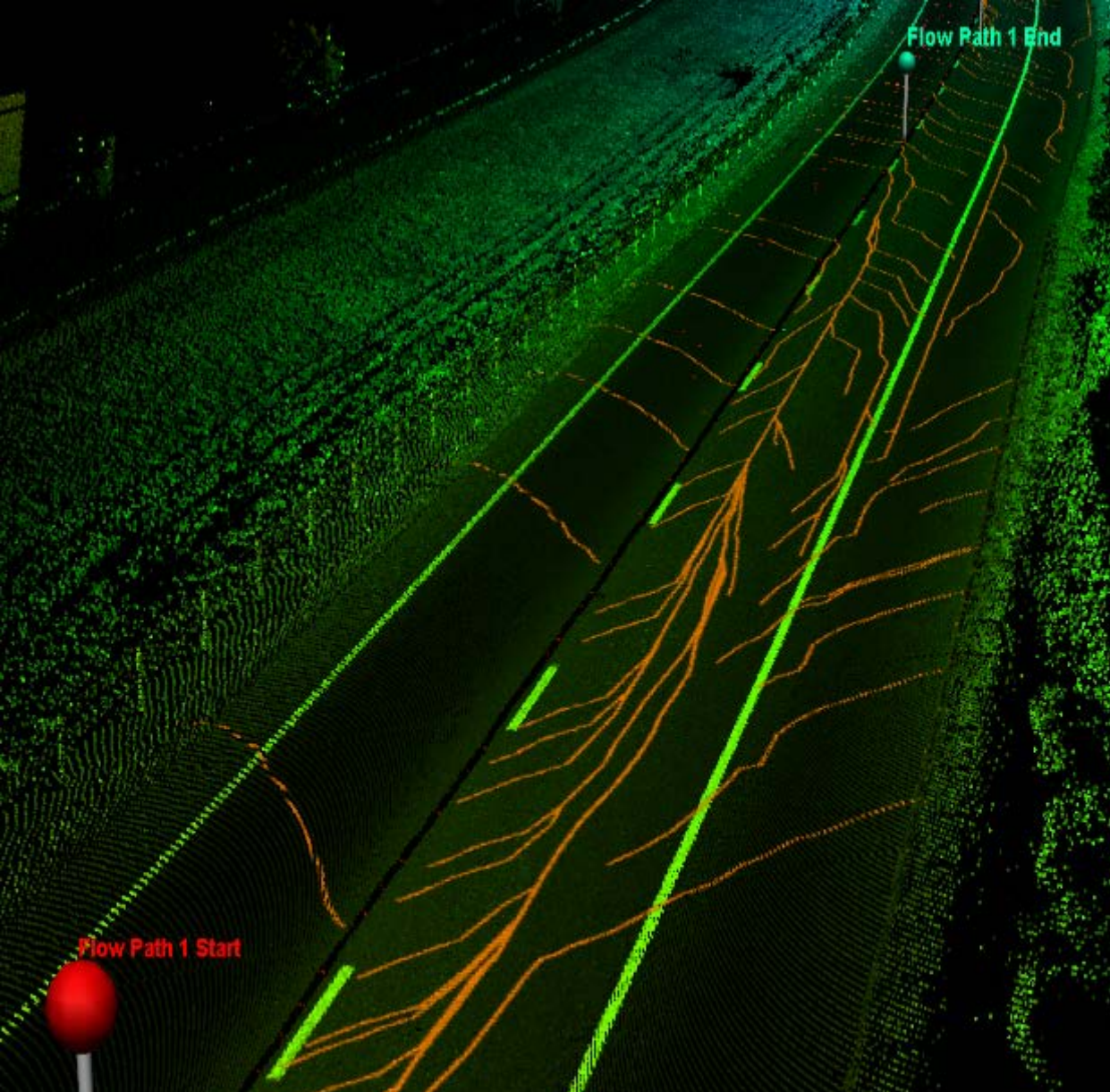
- Why evaluate new technologies for pavement delamination/forensics—RO6D
  - Pavements are an asset to our transportation network in Kentucky.
  - Kentucky has approximately 79,857 miles of roads.
  - Approximately 27% of Kentucky’s economy is in the “goods-producing industries” which highly depend on transportation for movement of those goods.
    - IE: UPS international, Ford truck plant, Toyota’s North American head quarters, Amazon distribution, Corvette plant, aggregates, farm products, thoroughbred horses, coal, bourbon, aluminum, oil, and 2<sup>nd</sup> most navigable in-land water ways state behind Alaska.
    - 500 mile radius (8 hour drive) from central KY—120 million people / 40% of US population.
  - Essentially, almost every person in Kentucky uses the road network sometime throughout their lifetime, if not every day along with many others.
  - But—Pavements fail and we have to fix them.



pavement failure could look like this?







## Identification of pavement rutting



TRB 1984:  $\frac{1}{4}$  inch water @ 45 mph on average tires will cause hydroplaning  
On average, there are over 5,760,000 vehicle crashes each year. Approximately 1,259,000 are weather related  
"USDOT"

When we choose to fix these pavements

Pavement designers need good field data to support their pavement rehabilitation plans

Choosing the right fix can save both time and money

AASHTO

“more quality data can translate into better results and solutions for highway projects”

Use Pavement Forensics



## Pavement Forensics is....

- Utilizing non-destructive technology (NDT) to better understand what might be causing a pavement to fail and using that information to assist in the pavement rehabilitation design process.





# Where: Forensic Project Site--Bourbon Co. US 60

- <https://kytranscenter.maps.arcgis.com/home/index.html>





Avoid First Change Order  
all cores came from the same project  
over a 1.5 mile area

Estimated Pavement Forensics  
Savings to Date  
August 2018: \$3.7 million





# What – How

Looking at the technology: Sonic Surface Scanner (SSS), 3D Radar and Impulse Radar





# Sonic Surface Scanner Impact Echo (IE) and Spectral Analysis of Surface Waves (SASW)



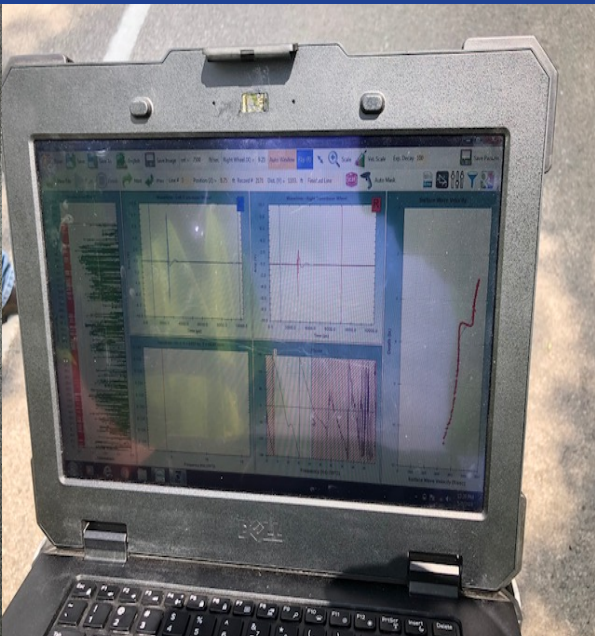
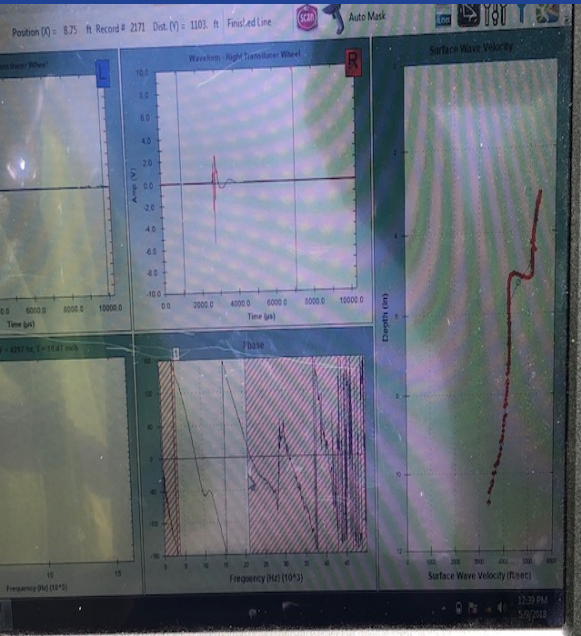
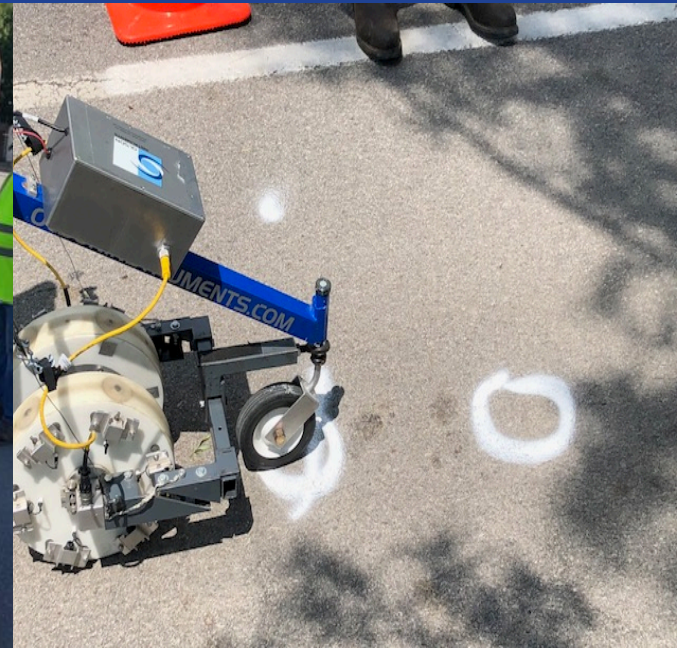
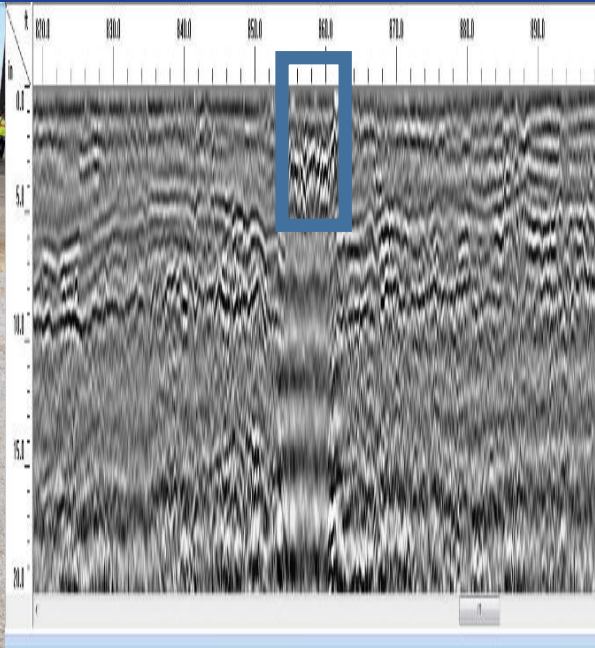
Safety First  
\$7,500







