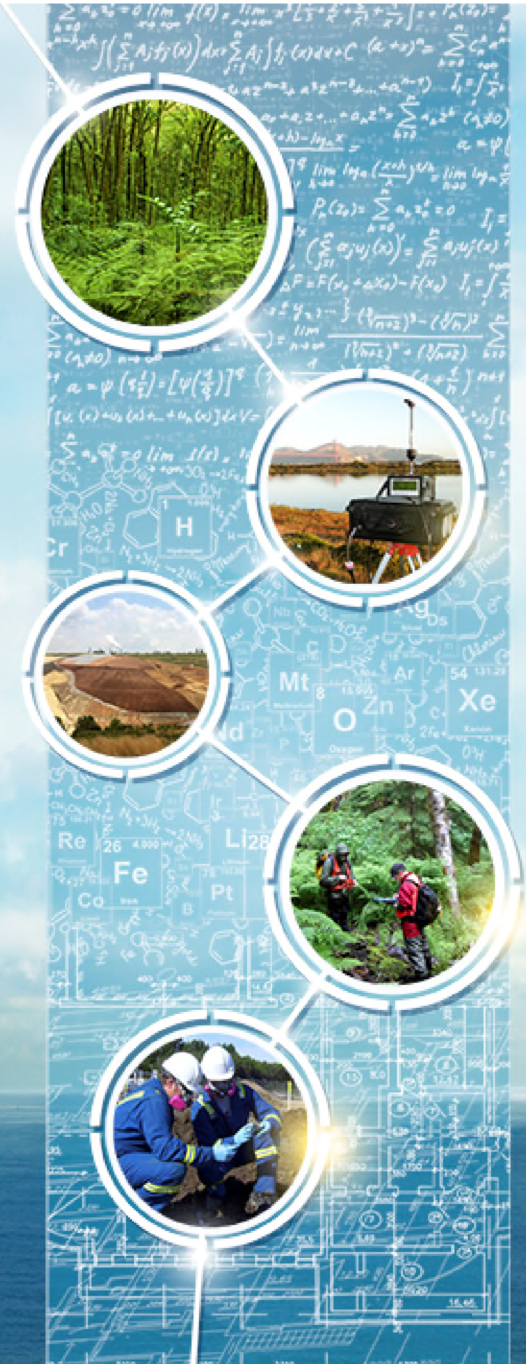

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Towed Array of VG Magnetics for Buried Munitions at the Naval EOD School, Eglin AFB, Florida

SAGEEP 2018

T. Jeffrey Gamey
William E. Doll

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Overview

- Survey Site
- System Specifications
- IVS Results
- Survey Results
- - Variable Speed Leveling
- - Analytic Signal Processing
- Conclusions

