WyCEHG – FINSE Groundwater Studies

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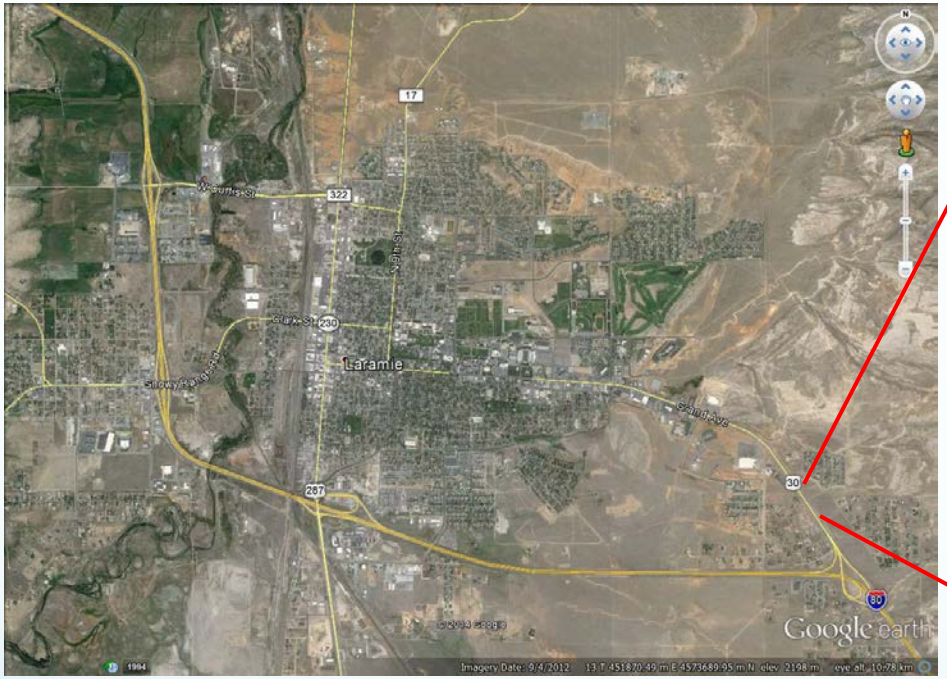
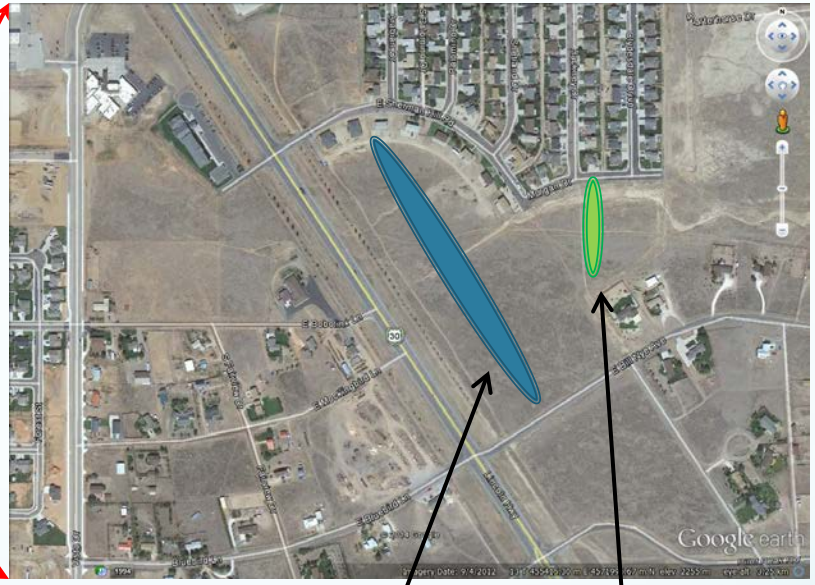
Investigating the Sherman Hills Fault Zone Laramie, WY Using Integrated Seismic Refraction, DC Resistivity and Borehole Geophysics

-Cooperative work between City of Laramie, Wyoming Groundwater, LLC., Hinckley Consulting, and WyCEHG - FINSE

Purpose:

To geophysically image the E-W oriented Sherman Hills Fault zone near the Imperial Heights neighborhood of Laramie, Wyoming in advance of drilling for the 2015 City of Laramie - Phase II - Monitor Well Project





Site Profiles:

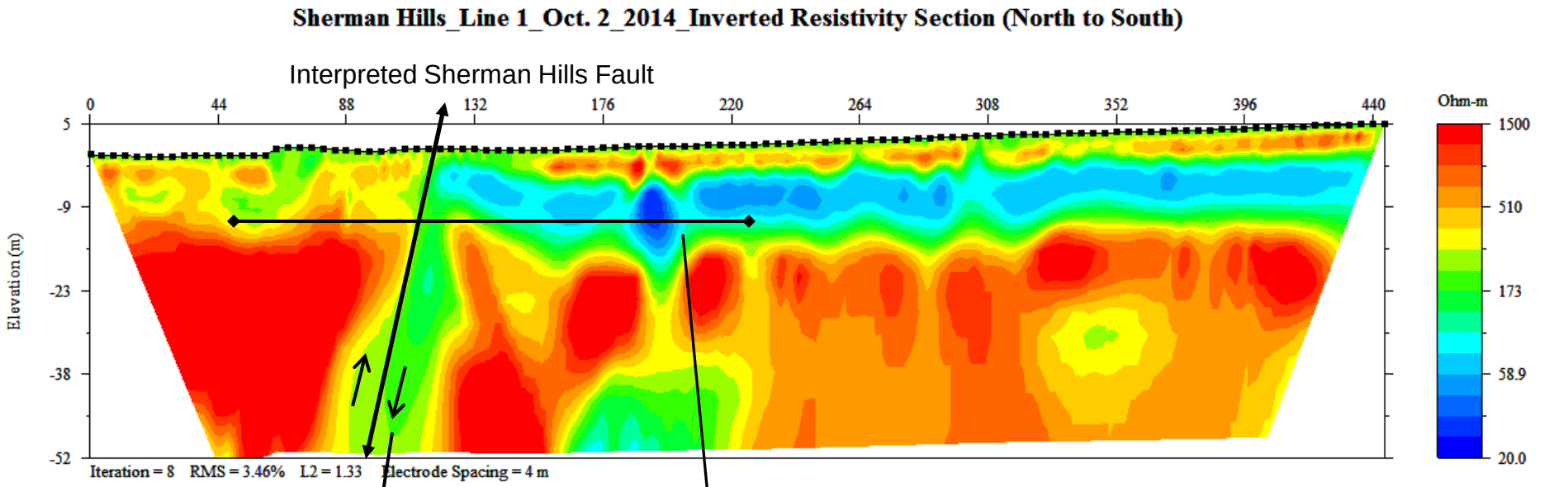
– Line 1 acquired Oct. 2, 2014

– Line 2 acquired Oct. 6th, 2014

Line 1 data acquired on UW Foundation property

Line 2 data acquired on City of Laramie property

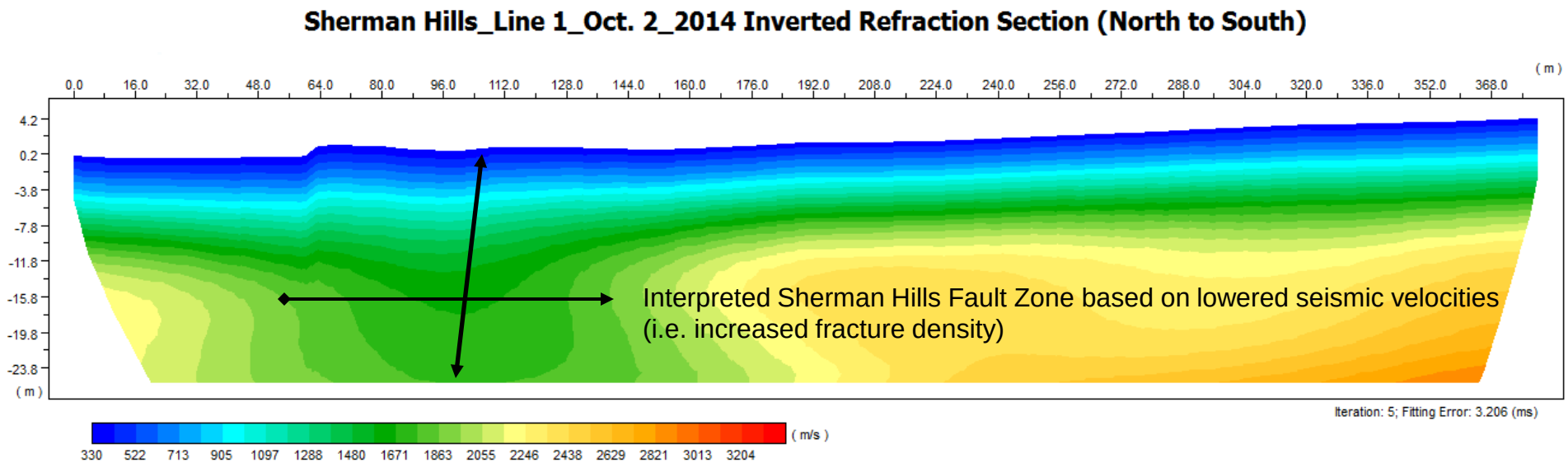
Line 1 Resistivity Data with Sherman Hills Fault Zone Interpretation



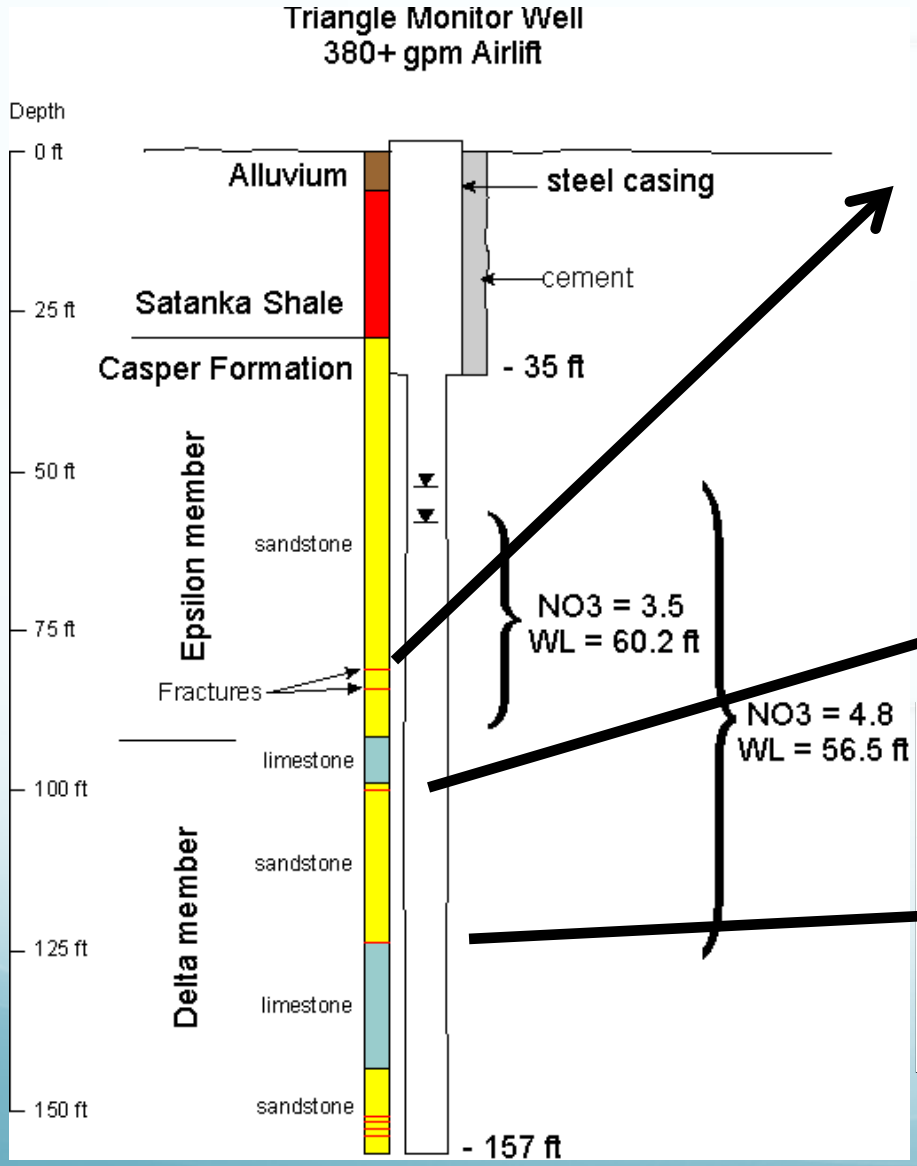
Interpreted Sherman Hills Fault Zone based on lowered electrical resistivity (i.e. increased clay or water presence in existing fractures)

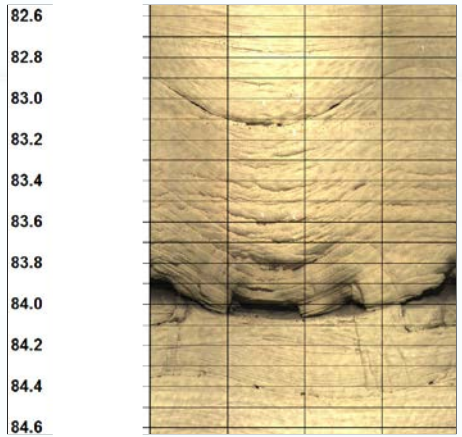
Relative movement along the Sherman Hills Fault (estimated from this image to be ~18m or ~59ft.)

Line 1 Seismic Refraction Data with Sherman Hills Fault Zone Interpretation

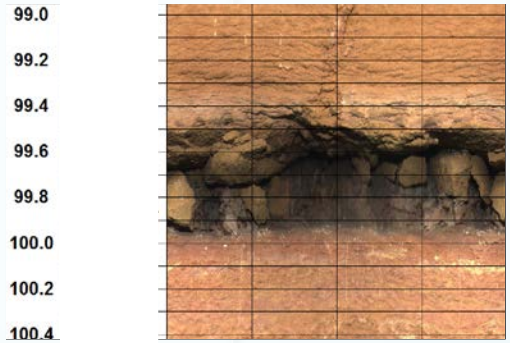


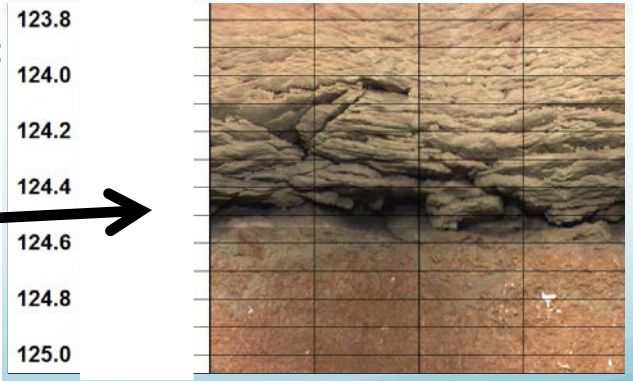
Interpreted Sherman Hills Fault – dip angle is inferred due to the asymmetry of the fault zone