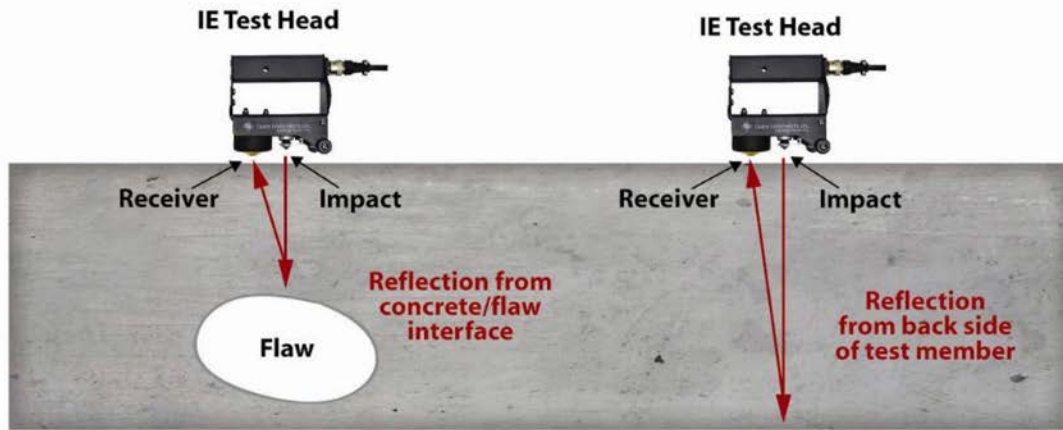
# Field Data Collection and Verification



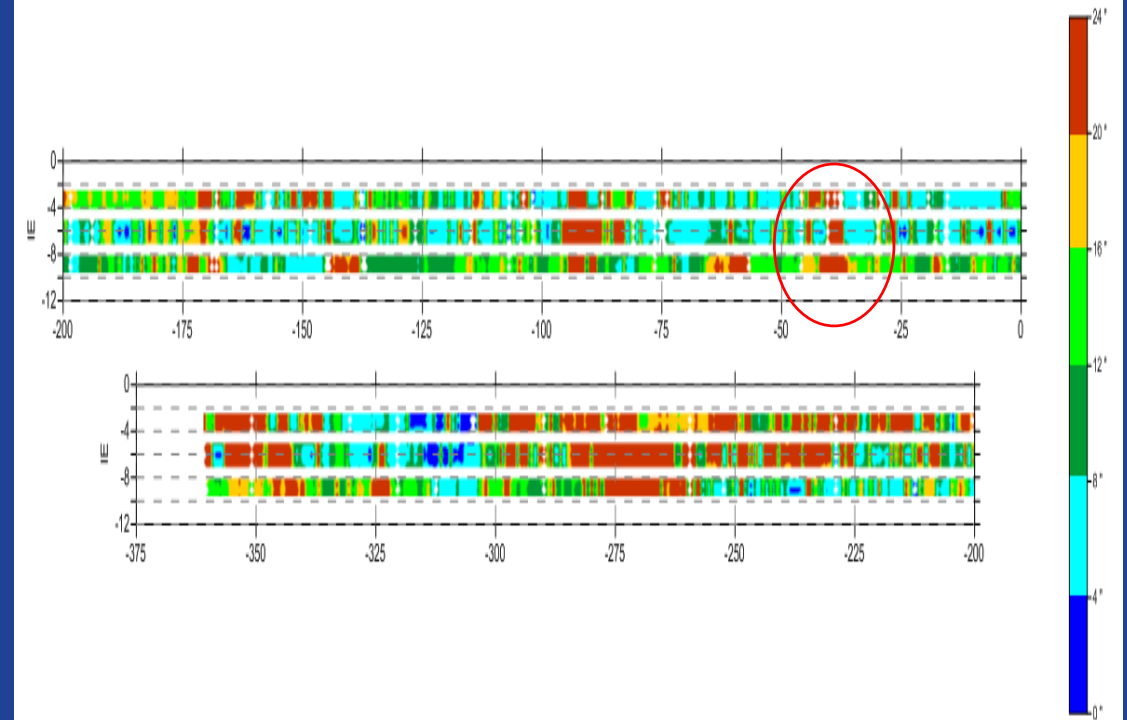


# Impact Echo (IE) Theory / Data

## Impact Echo Test - IE



Reflection from back side occurs at a lower frequency than that from shallower concrete/flaw interface.

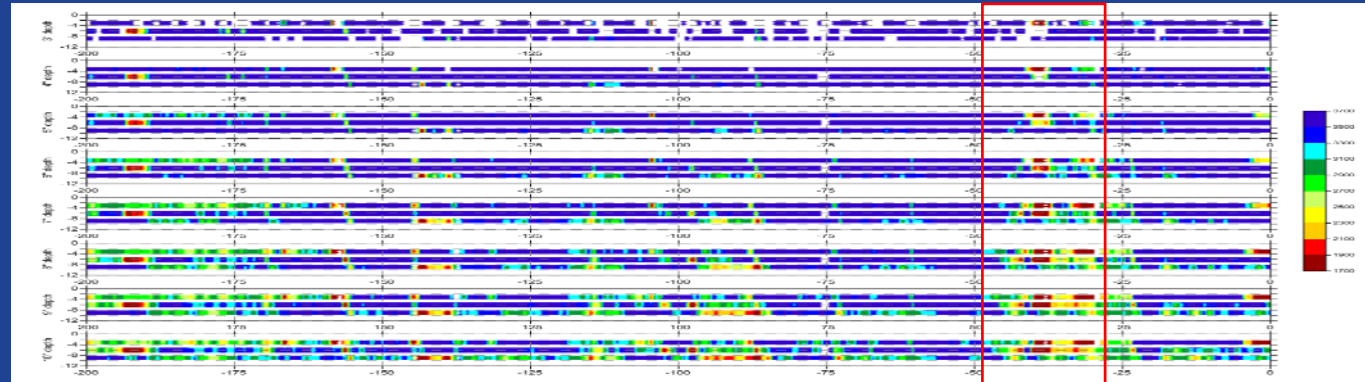


# SASW Theory / Data

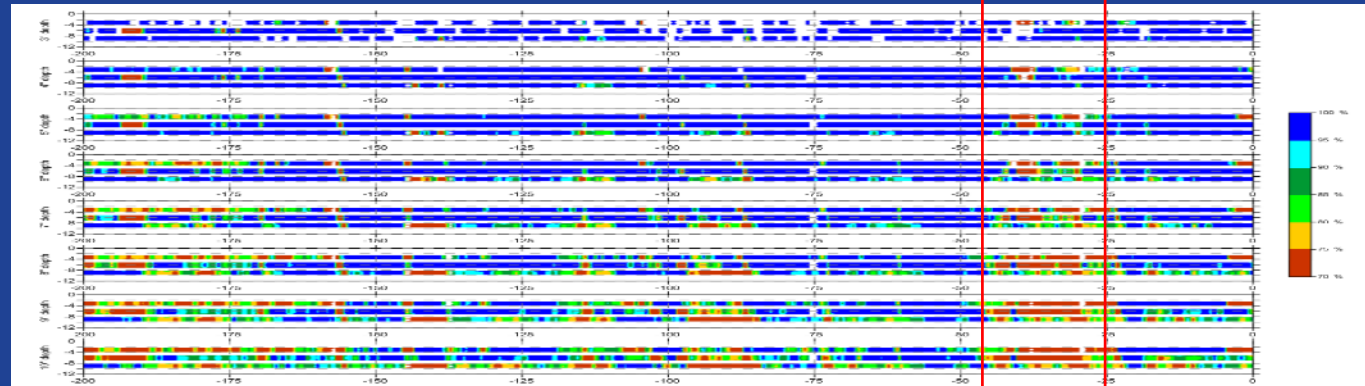
## Spectral Analysis of Surface Waves Test - SASW



