CENTER FOR TRANSPORTATION INFRASTRUCTURE AND SAFETY

Assessment of Active Karst Features in Proximity to Paved Roadways

by

Neil Anderson

A National University Transportation Center at Missouri University of Science and Technology

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16. Abstract

In an effort to better understand and define the lateral and vertical extent of active karst features in immediate proximity to paved municipal roadways in Nixa Missouri, MS&T will acquire electrical resistivity tomography (ERT) data. The intent is to use this non-invasive technology to map the lateral and vertical extent of the active karst features so that appropriate mitigation plans can be developed

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Assessment of Active Karst Features in Proximity to Roadway

Brief Summary of Geophysical Findings

The top of competent rock (as interpreted) on ERT Profiles 1-4 (slides 6, 8, 10 and 12) is coincident with the 150 ohm-meter contour interval. The top of competent rock (as interpreted) on MASW Profiles 1-4 (slides 13-16) is characterized by shear-wave velocities in excess of 1500 feet/second. As shown below, the ERT and MASW estimated depths to top of competent rock are consistent.

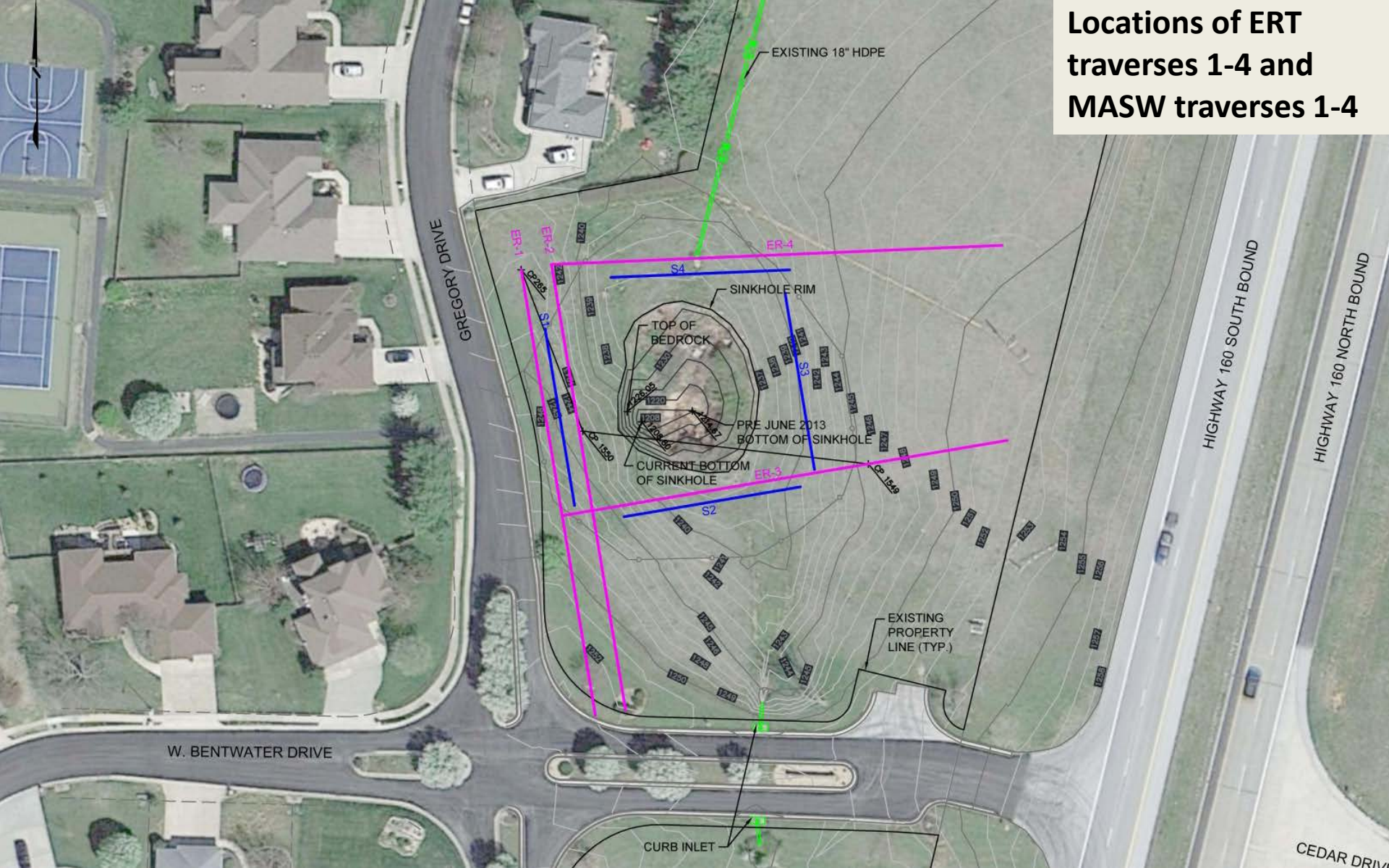
ERT and MASW estimated depth to top of competent rock:

MASW Profile 1: **32 feet**	Corresponding location on ERT Profile 1: **28 feet**
MASW Profile 2: **30 feet**	Corresponding location on ERT Profile 3: **31 feet**
MASW Profile 4: **33 feet**	Corresponding location on ERT Profile 1: **>25 feet**