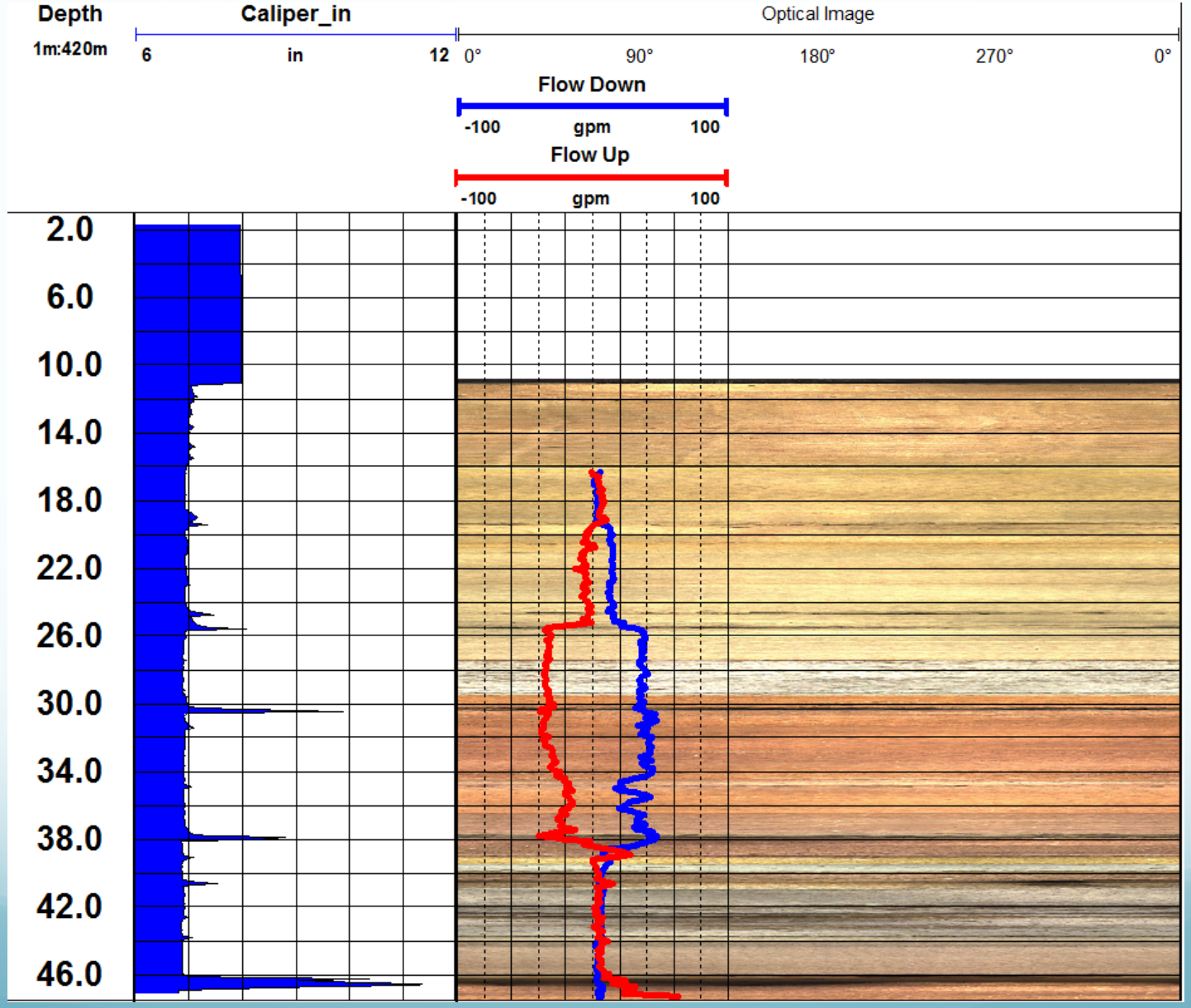


Bedding-plane openings in Triangle Well





Down-hole images from Laramie Monitor Well Project - June, 2015 (vertical scale in feet)


Depth
1m:420m
Caliper_in
6
in
12
Optical Image
0°
90°
180°
270°
0°
Flow Down
-100
gpm
100
Flow Up
-100
gpm
100
2.0
6.0
10.0
14.0
18.0
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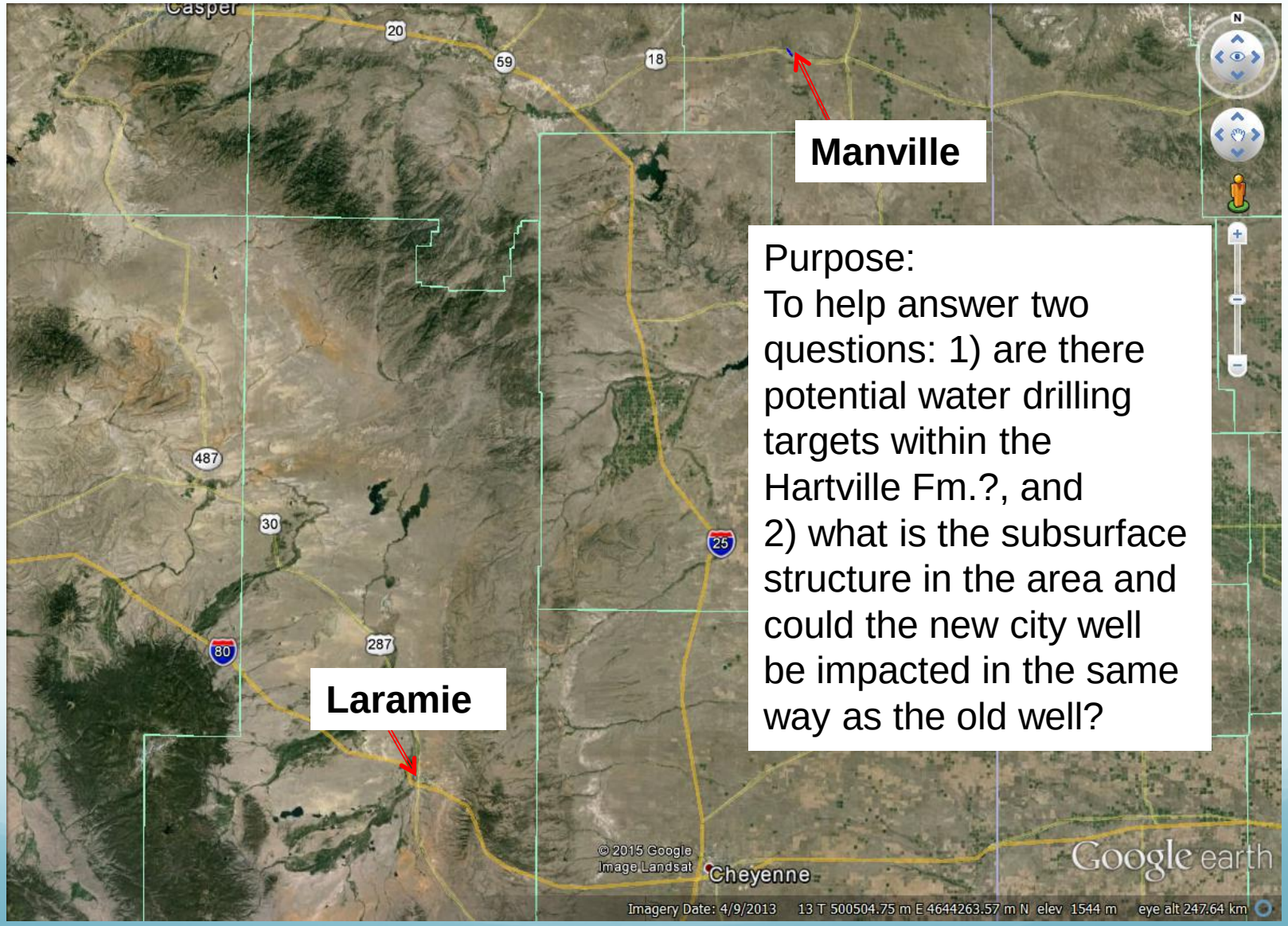
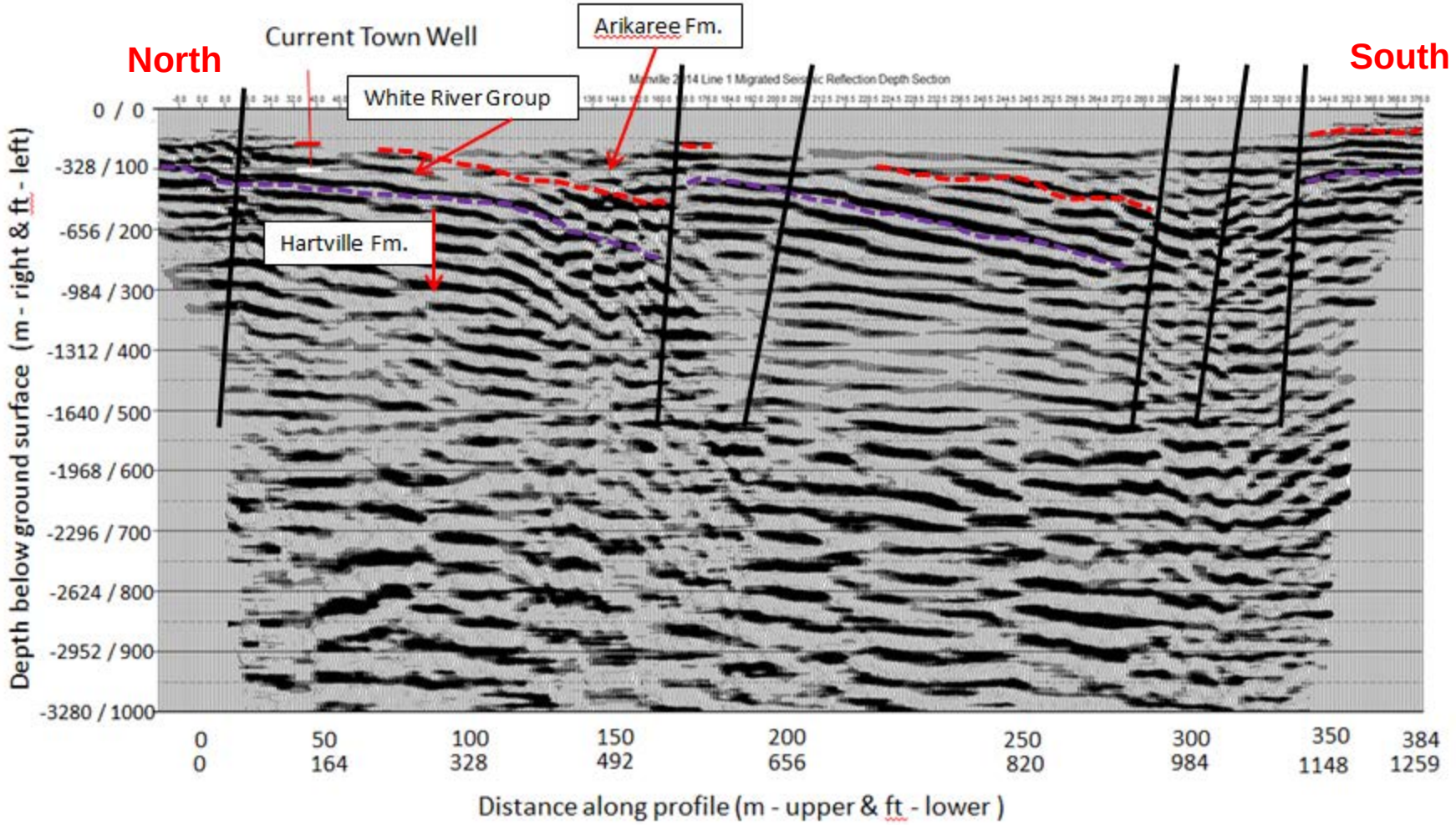
26.0
30.0
34.0
38.0
42.0
46.0