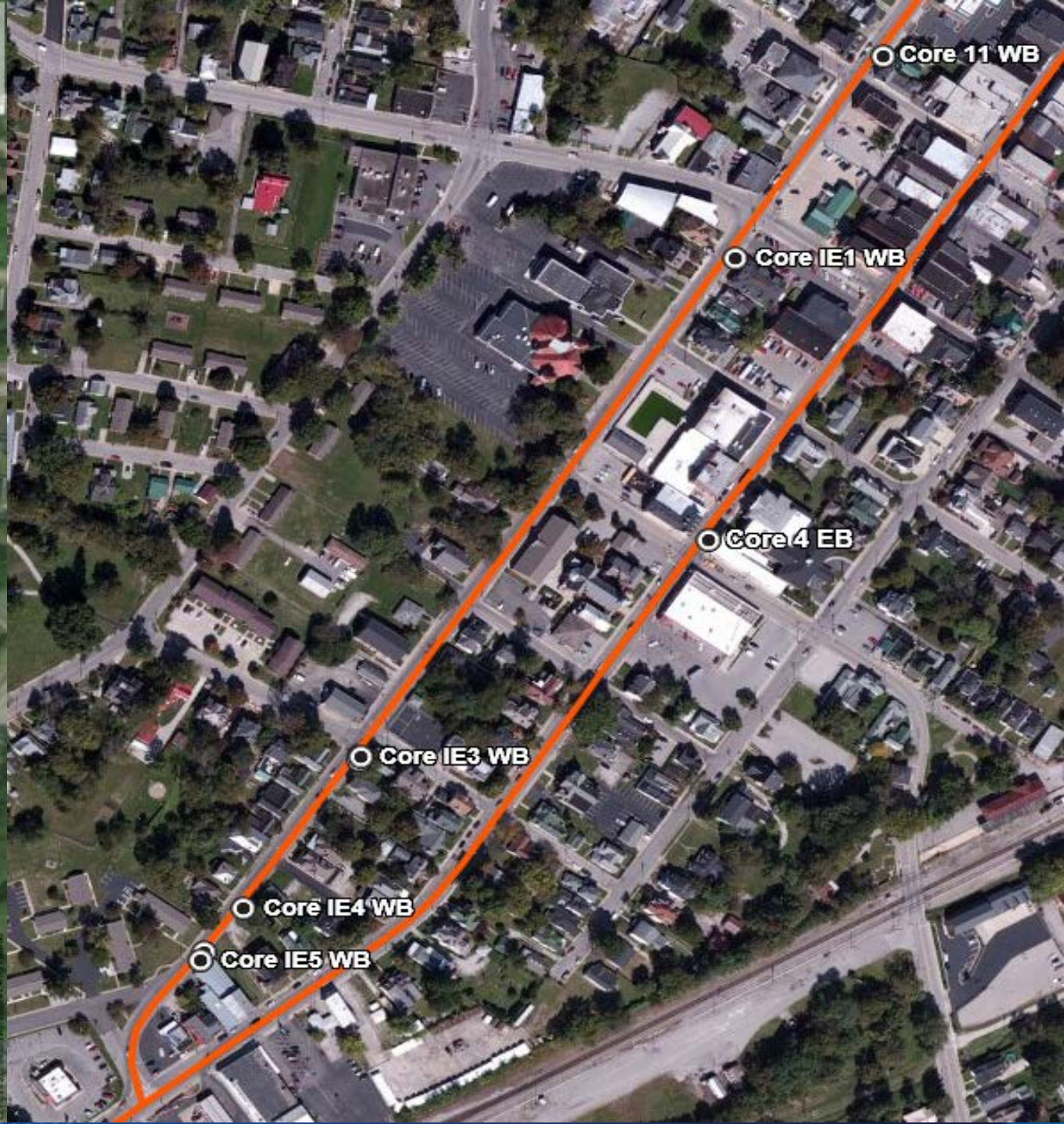
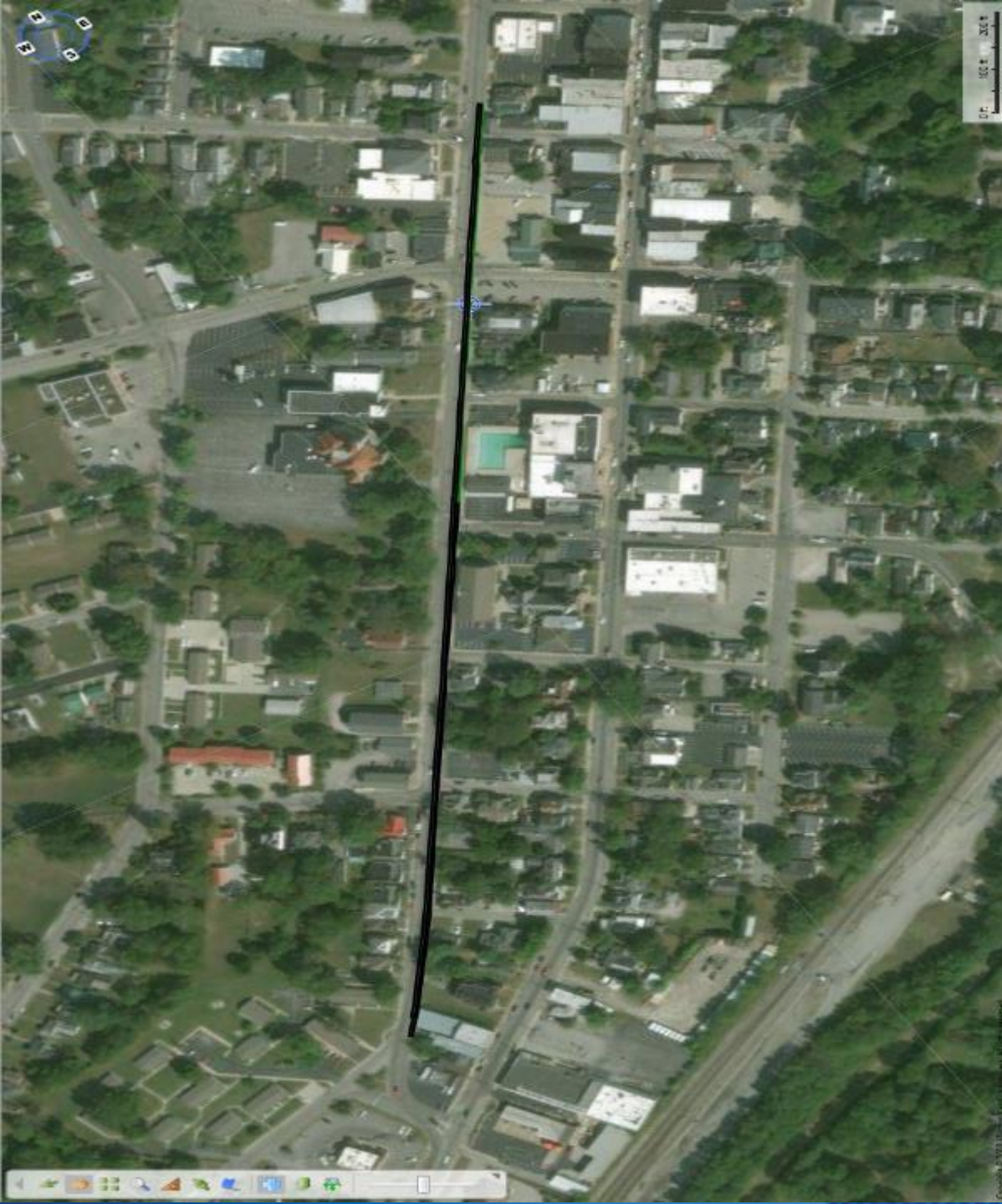
absolute velocity



normalized velocity









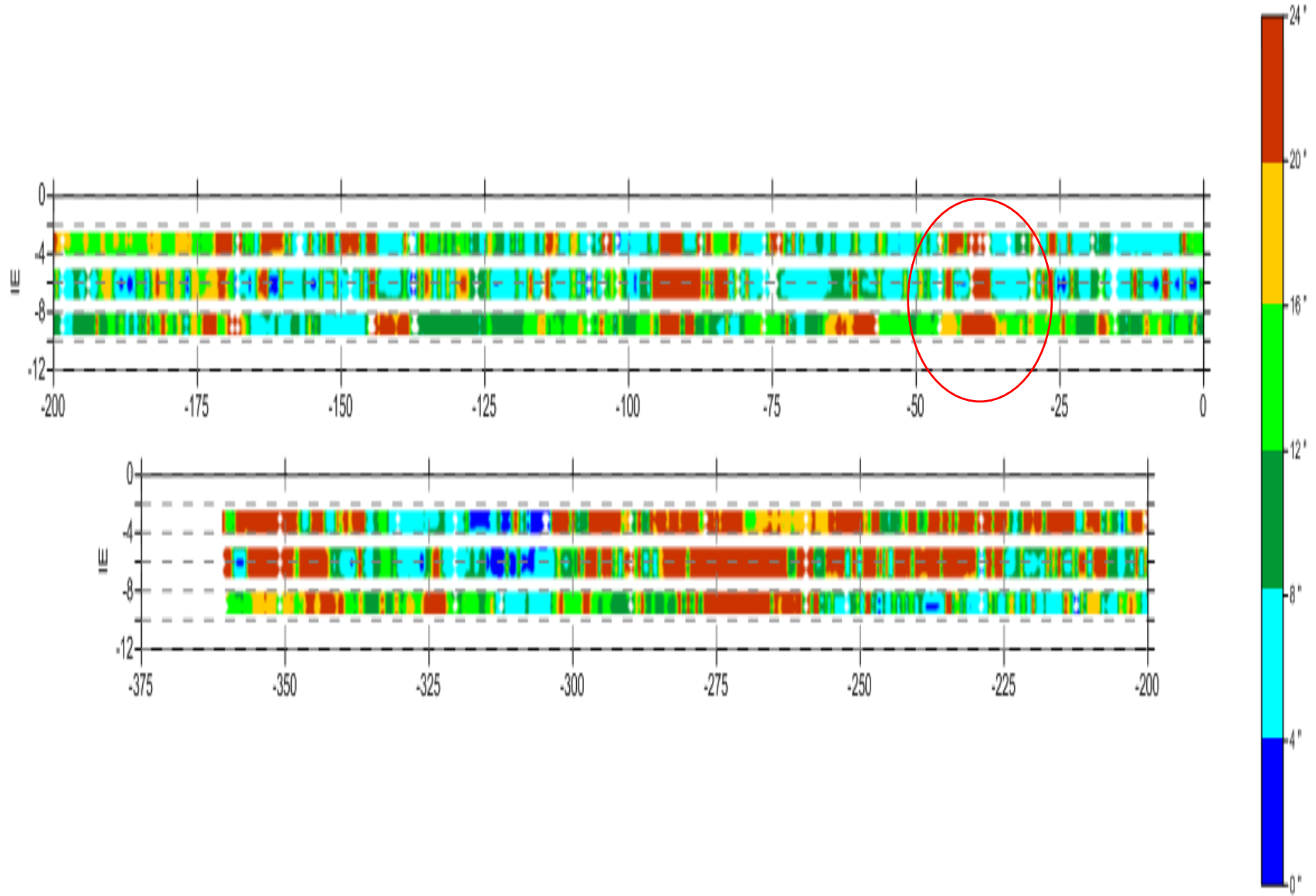
# Matching up Field Data to Report Data (GPS conversion to DMI)