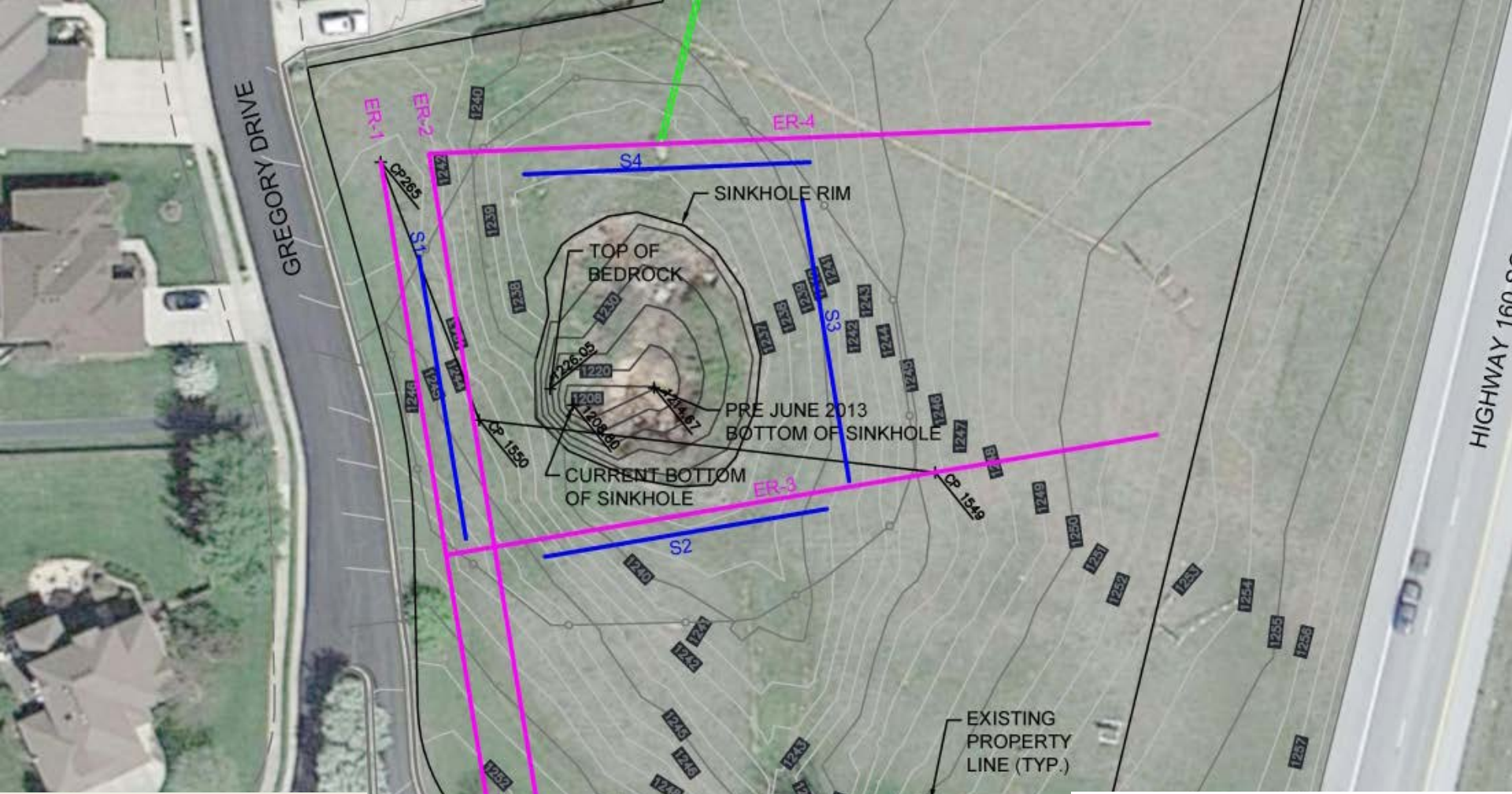
Competent rock in the study area appears to be overlain by 20-25 feet of weathered/fractured rock (pinnacle/cutters?) and 5-10 feet of lower velocity soil (MASW interpretations; slides 13-16). These two interpreted layers (soil and weathered/fractured rock) are identified on the MASW profiles (slides 13-16) on the basis of contrasting acoustic properties. However, these units cannot be readily differentiated on the ERT profiles (slides 6, 8, 10 and 12), presumably because soil and fractured/weathered rock have similar electrical properties (primarily similar moisture contents).

Two interpreted solution-widened joints (west-east and north-south) have been identified on the ERT profiles (slides 6, 8, 10 and 12). The interpreted solution-widened joints are characterized by relative structural lows at the top of competent rock and the presence of anomalously conductive (low resistivity) moist clayey soils in the shallow subsurface. The structural lows at the top of competent rock are attributed to the dissolution of limestone in proximity to the solution-widened joints. The presence of the conductive moist clayey soils is attributed the gradual infilling of karst-related subsidence features (in response leaching and piping). The zones of clayey soils identified on the ERT profiles are not extensive (width/depth) compared to those associated with many of the karst features we've analyzed at other locations.

If the solution-widened joints are located as shown, the inference is that the sinkhole developed at or near the intersection of two near-orthogonal fractures.