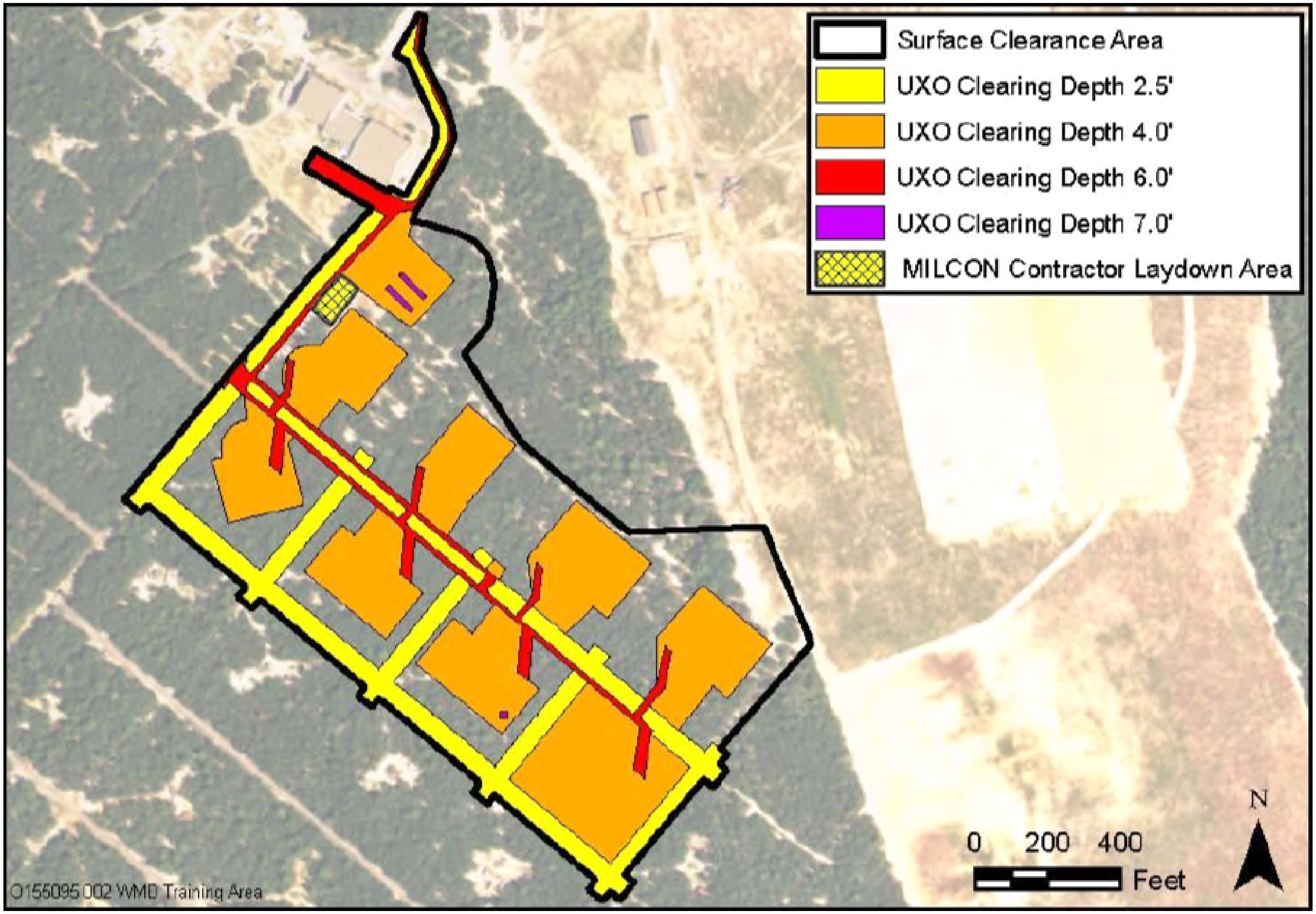
Survey Site

- Bay West LLC
- Ground clearance in preparation for extension of the Naval EOD School at Eglin AFB
- 21.3 acre site
- 30mm to 2ft
- 2.75” to 4ft
- Chose VG to meet detection depth requirements