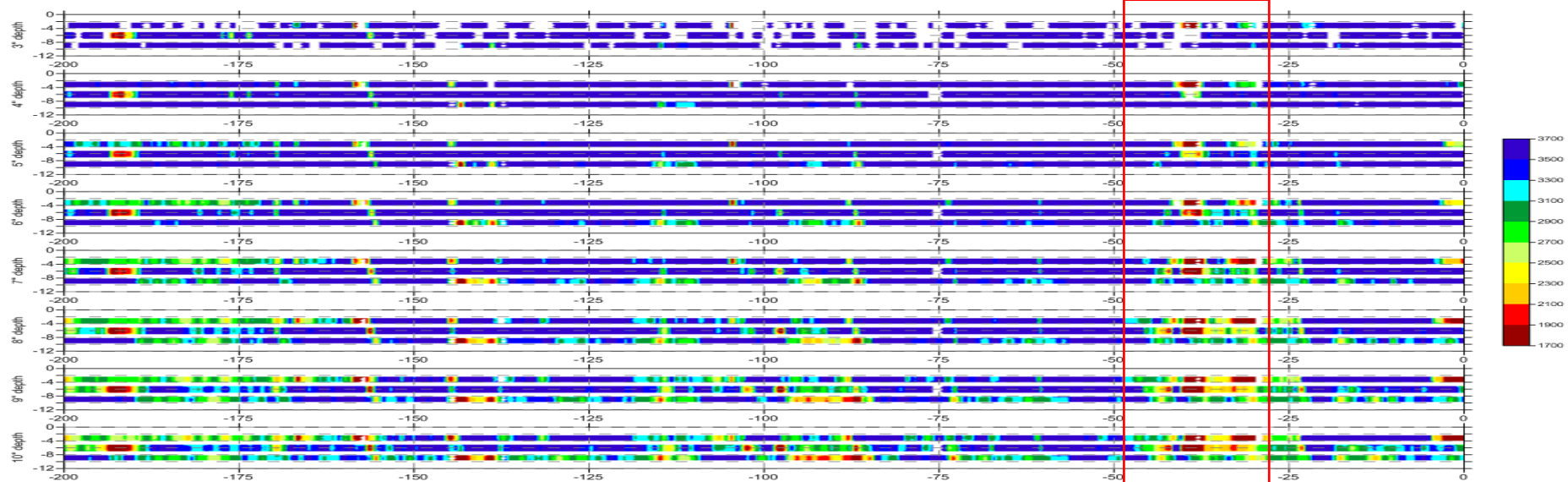
# Impact Echo: core 11, section one, RWP--30.7 feet