Locations of ERT traverses 1-4 and MASW traverses 1-4

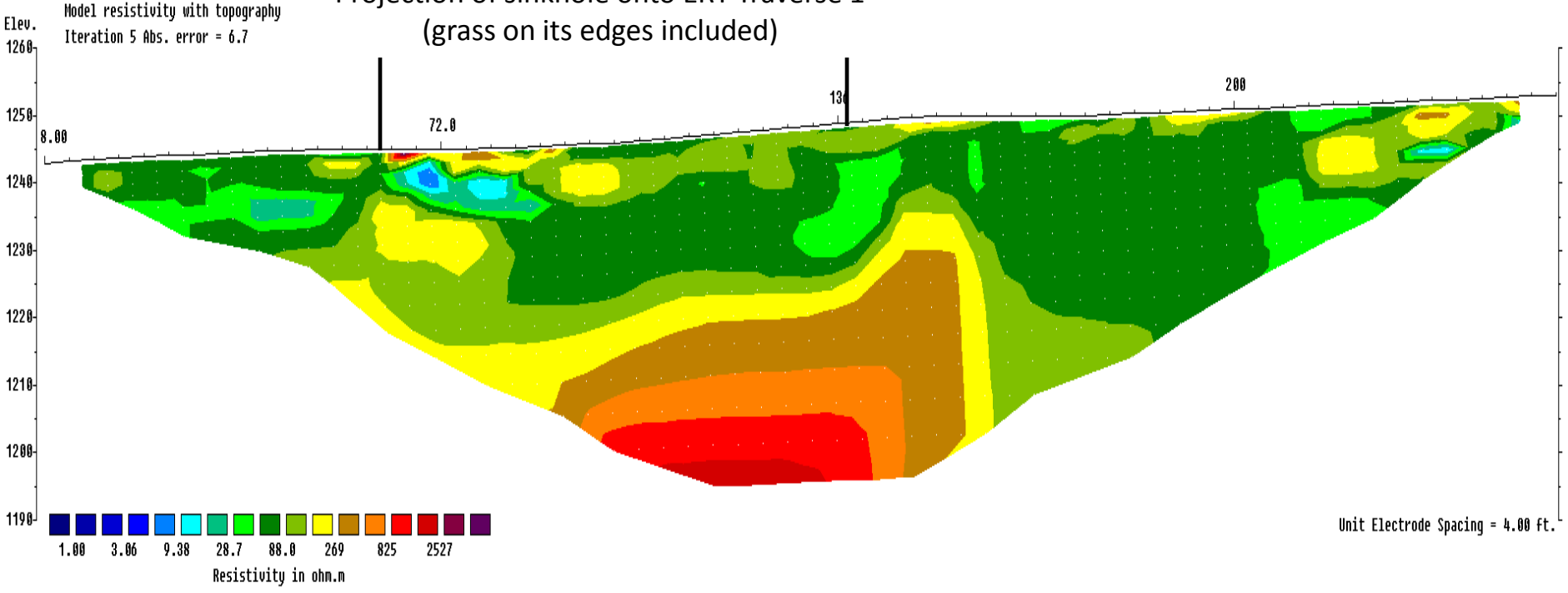


Locations of ERT traverses 1-4 and MASW traverses 1-4

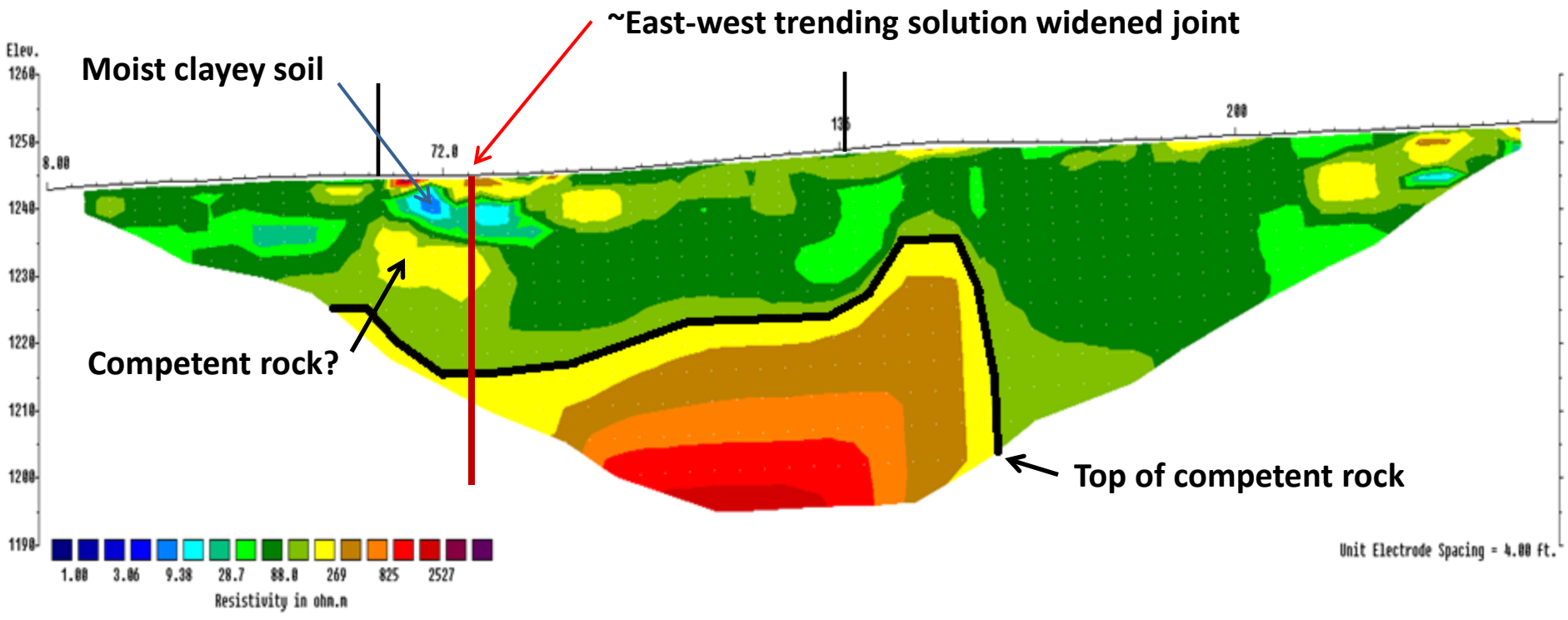
N

S

Projection of sinkhole onto ERT Traverse 1
(grass on its edges included)



ERT Profile 1



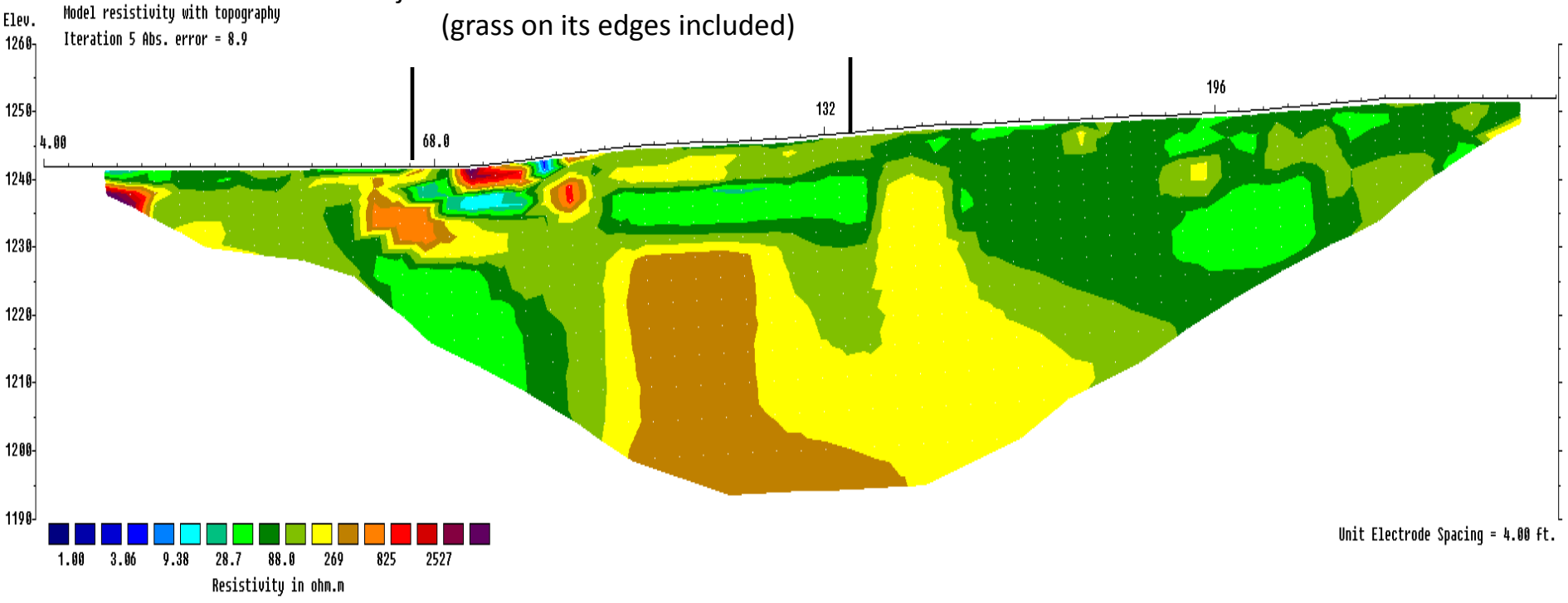
Competent rock is less porous (and therefore less moist) than either soil or weathered/fractured rock. Hence competent rock is characterized by higher values of electrical resistivity.