Purpose:
To help answer two questions: 1) are there potential water drilling targets within the Hartville Fm.?, and 2) what is the subsurface structure in the area and could the new city well be impacted in the same way as the old well?


North
South
Current Town Well
Arikaree Fm.
White River Group
Hartville Fm.
0 / 0
-328 / 100
-656 / 200
-984 / 300
-1312 / 400
-1640 / 500
-1968 / 600
-2296 / 700
-2624 / 800
-2952 / 900
-3280 / 1000
Depth below ground surface (m - right & ft - left)
0 0
50 164
100 328
150 492
200 656
250 820
300 984
350 1148
384 1259
Distance along profile (m - upper & ft - lower)

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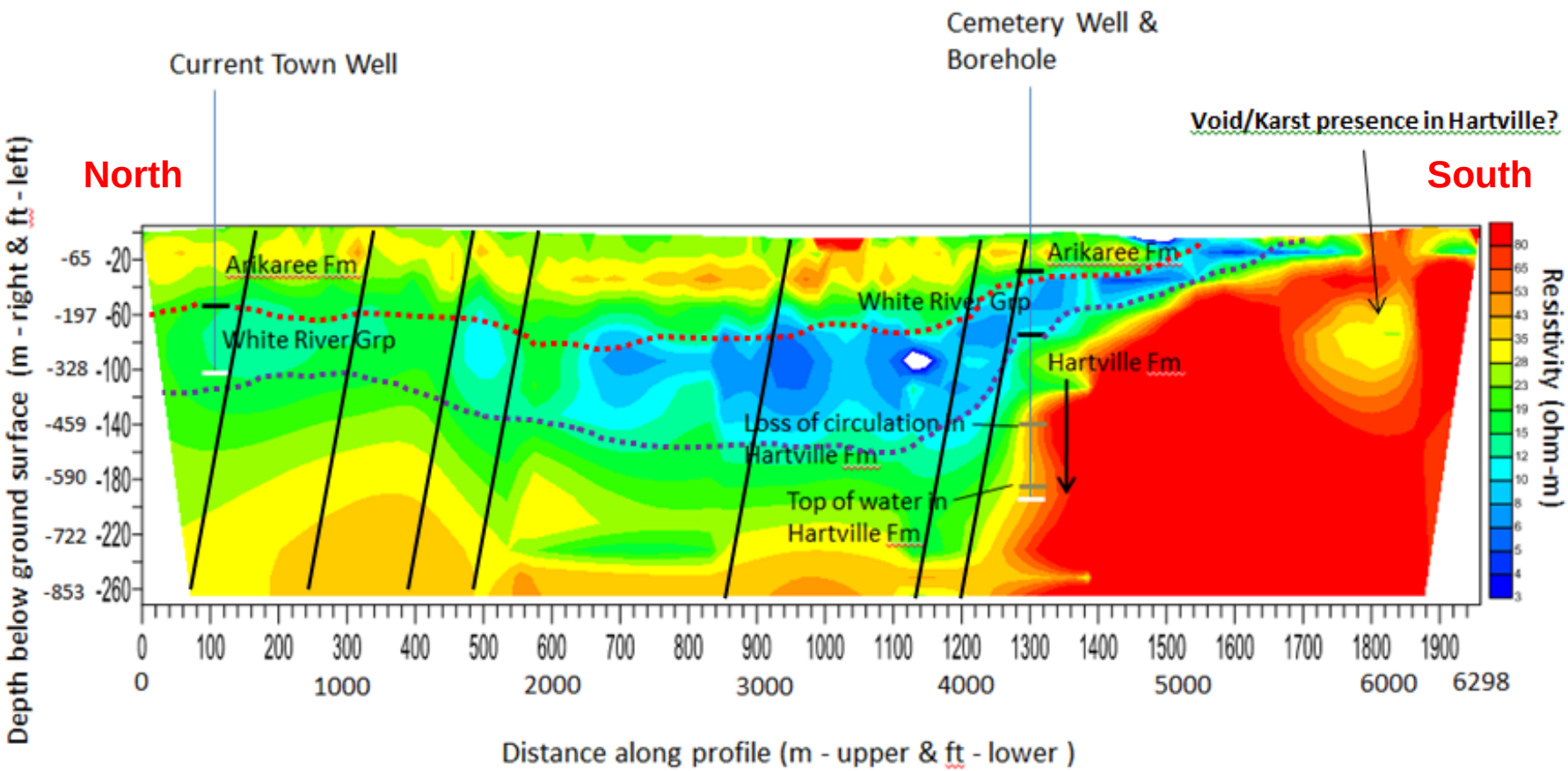
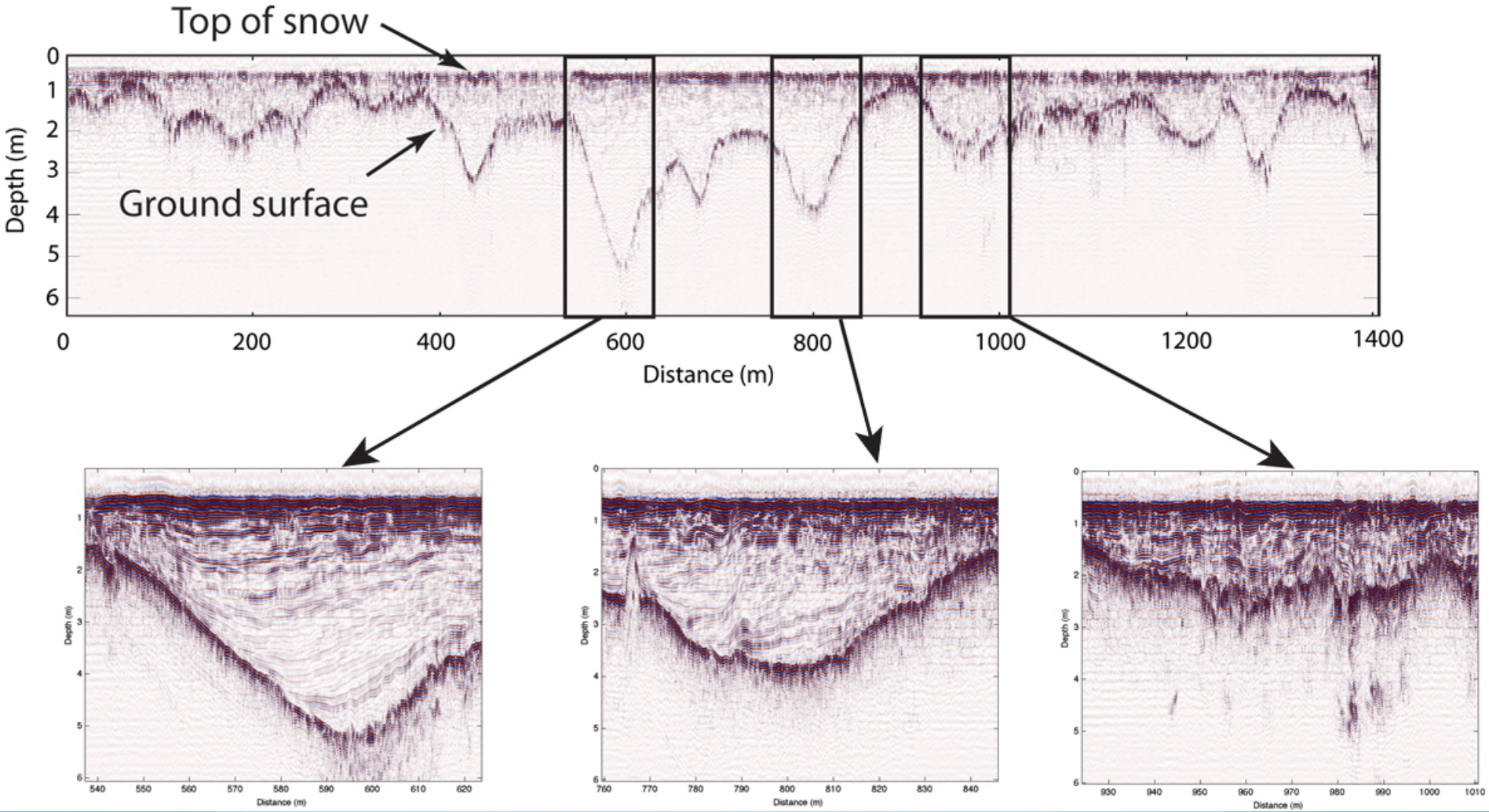


Snow Hydrology

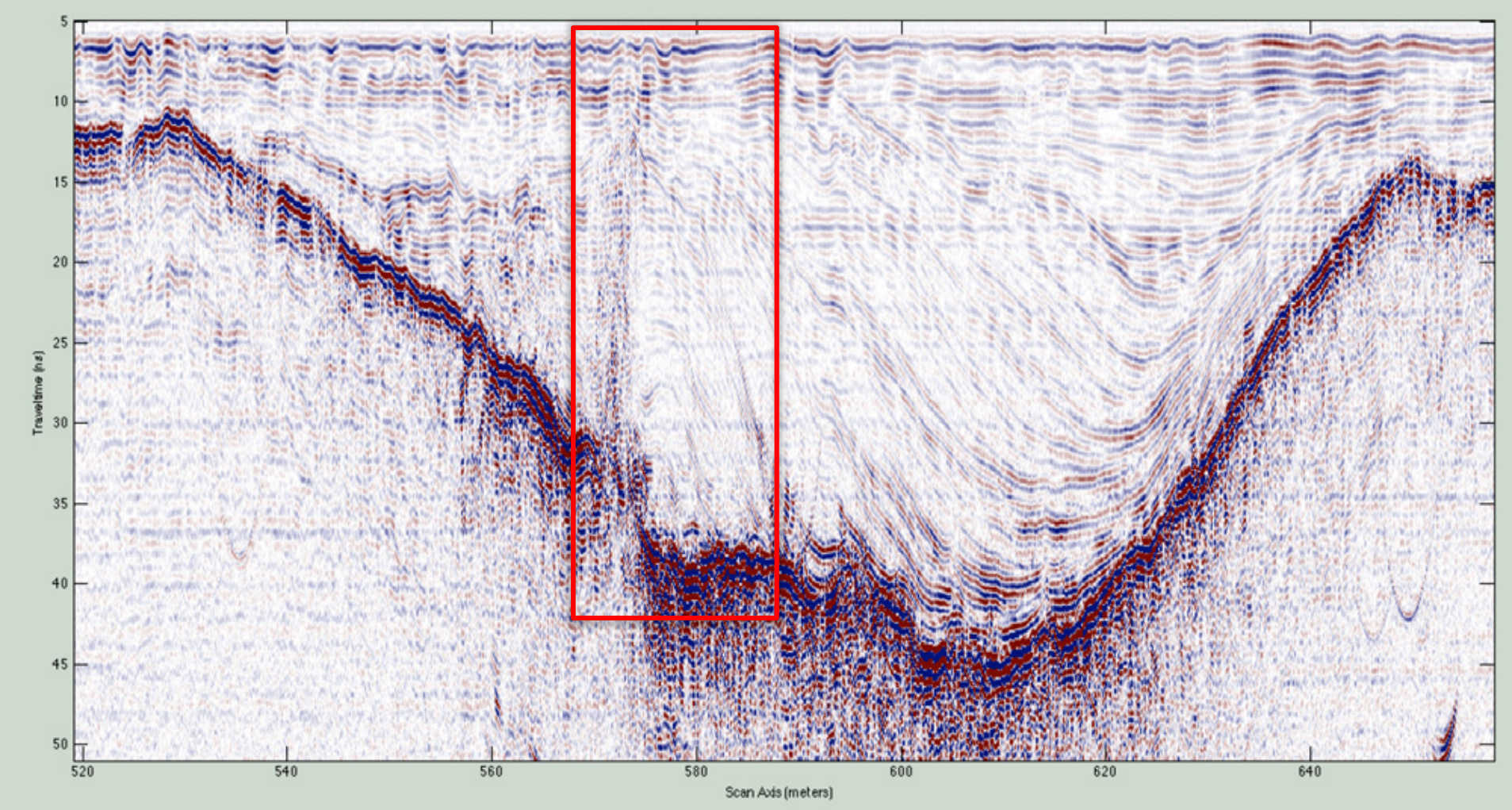
Snowmobile-mounted GPR provides long transect measurements of Snow Water Equivalent (SWE).