Core 11

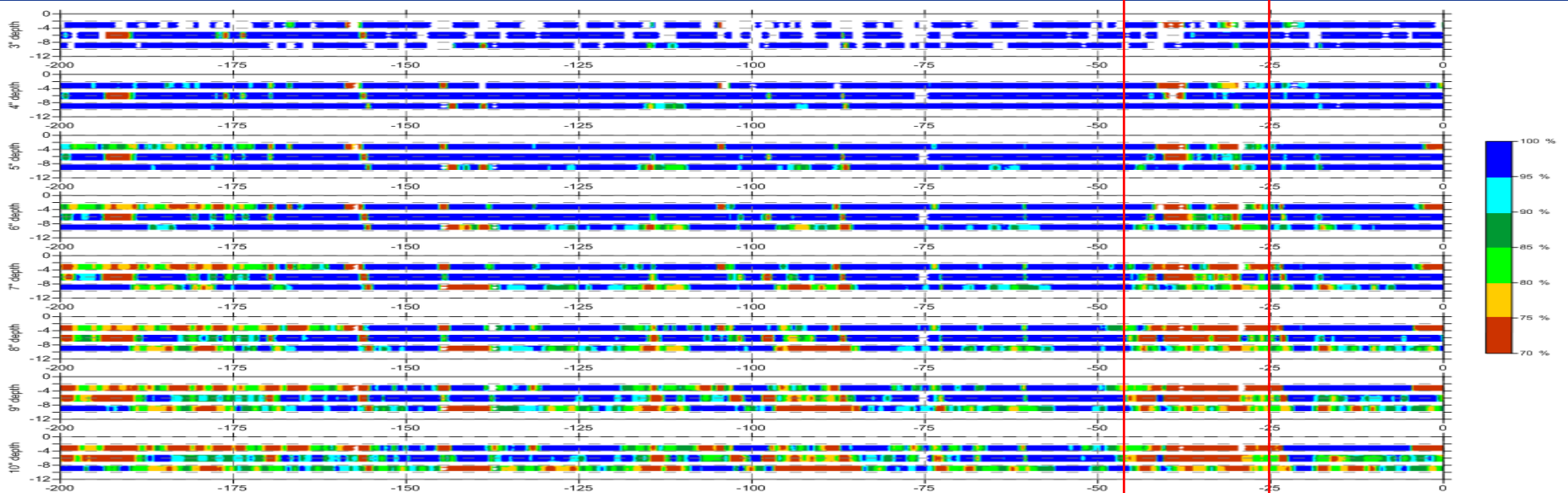


# SASW: core 11, section one, RWP--30.7 feet

absolute velocity



normalized velocity



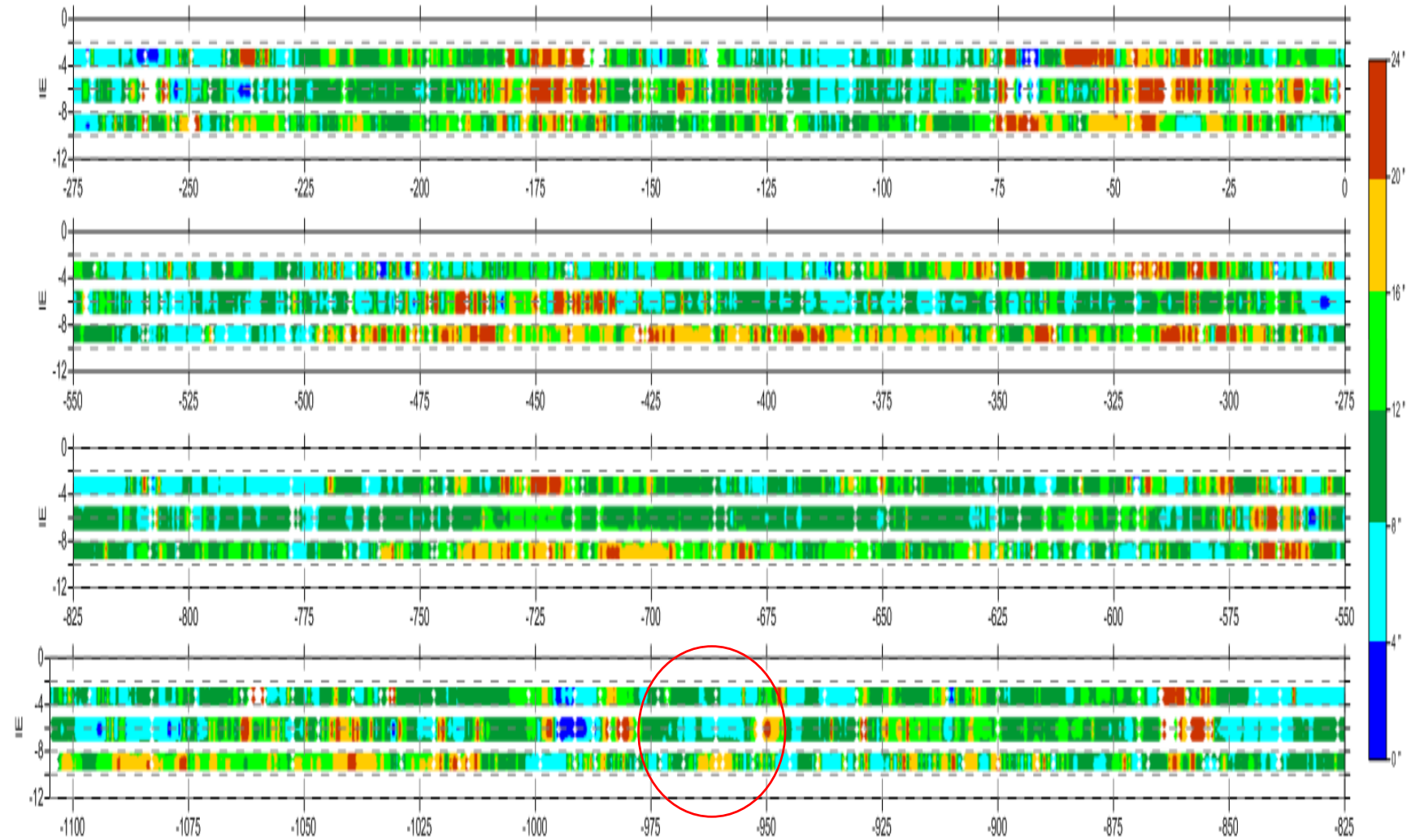
Core 11





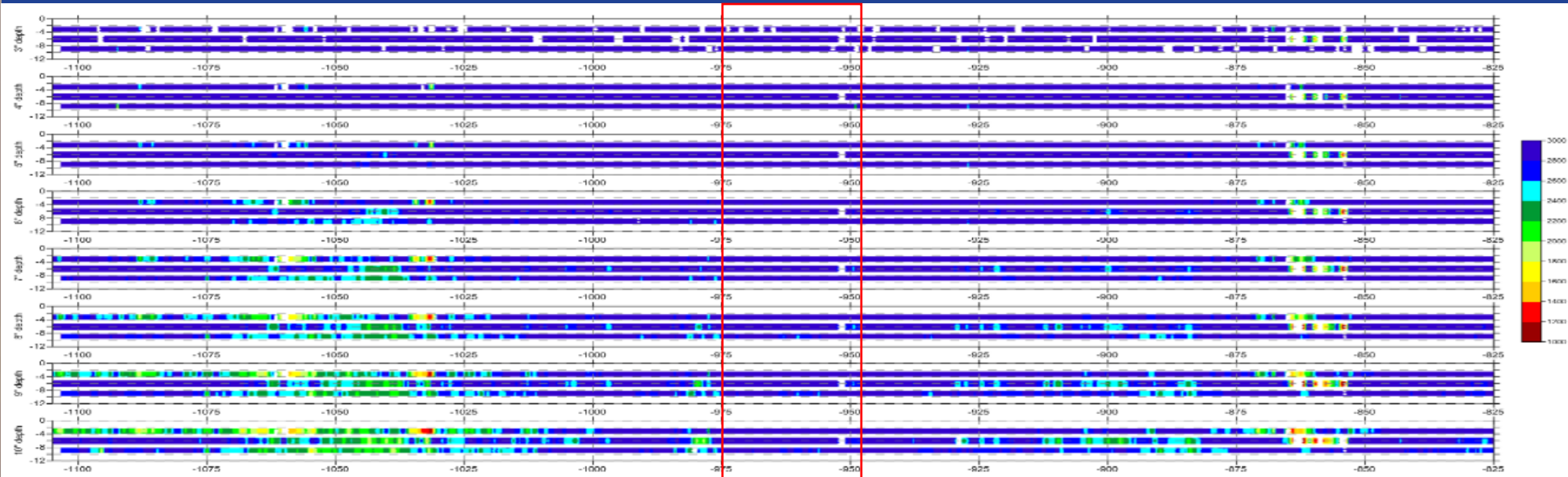
# Impact Echo: core IE4, section three, CWP--960.7 feet