ERT Profile 1

N

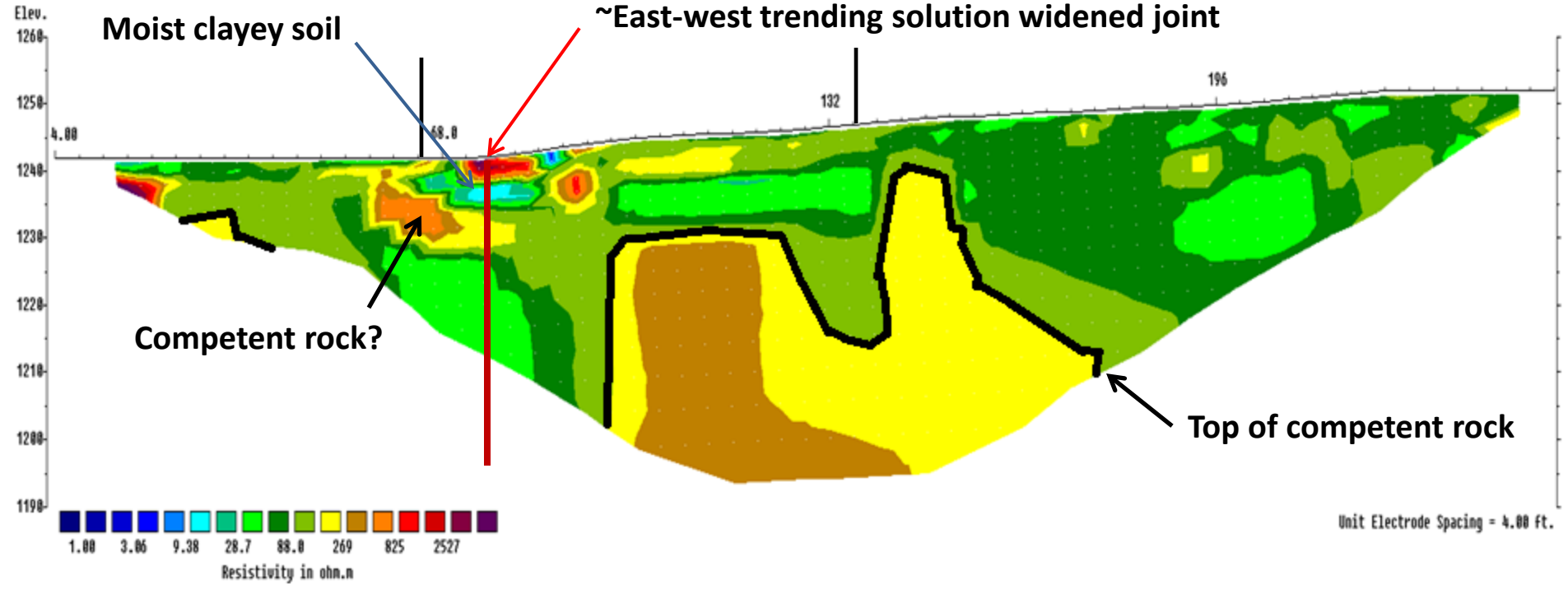
S

Projection of sinkhole onto ERT Traverse 2
(grass on its edges included)



ERT Profile 2

N S

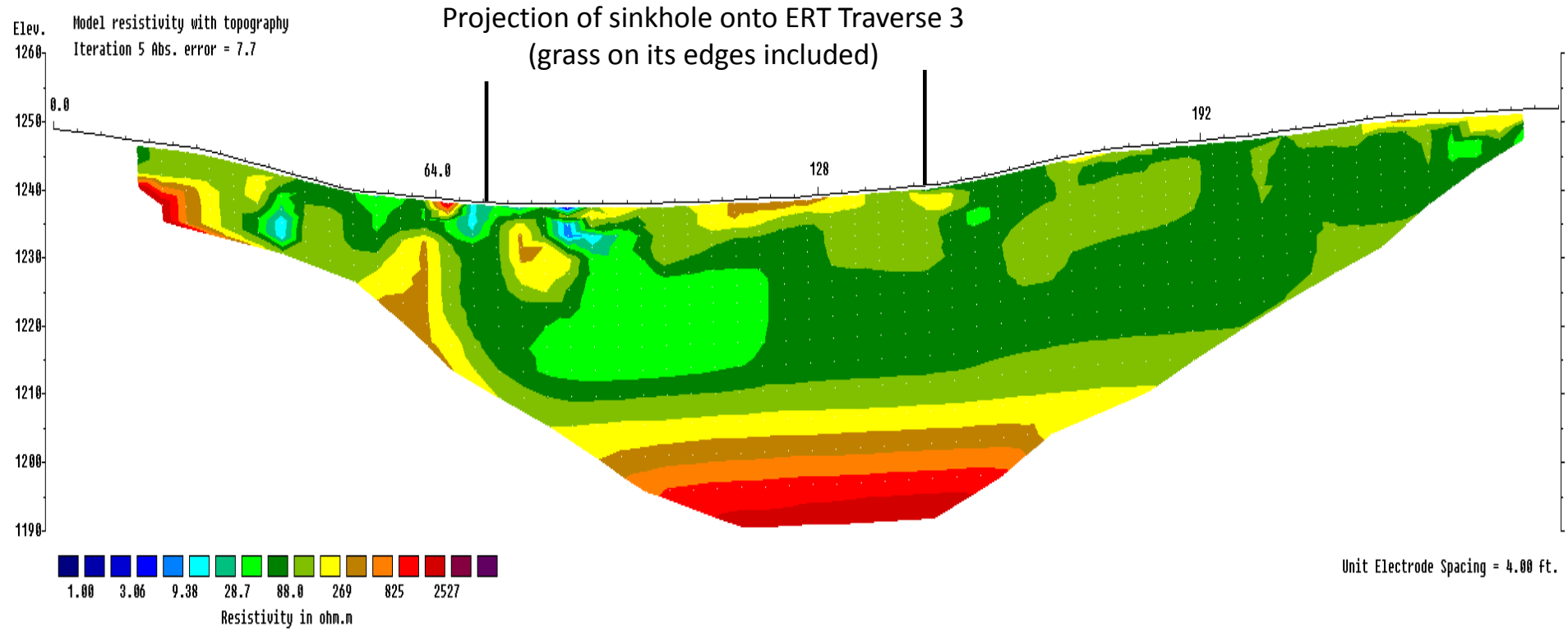


Competent rock is less porous (and therefore less moist) than either soil or weathered/fractured rock. Hence competent rock is characterized by higher values of electrical resistivity.