Figure A-1 Eglin Air Force Base MRS Location

Survey Site

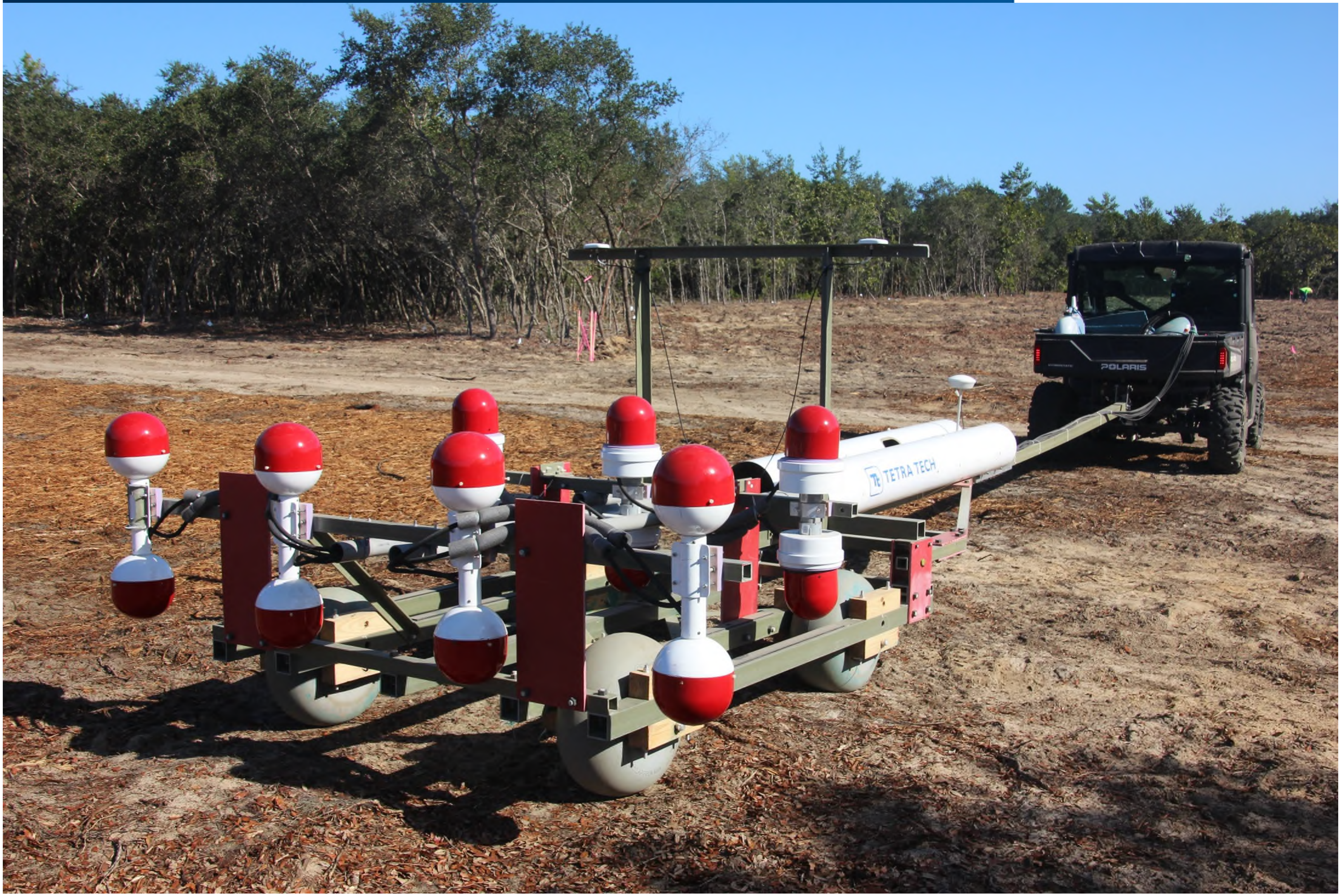
Figure A-2 Site Location



System Specifications

- Array of 14 airborne Cs magnetometers in 7 pairs
- 0.5m vertical separation, 0.4m horizontal separation
- 120Hz recording rate, nominal 0.01m between survey points
- 2.5m swath, 2m line spacing to maintain overlap
- Twin cm-accuracy GPS for positioning and orientation
- Navigation combines agricultural display and foam markers
- Platform reused several components from previous airborne and ground systems, together with new fabrication
- Platform allowed multiple options for ground clearance
- 20ft tow bar minimized ATV response
- Balloon tires for soft suspension