IE 4

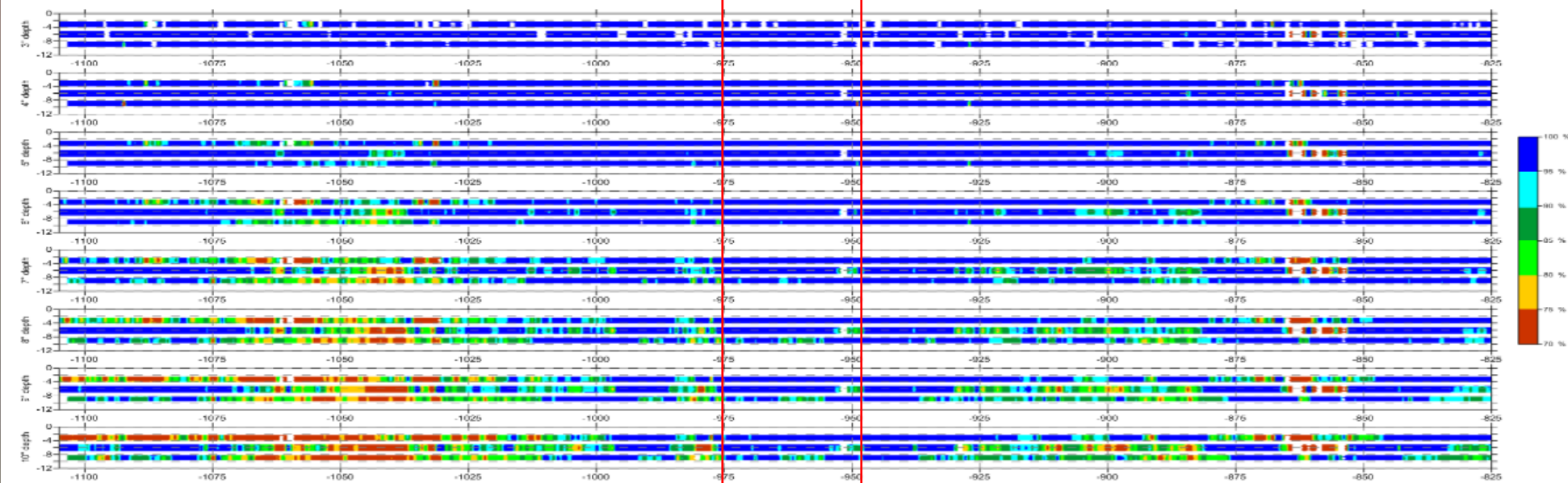


# SASW: core IE4, section three, CWP--960.7 feet

## absolute velocity



## normalized velocity

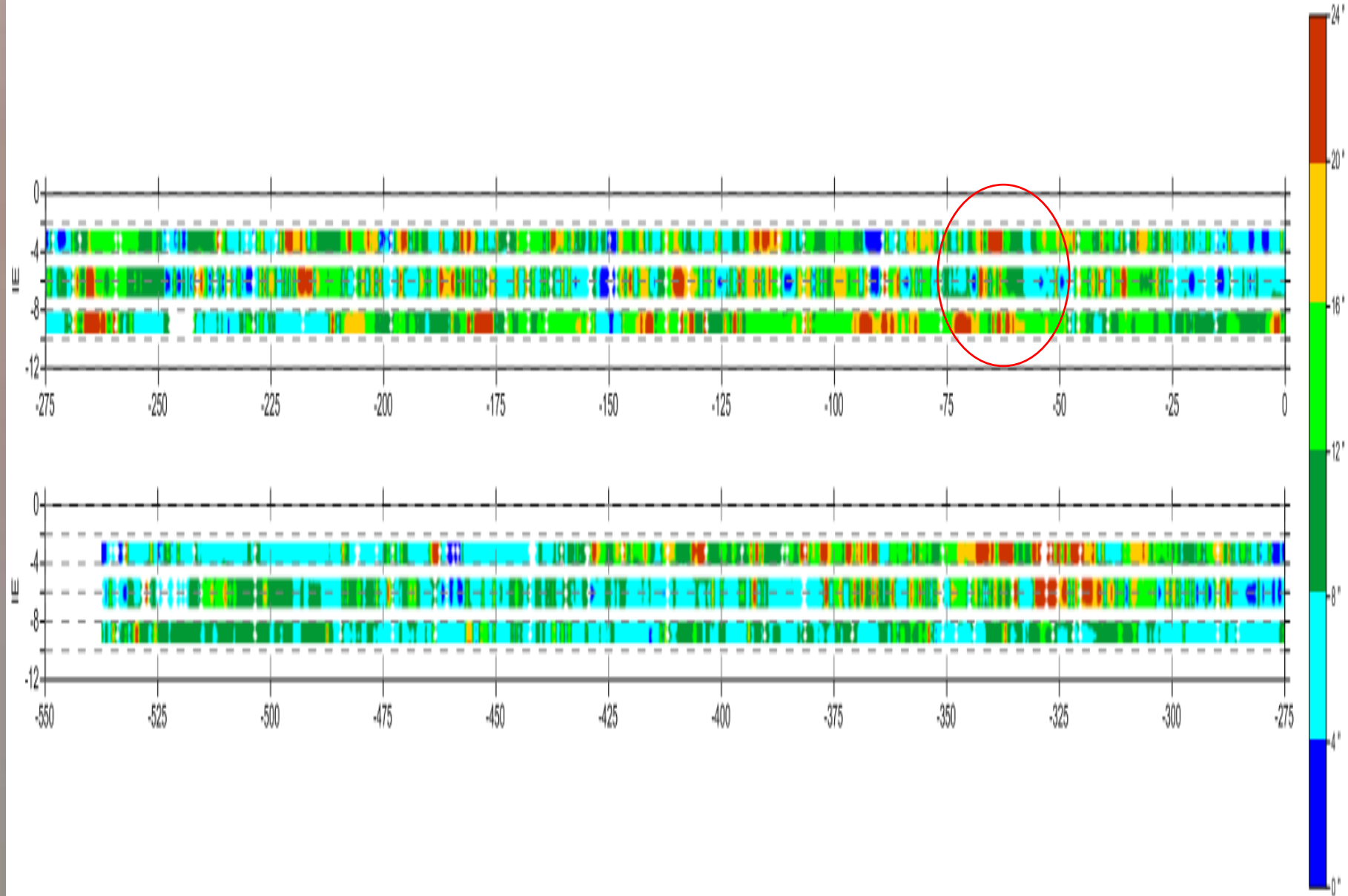


IE 4



# Impact Echo: core IE1, section two, LWP--60.5 feet

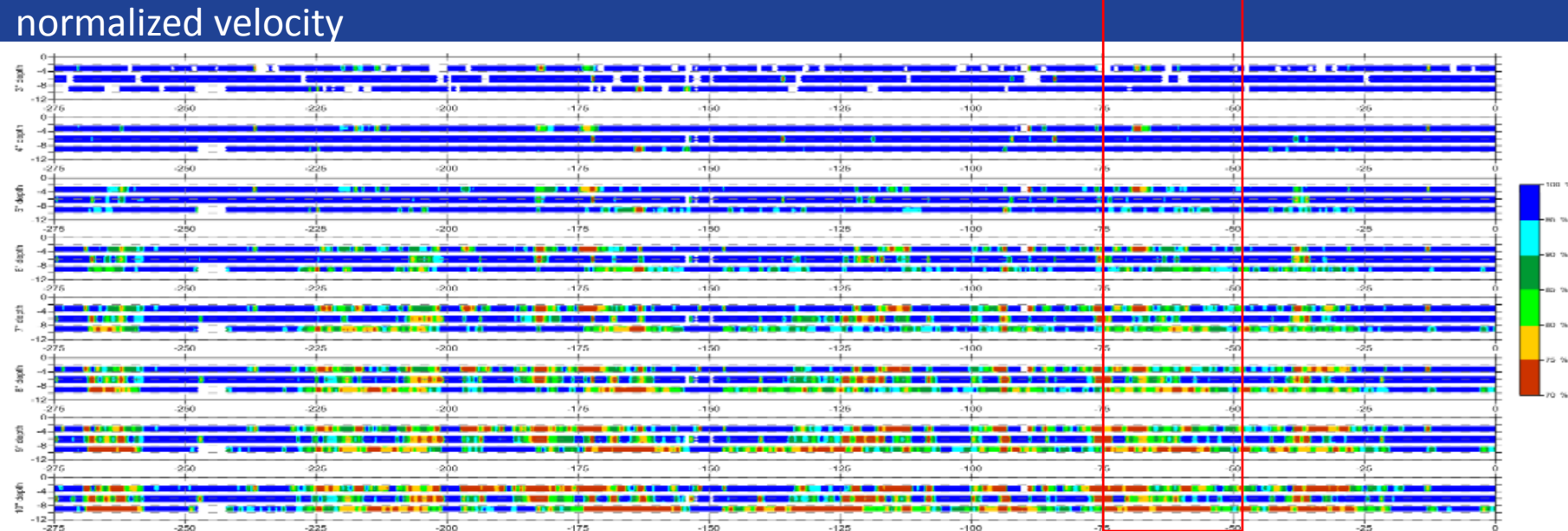
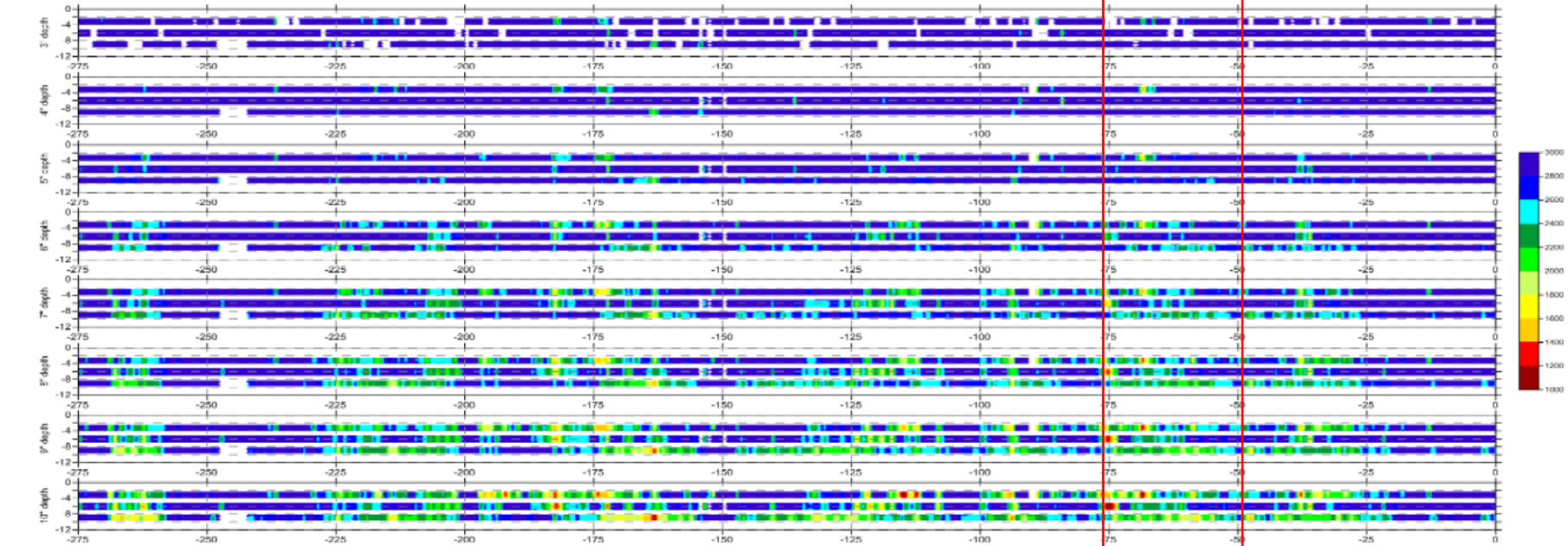
Core IE1