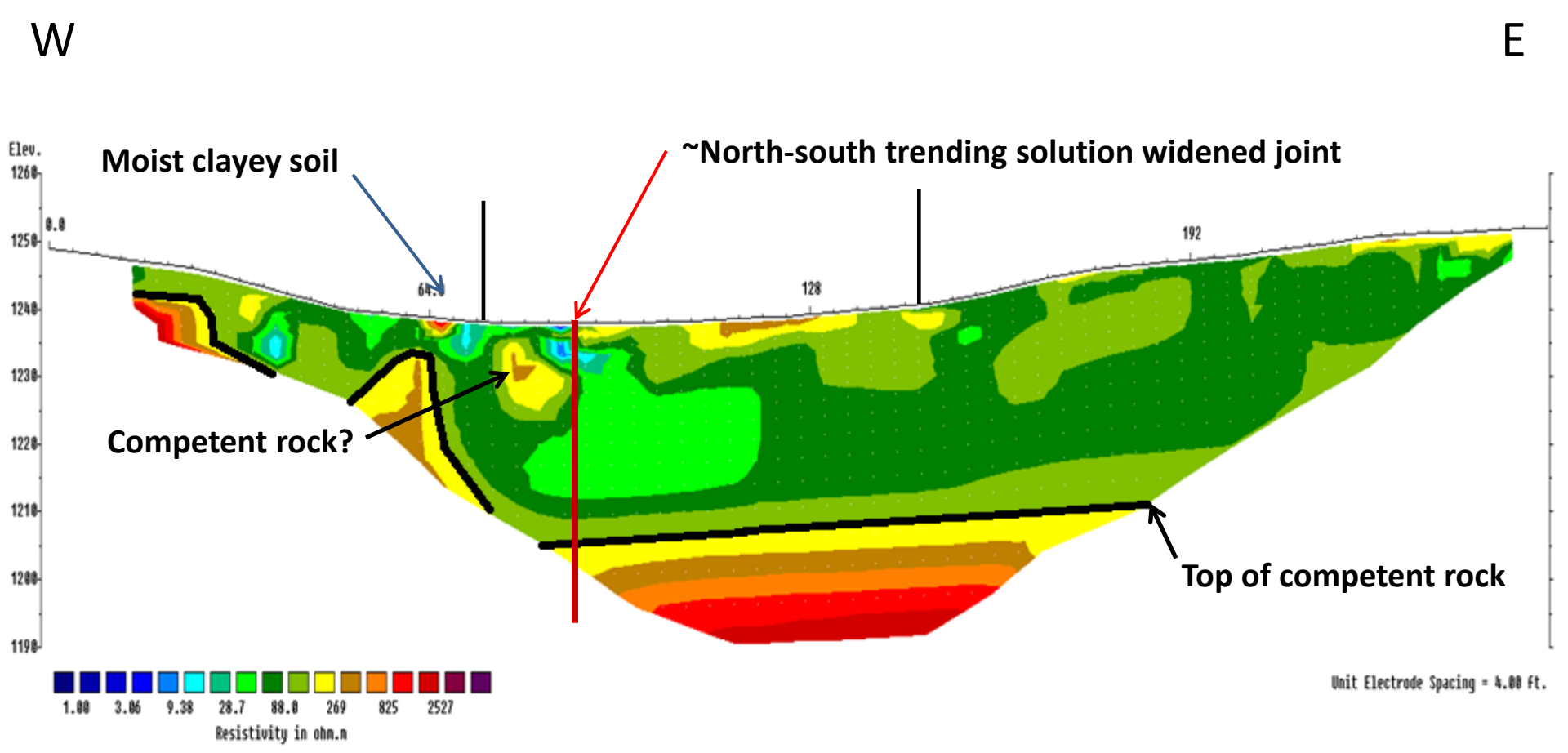
ERT Profile 2

W

E



ERT Profile 3



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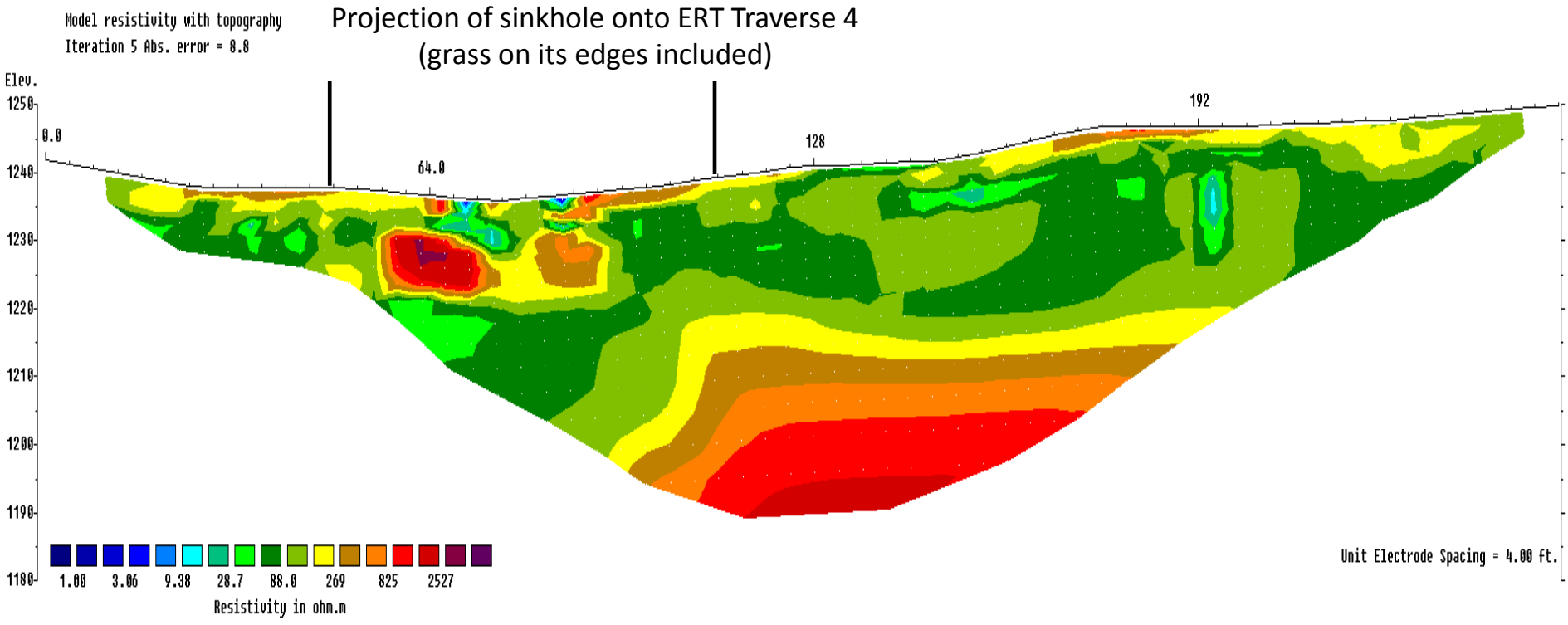
ERT Profile 3