Images of Snowpack



Holbrook et al., in press, *Geophysics*

Snow GPR Image



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Why Are We Doing This?

Goals:

- Image plumbing system beneath hot springs/geysers
- Test hypotheses about source depths, circulation patterns, and phase separation of hydrothermal systems

Targets:

- Hydrothermal reservoirs
- Pathways & movement of hydrothermal fluids
- Subsurface gas vs. hot water

Obsidian Pool Thermal Area

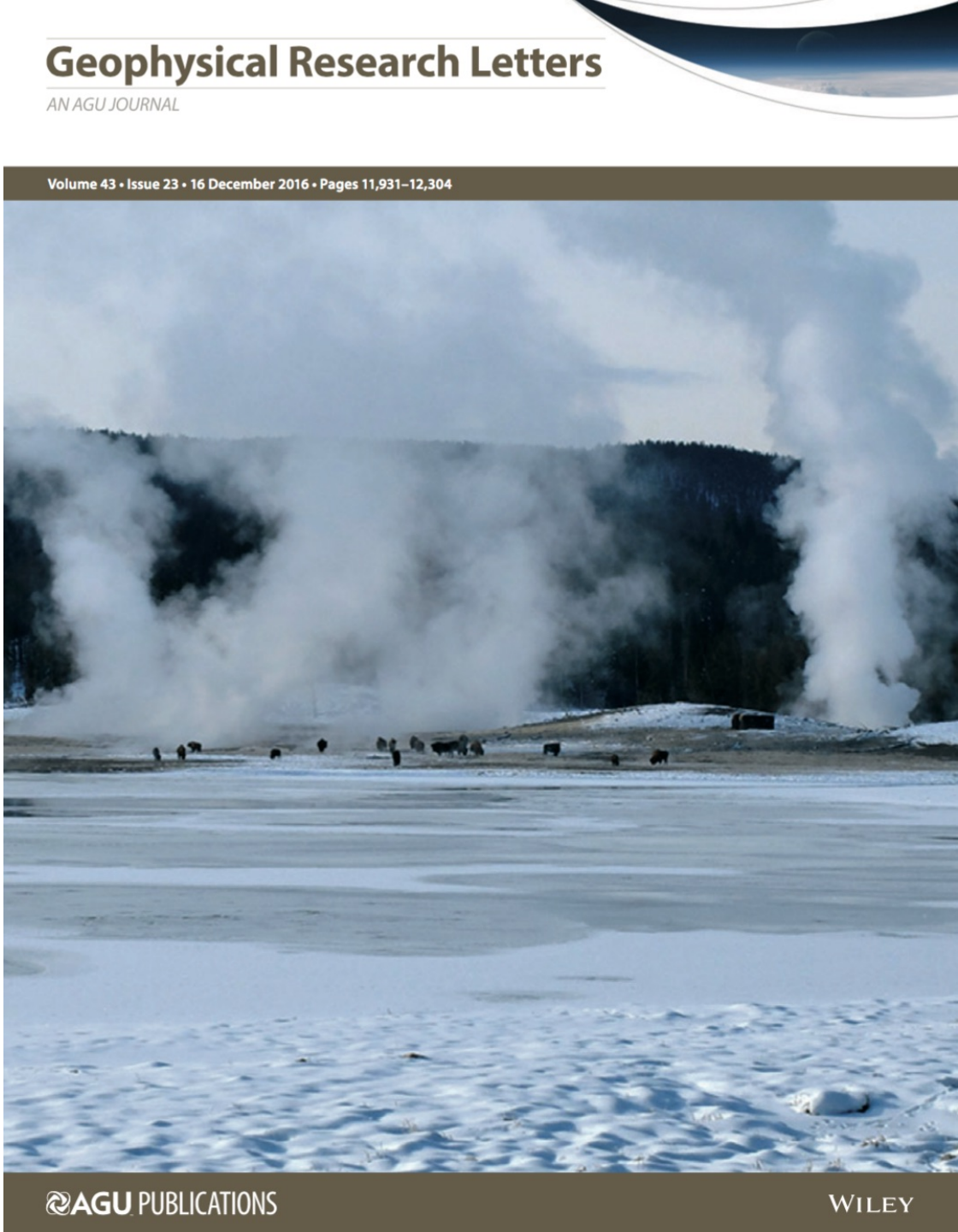


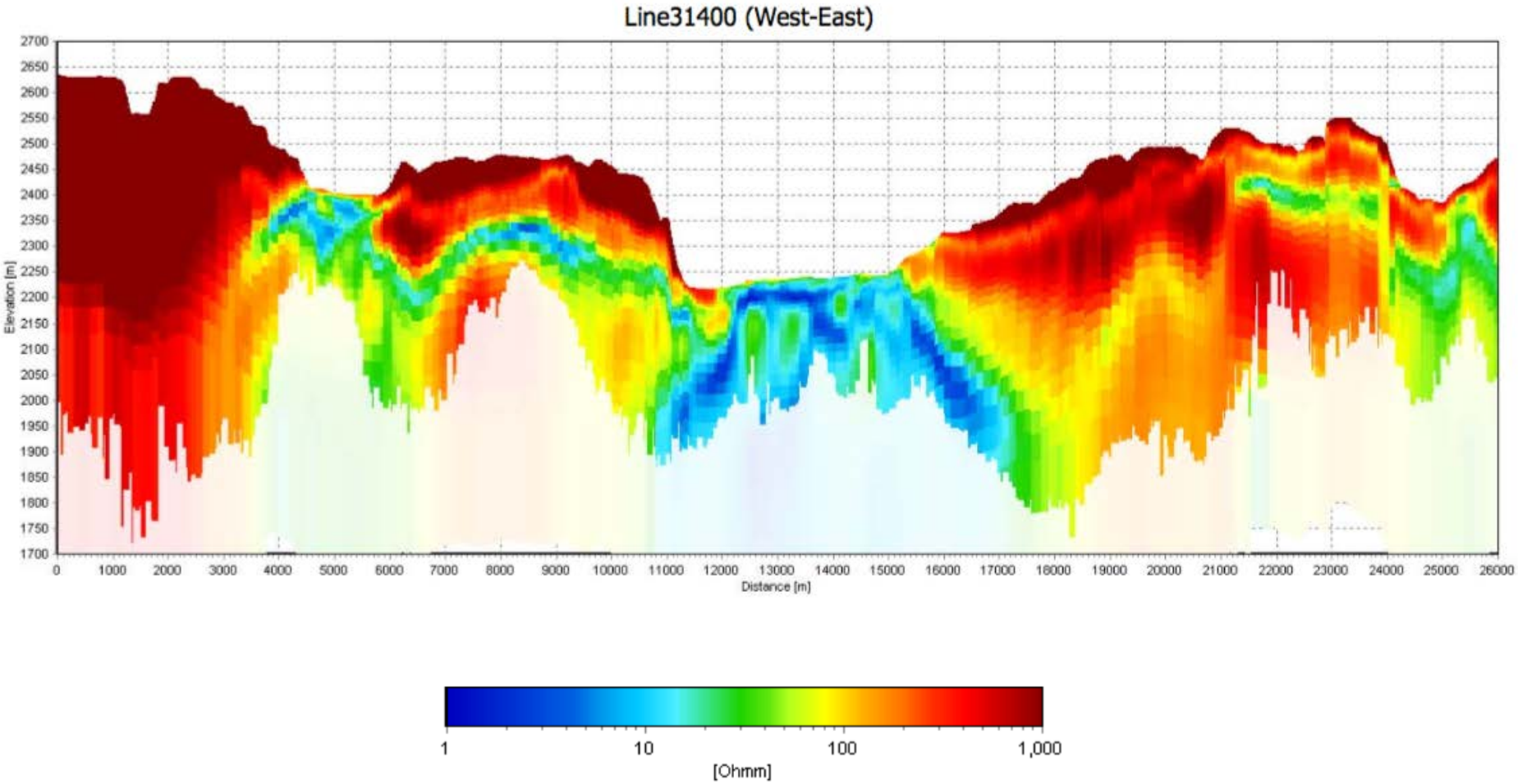
Photo by Sylvain Pasquet

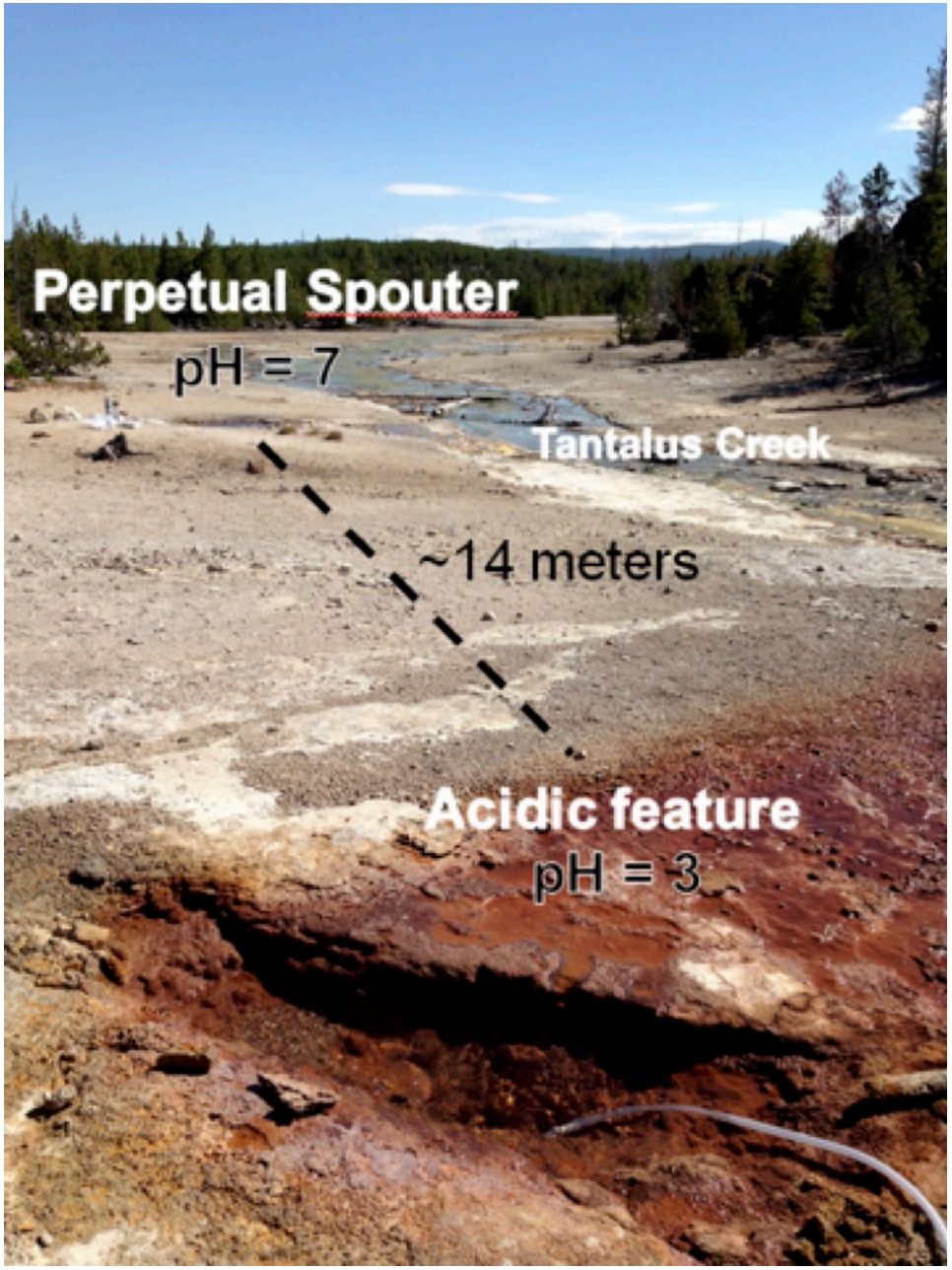
The Frying Pan

3D electrical resistivity survey: WyCEHG – FINSE – Summer 2016

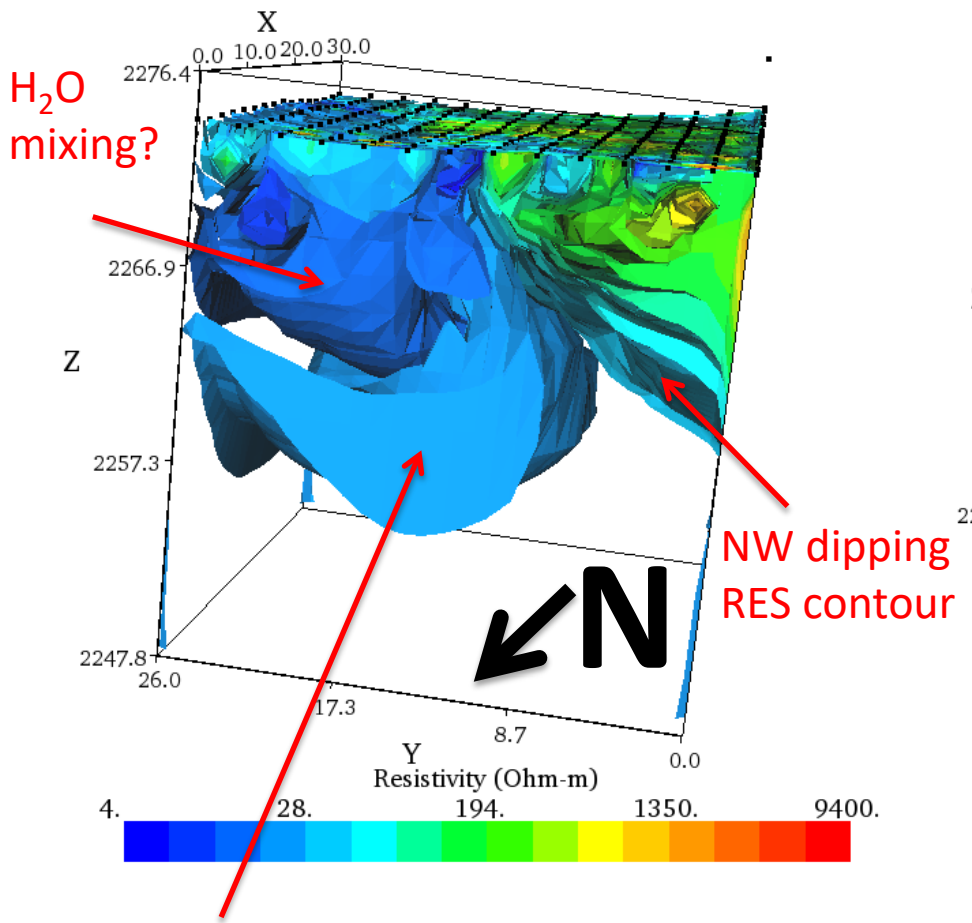
OPTA 3D Resistivity (20 x 38 m)