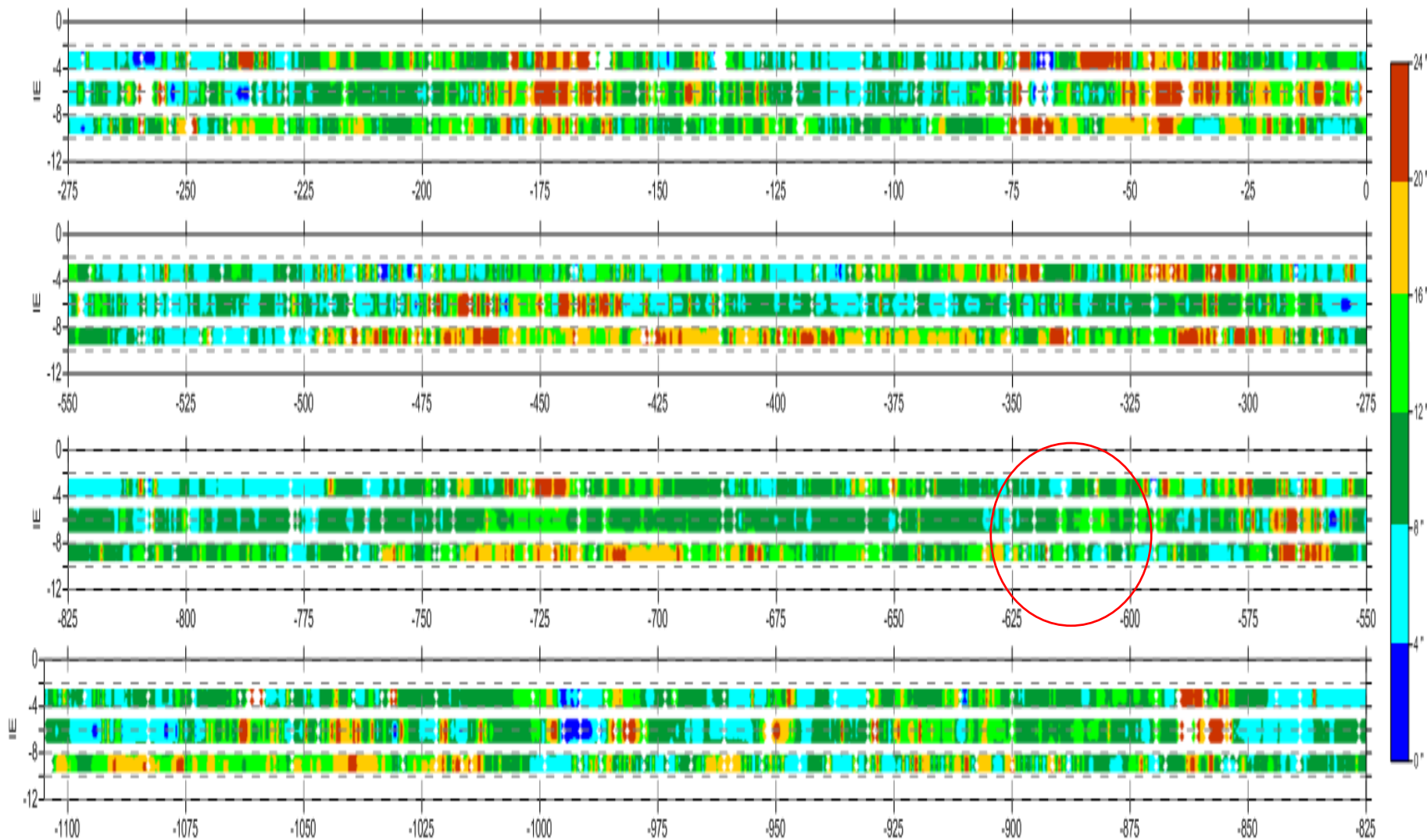
Core IE1

# SASW: core IE1, section two, LWP—60.5 feet



# Impact Echo: core IE2, section three, LWP--616.8 feet

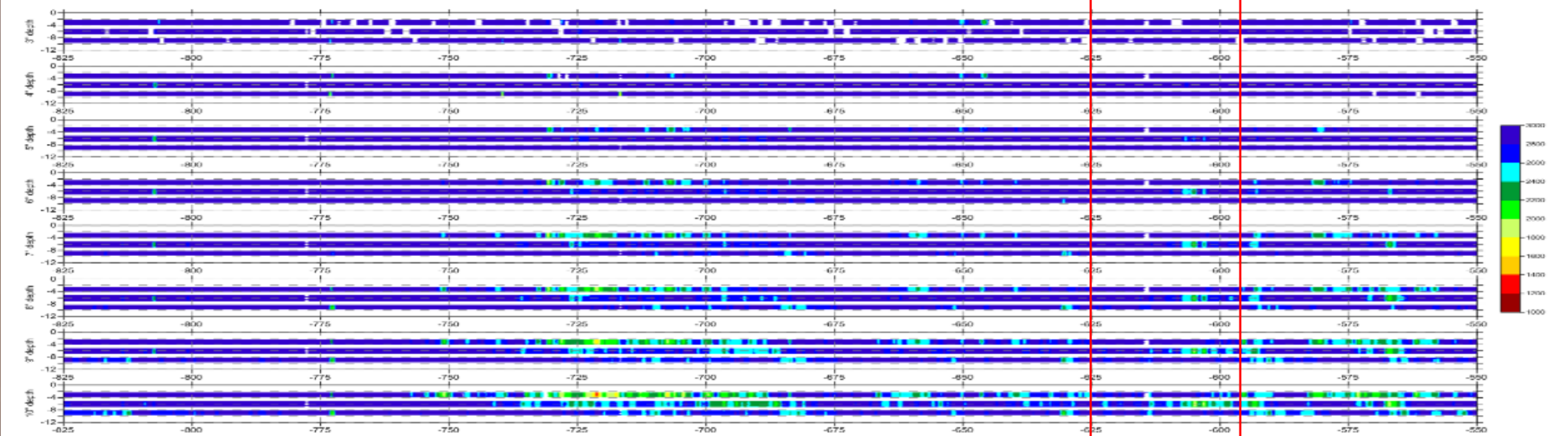
IE 2



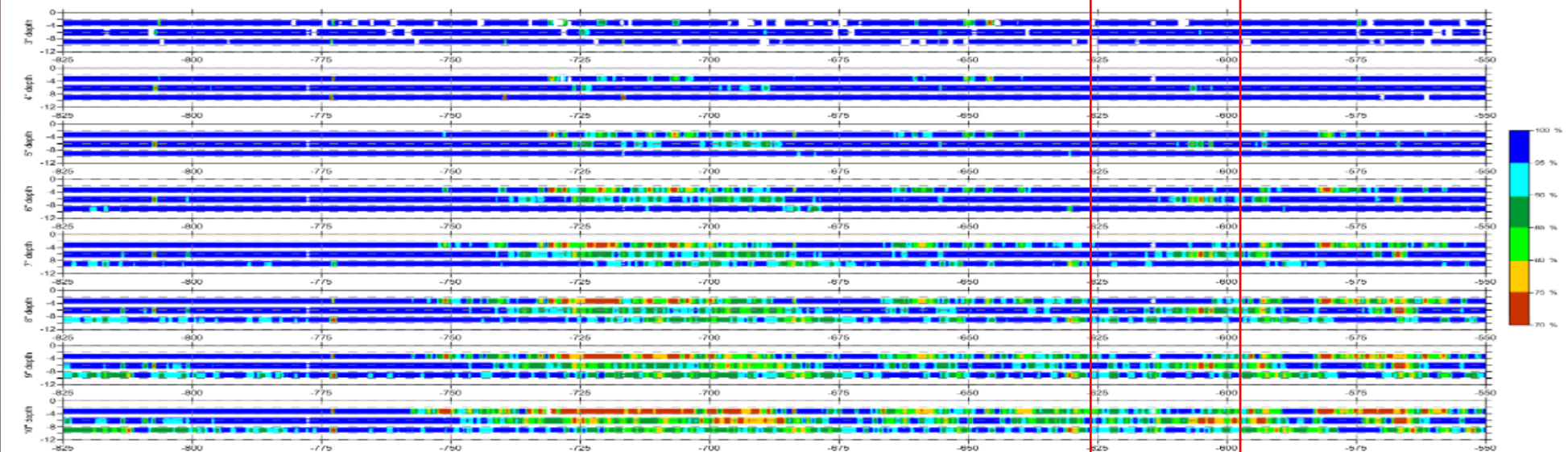


# SASW: core IE2, section three, CWP--616.8 feet

absolute velocity



normalized velocity

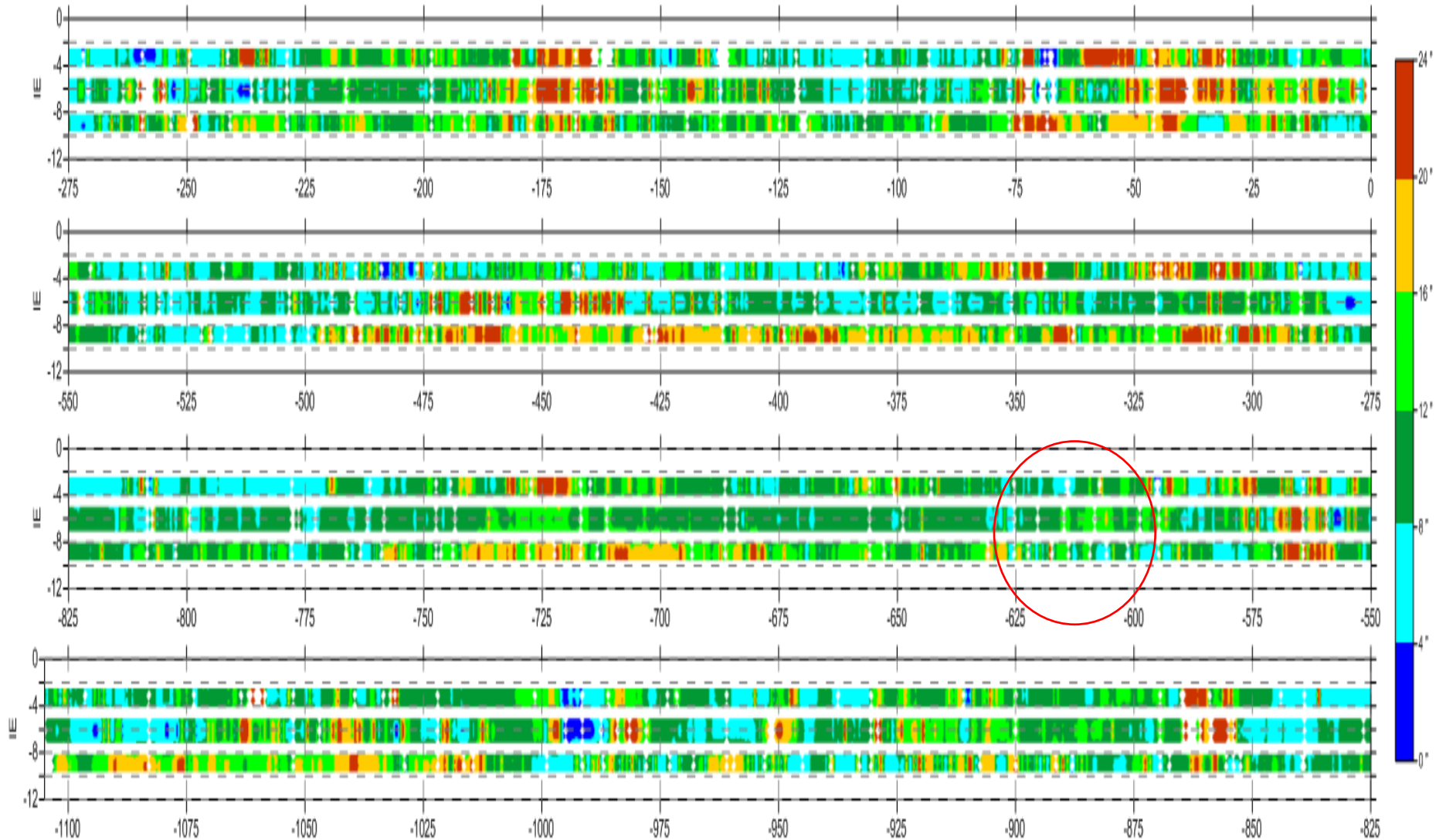


IE 2



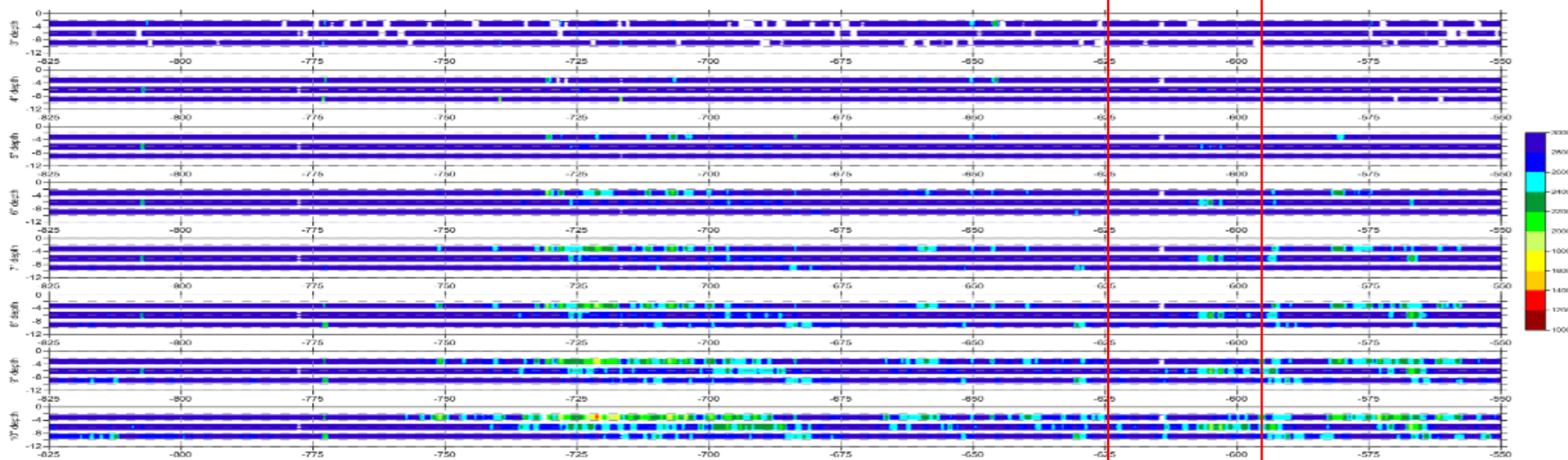
# Impact Echo: core IE3, section three, CWP—612.1 feet