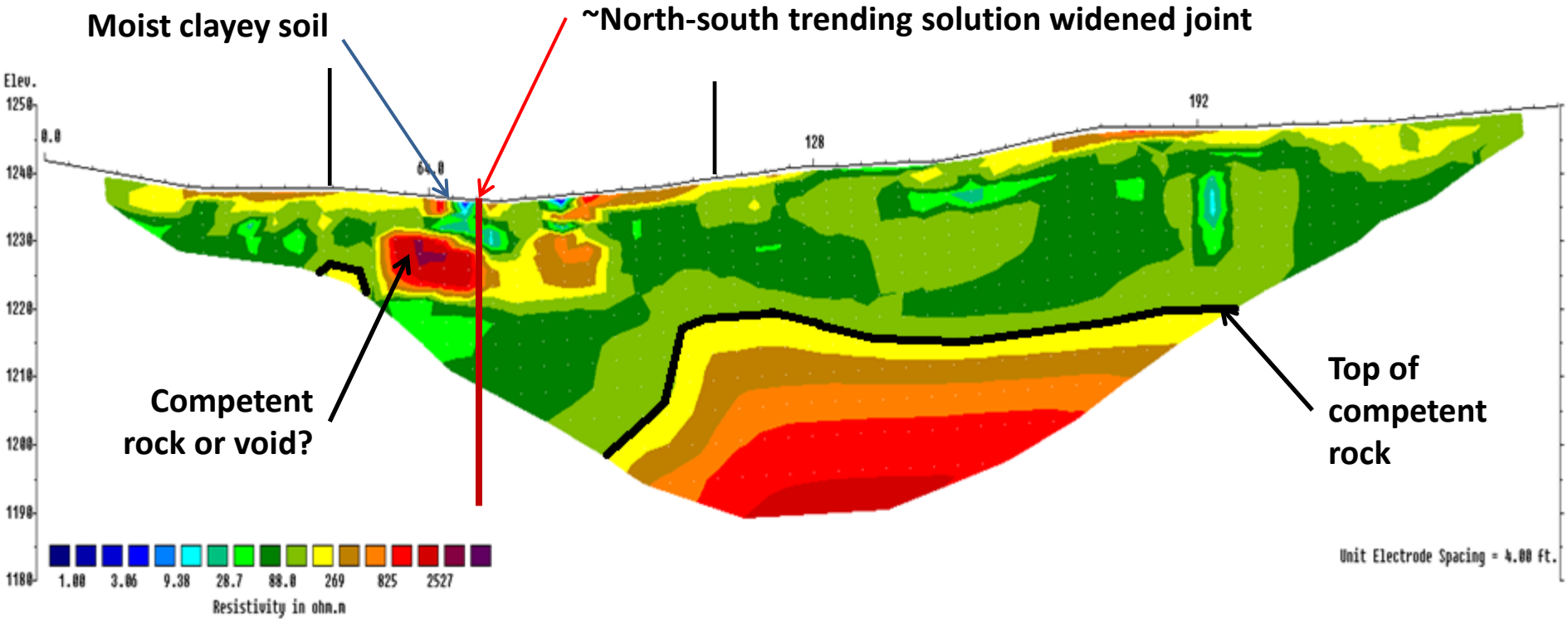
W

E



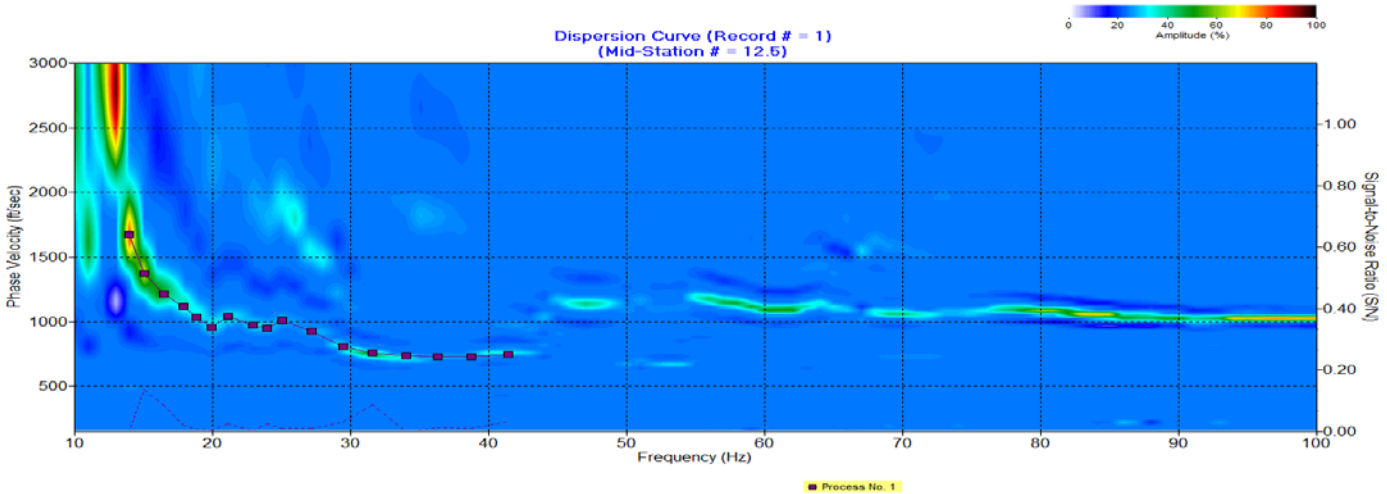
ERT Profile 4

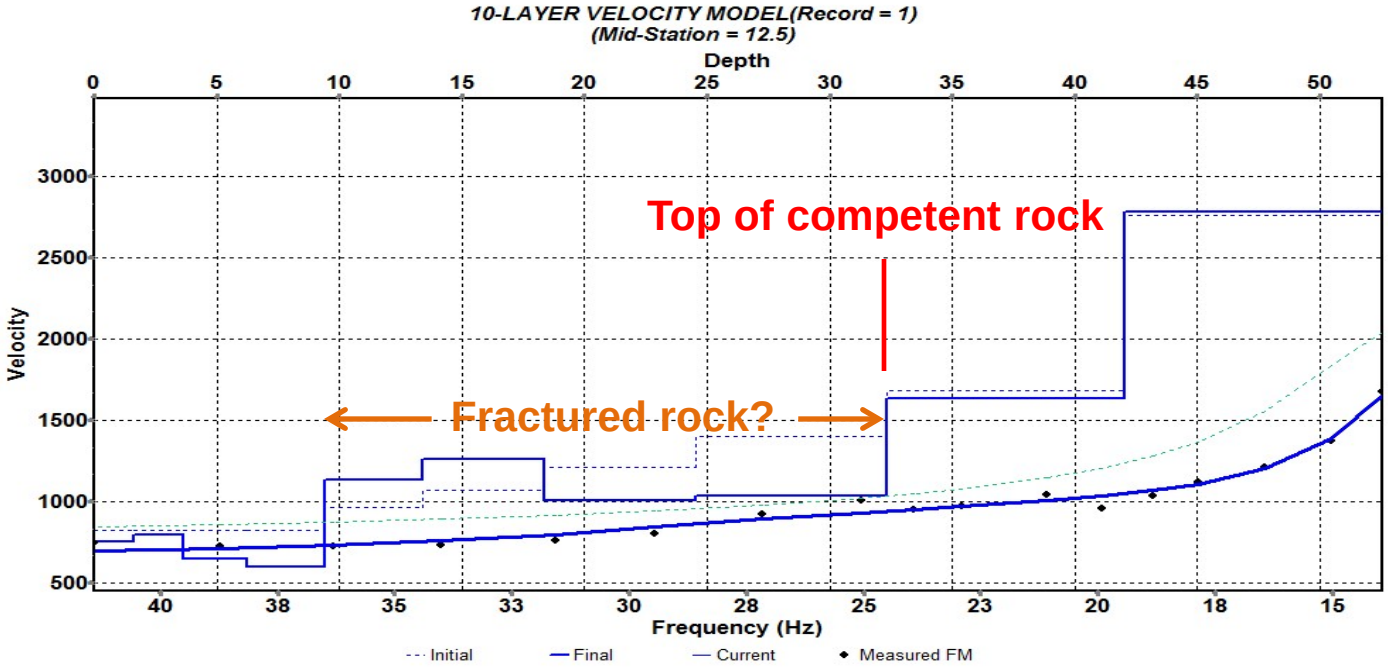
W E



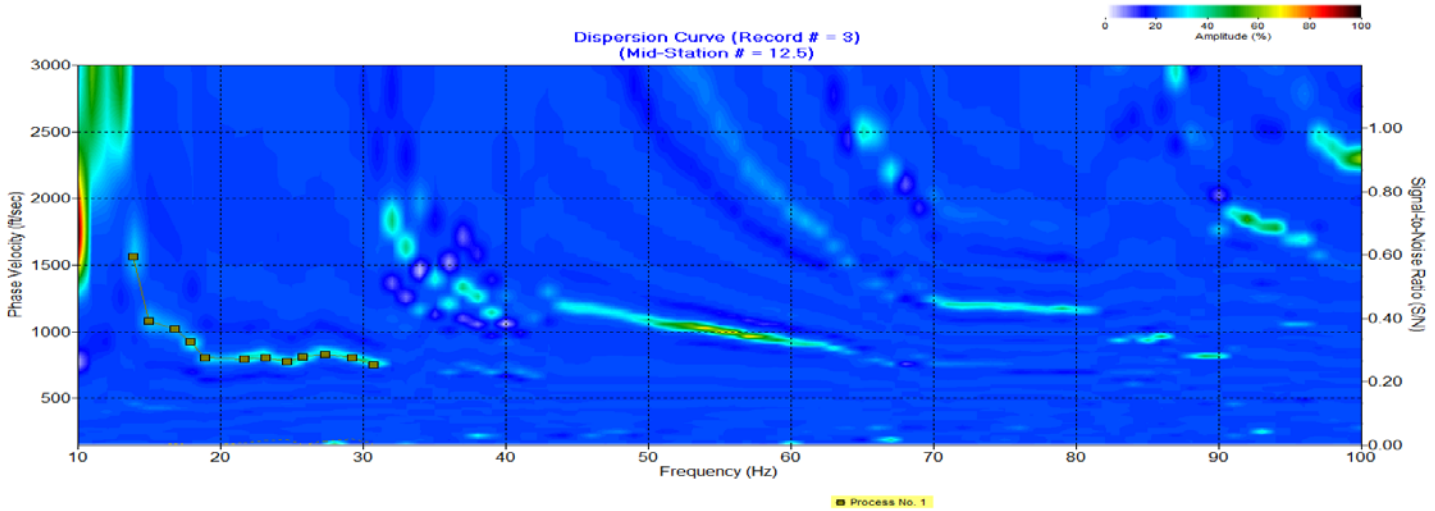
Competent rock is less porous (and therefore less moist) than either soil or weathered/fractured rock. Hence competent rock is characterized by higher values of electrical resistivity.