Old Faithful Line




Perpetual Spouter
pH = 7
Tantalus Creek
~14 meters
Acidic feature
pH = 3

3D Resistivity Contour Plot

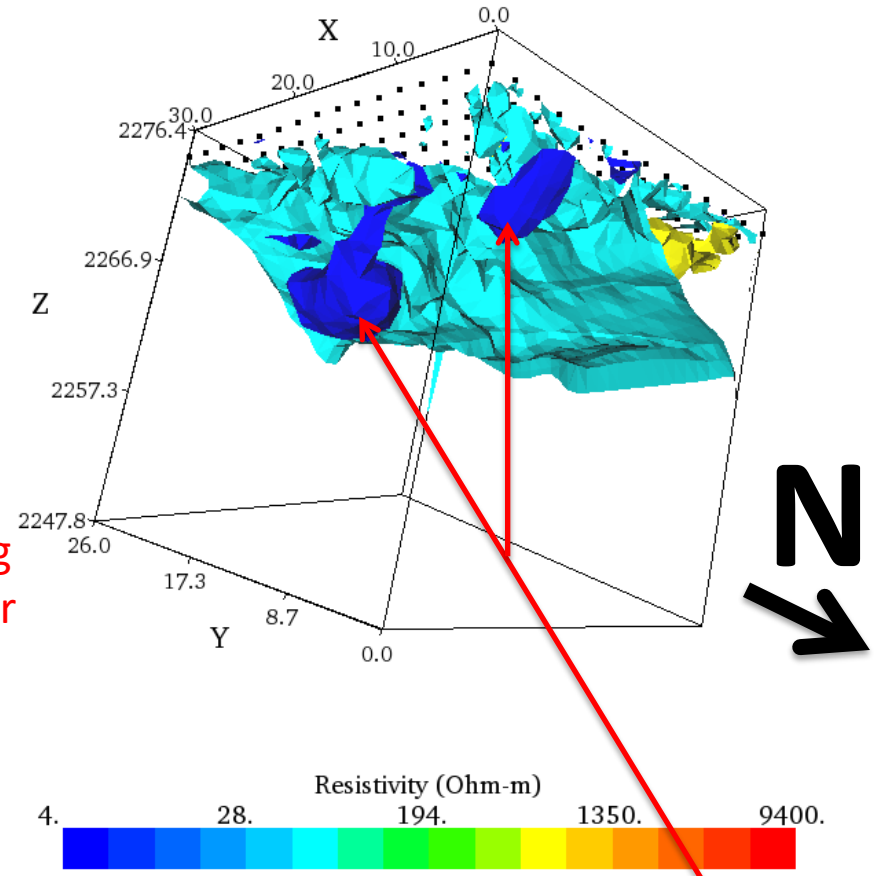


H_2O mixing?

NW dipping RES contour

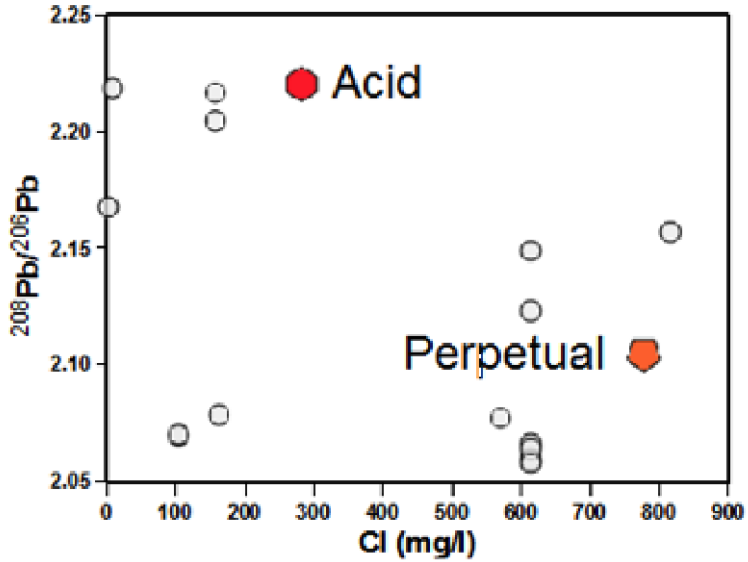
- Slightly elevated RES values ~20m bsl
- Gas?

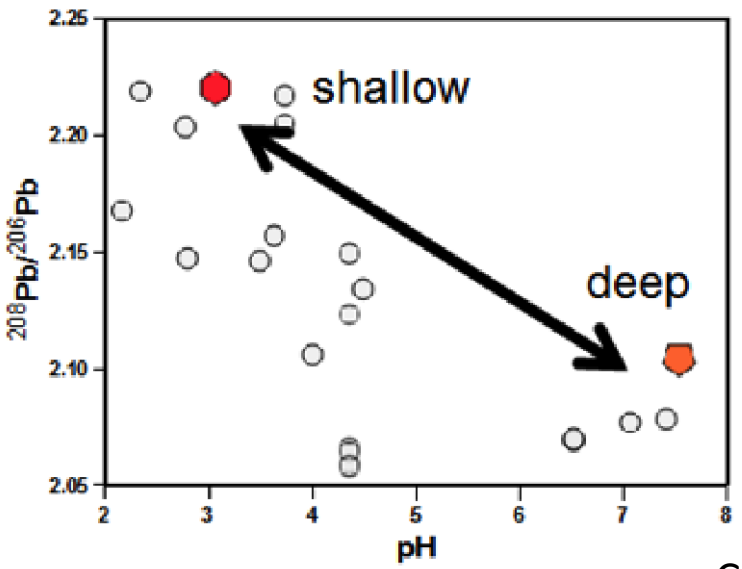
3D Resistivity Contour Plot

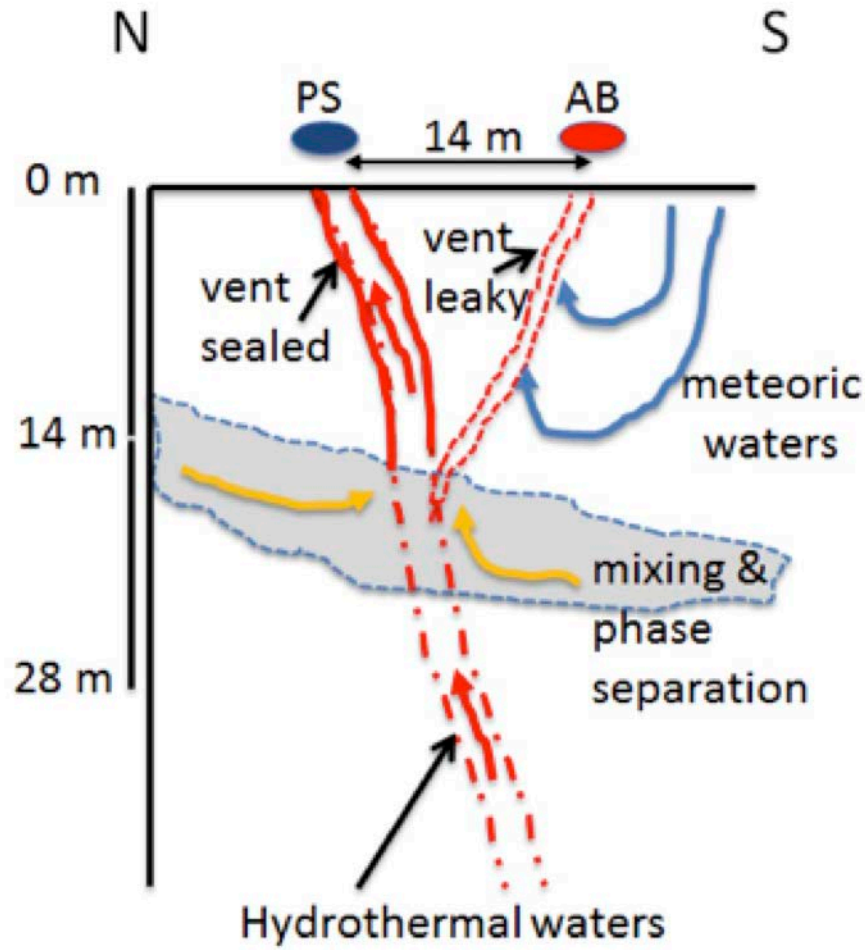


- Lowest RES values below the dipping interface from ~10m bsl to surface & orientated SW to NE
- Phase separated water pipes to surface?

Norris Geyser Basin: Conceptual Model







Carr et al., in prep

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Thank you

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