IE 3

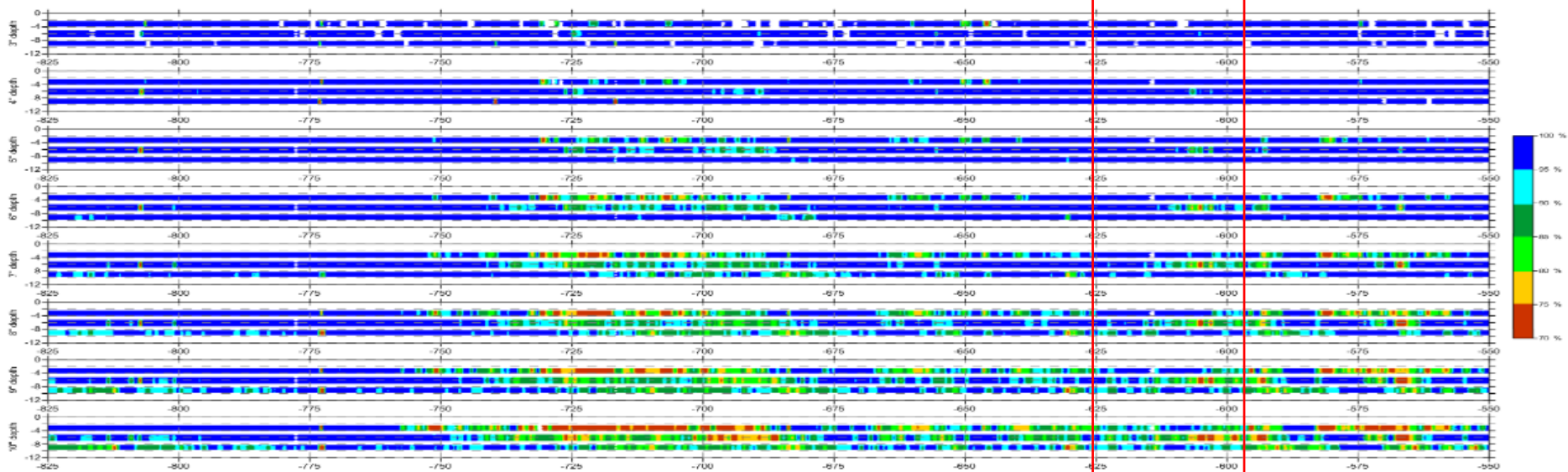


# SASW: core IE3, section three, CWP--612.1 feet

absolute velocity



normalized velocity

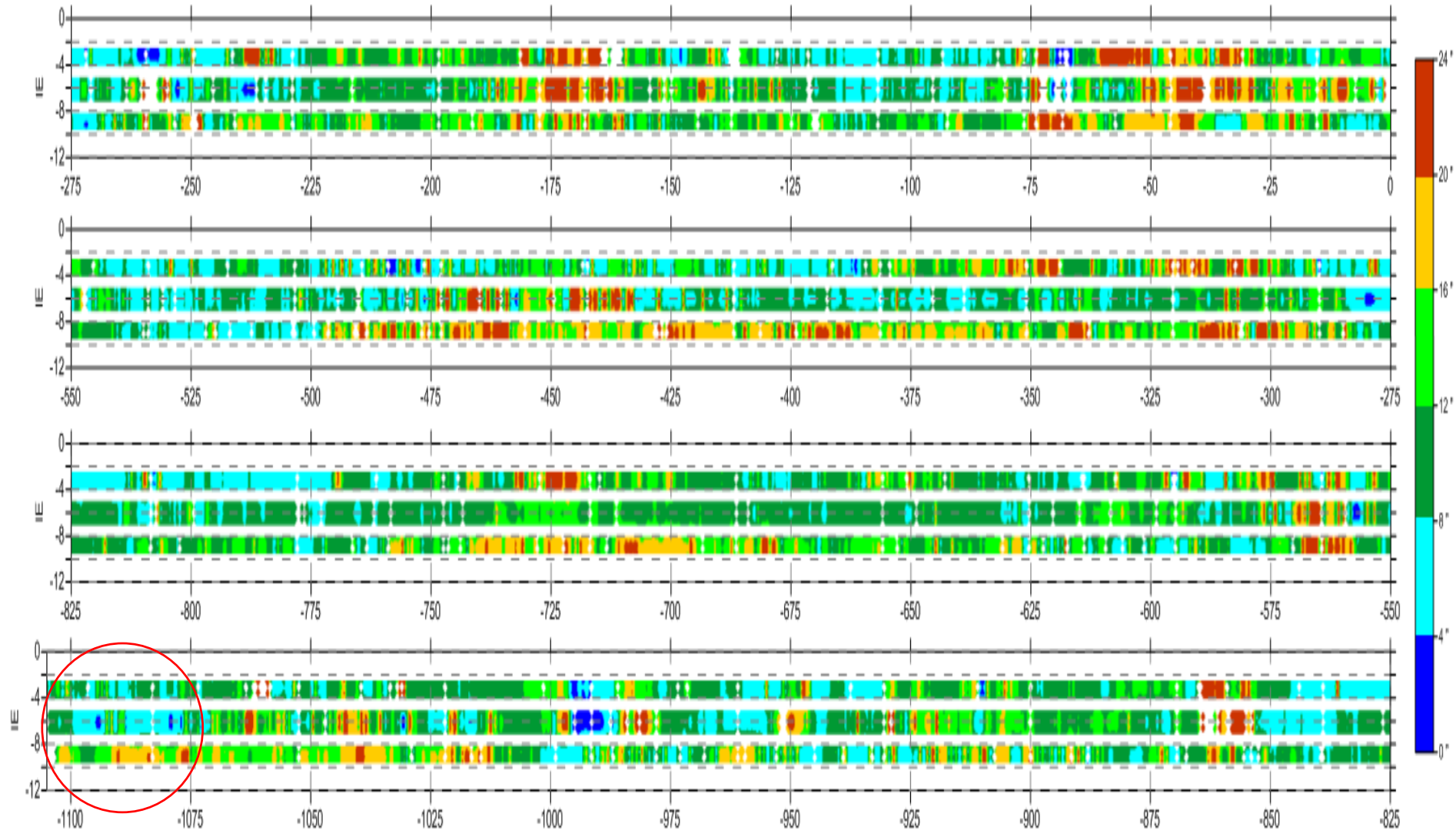


IE 3



# Impact Echo: core IE5, section three, CWP--1084.6 feet

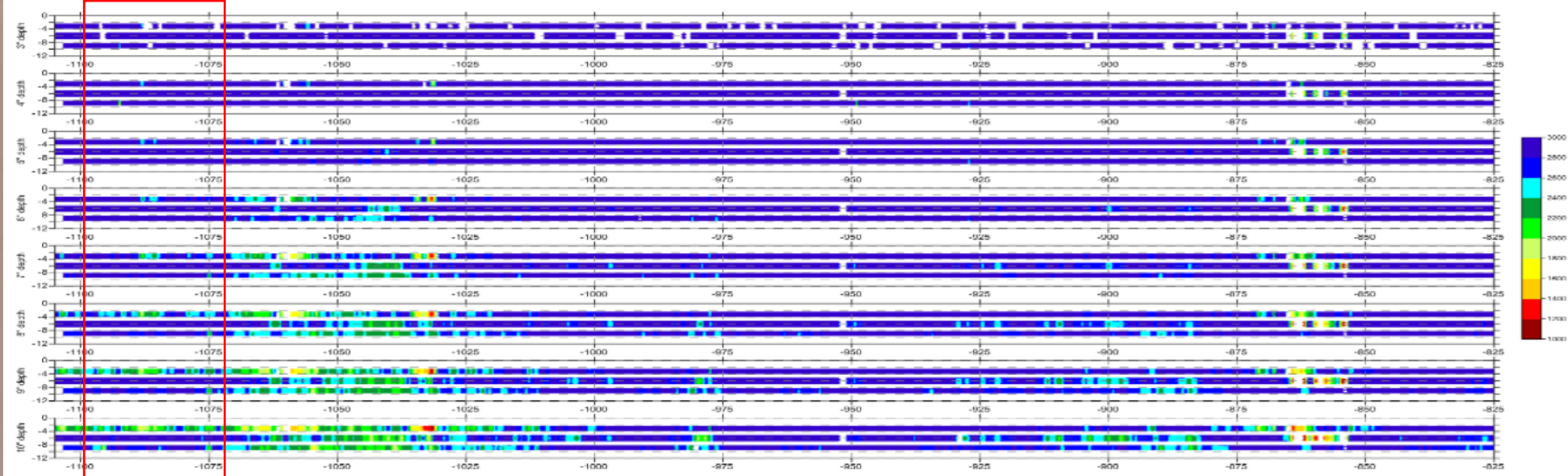
IE 5



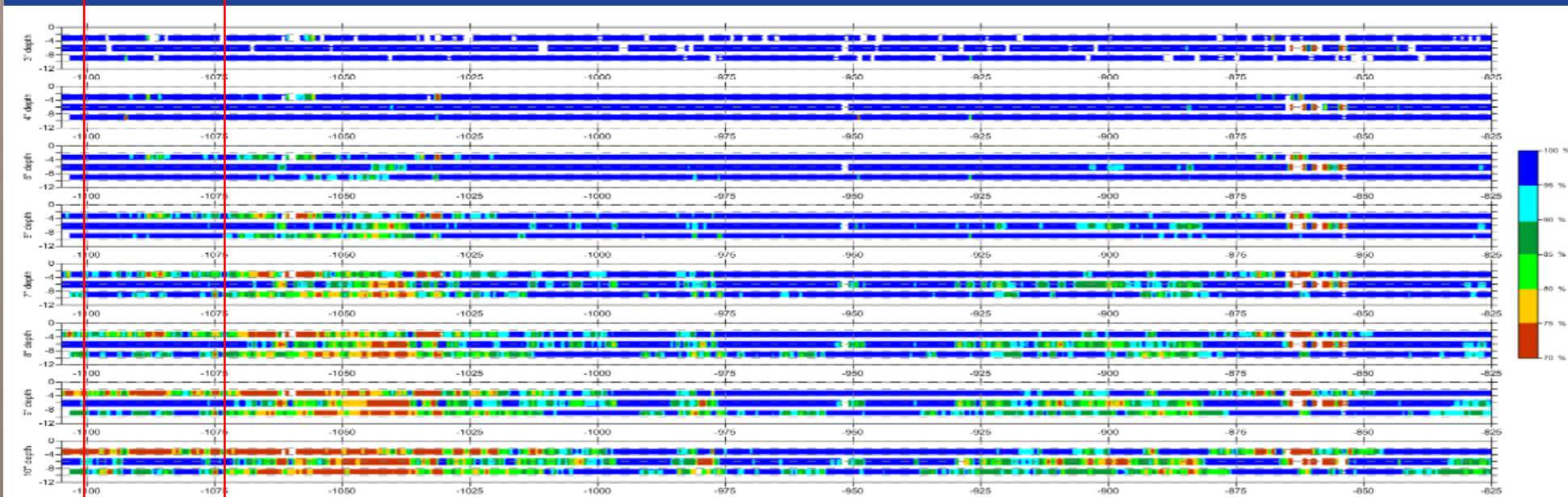


# SASW: core IE5, section three, CWP--1084.6 feet

## absolute velocity



## normalized velocity



IE 5





KENTUCKY  
TRANSPORTATION  
CABINET