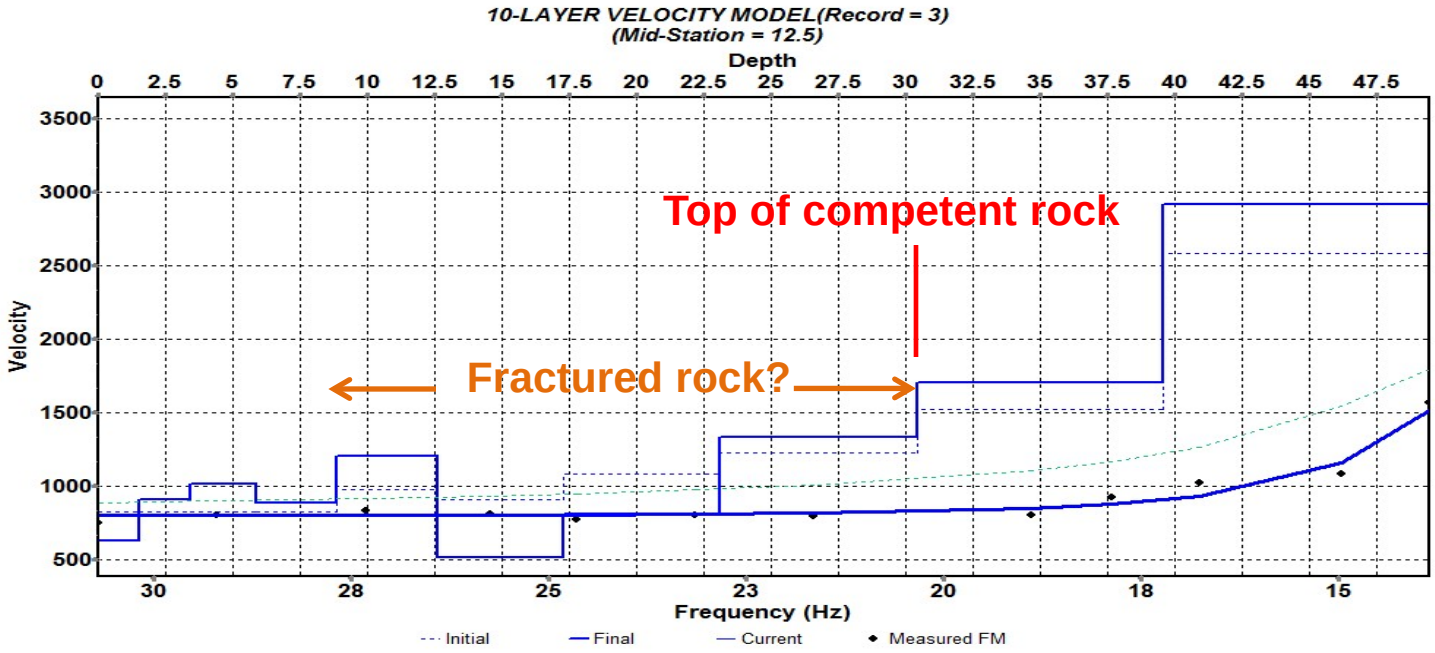
ERT Profile 4


Dispersion Curve (Record # = 1)
(Mid-Station # = 12.5)
Amplitude (%)
Phase Velocity (ft/sec)
Signal-to-Noise Ratio (S/N)
Frequency (Hz)
Process No. 1

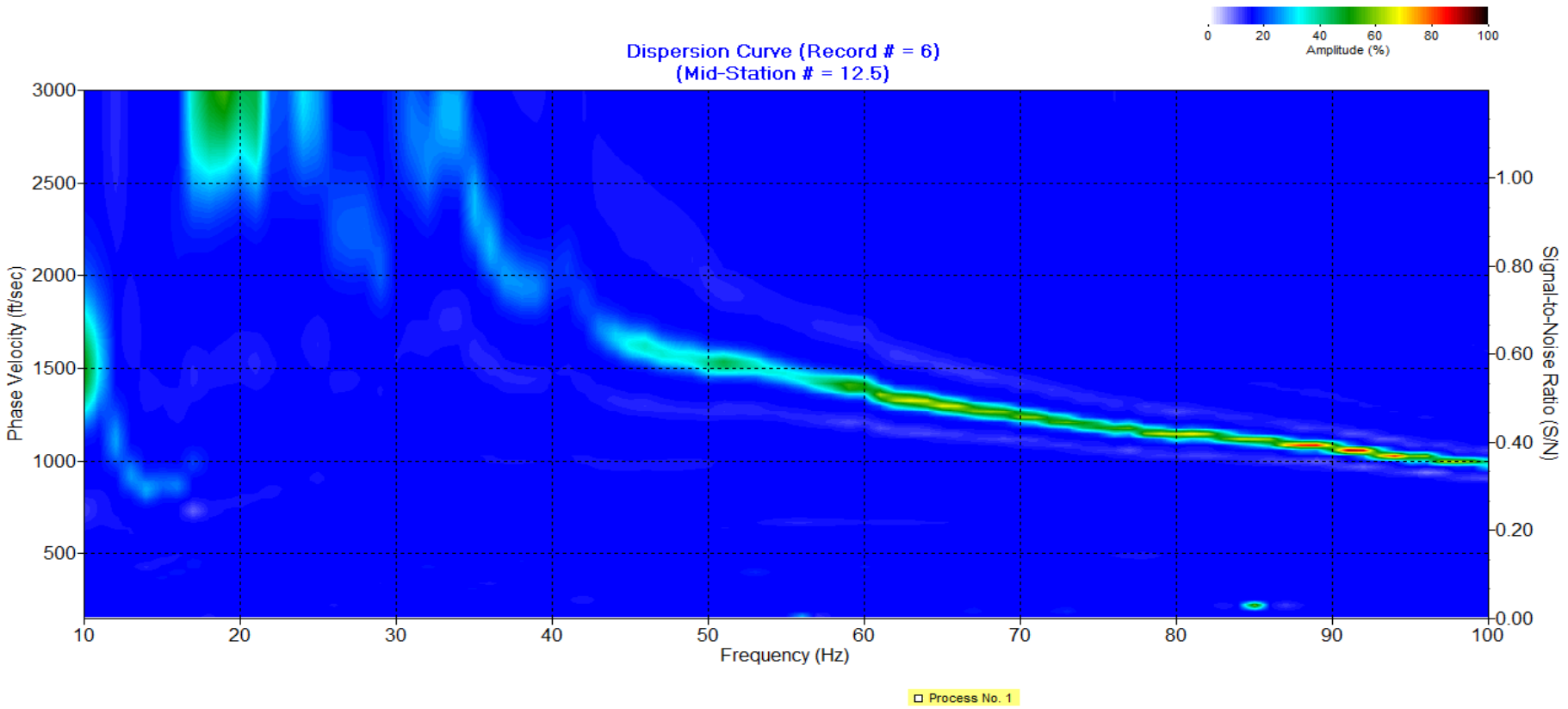

10-LAYER VELOCITY MODEL(Record = 1)
(Mid-Station = 12.5)
Depth
Top of competent rock
Fractured rock?
Velocity
Frequency (Hz)
Initial
Final
Current
Measured FM

MASW S1


Dispersion Curve (Record # = 3)
(Mid-Station # = 12.5)
Amplitude (%)
Phase Velocity (ft/sec)
Signal-to-Noise Ratio (S/N)
Frequency (Hz)
Process No. 1

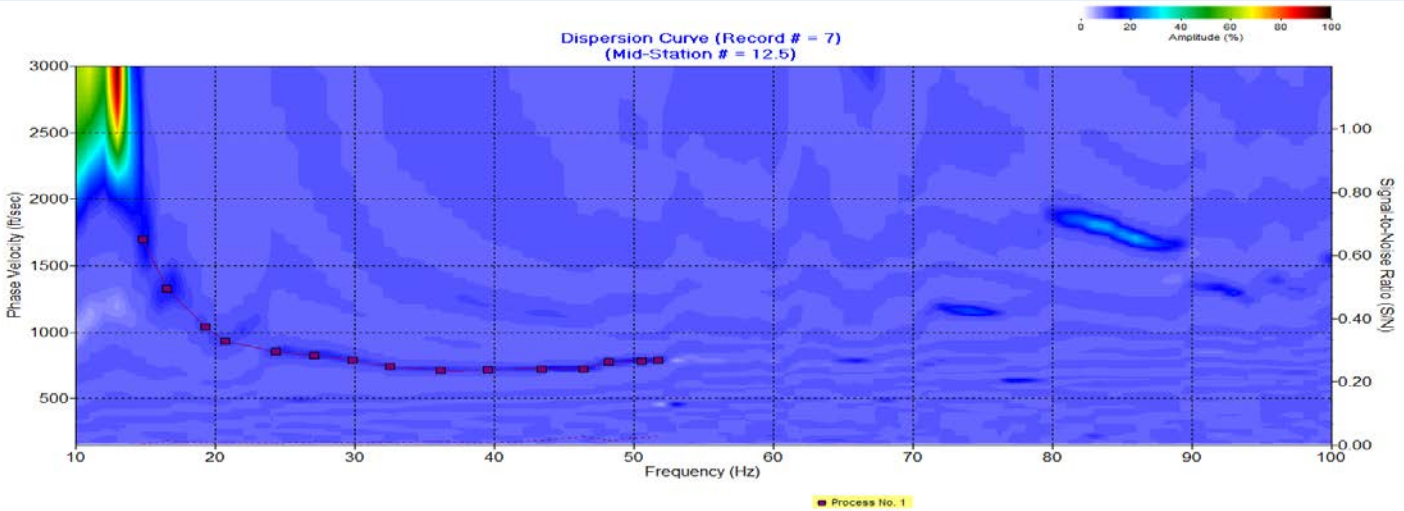

10-LAYER VELOCITY MODEL(Record = 3)
(Mid-Station = 12.5)
Depth
Velocity
Top of competent rock
Fractured rock?
Frequency (Hz)
Initial
Final
Current
Measured FM

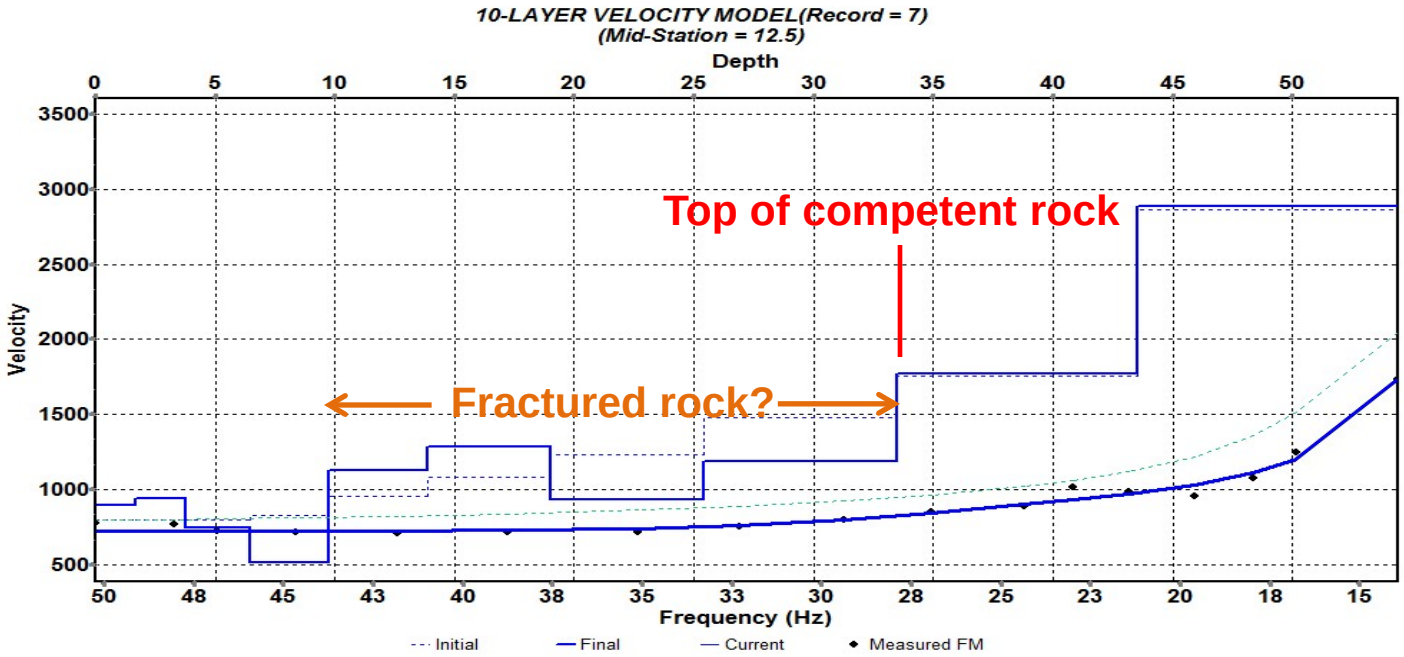
MASW S2



Uninterpretable Dispersion Curve: MASW S3

MASW S3


Dispersion Curve (Record # = 7)
(Mid-Station # = 12.5)
Amplitude (%)
Phase Velocity (ft/sec)
Signal-to-Noise Ratio (S/N)
Frequency (Hz)
Process No. 1


10-LAYER VELOCITY MODEL(Record = 7)
(Mid-Station = 12.5)
Depth
Velocity
Top of competent rock
Fractured rock?
Frequency (Hz)
Initial
Final
Current
Measured FM

MASW S4