System Specifications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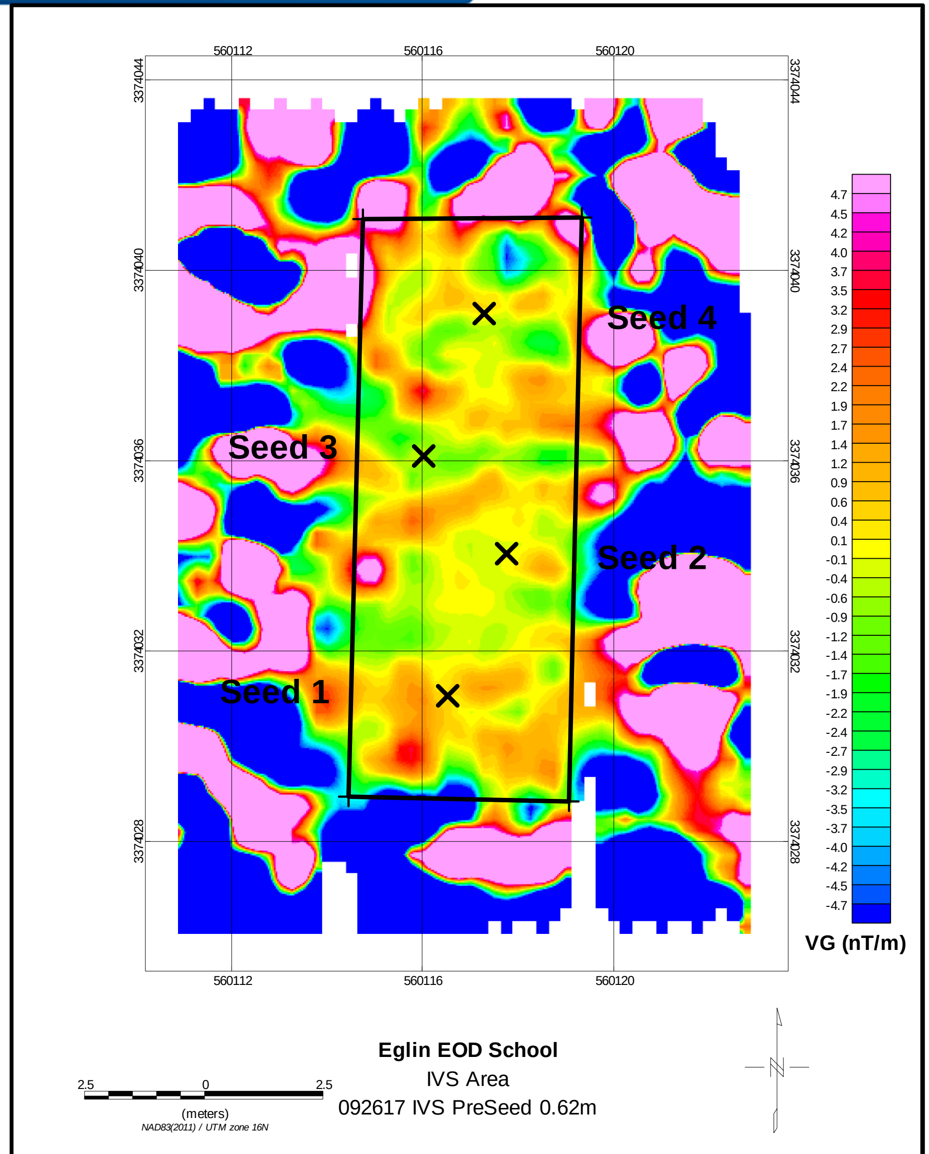
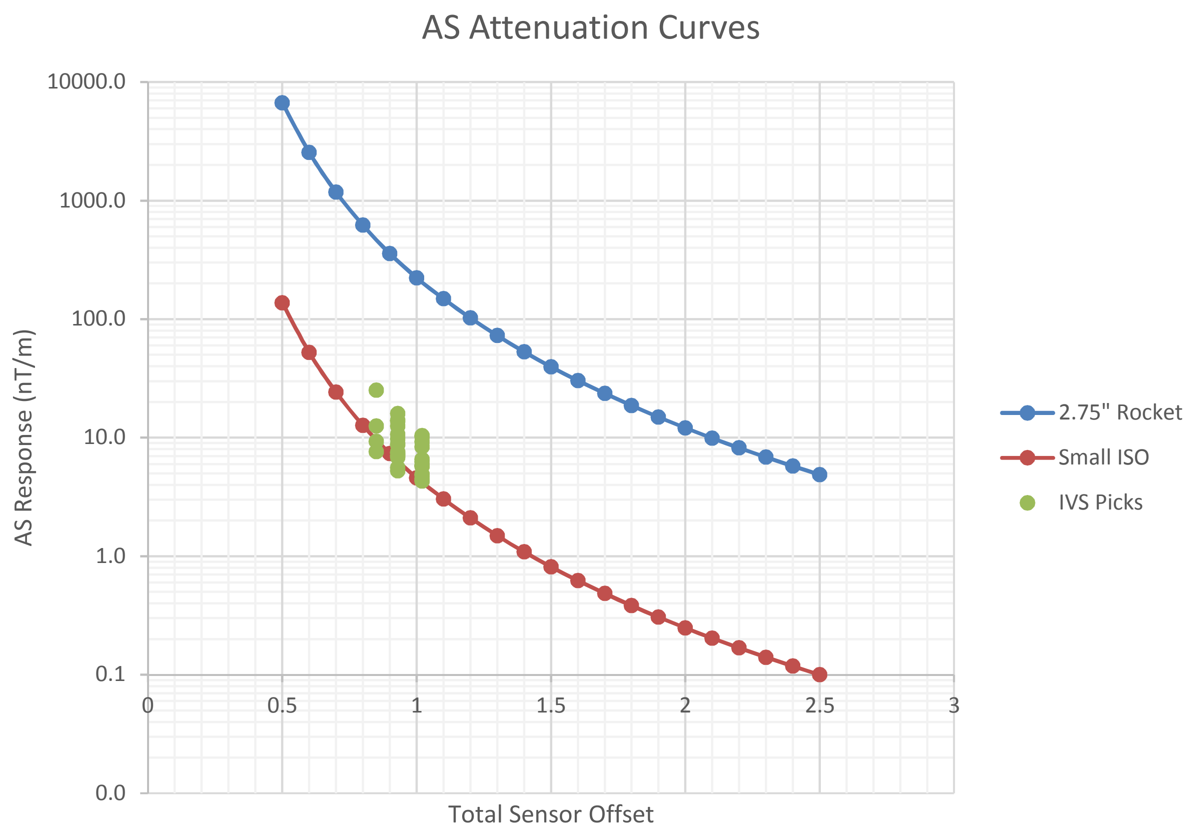
IVS Results

- Pre-seed survey of IVS site for anomaly avoidance when placing seed items (±5 nT/m color scale)
- IVS site cleared by Bay West
- Removed 400-lb of MD from a 5m x 12m area
- Residual response (±2 nT/m) was repeatable over all subsequent passes



IVS Results

- Small ISO were used for IVS and BSI
- Considerably smaller than the 2.75” rocket (smallest/deep TOI)
- Set two different picking thresholds
- 5nT/m for BSI 10nT/m for TOI
- Bottom sensor set at 0.52m agl (middle ht setting)



- SmISO modelled as 0.006 A·m^2 dipole
- 2.75”R modelled as 0.3 A·m^2 dipole

IVS Results

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- Other parameters
- Static noise level 0.06nT/m stdev
- Dynamic noise level (calculated in the clean space of the IVS) was much higher at 0.6nT/m stdev, mostly due to repeatable geologic background
- Average AS values in IVS area were also elevated (>3nT/m) due to FFT bleed over extrapolated from surrounding frag response
- Three sensor heights were tested (0.45m, 0.53m, 0.62m) - Surveyed with middle height setting
- Theoretical attenuation curves were set for minimum coupling, but do not include potential remanence
- Picking thresholds were therefore conservative, actual values from curves were 7nT/m for SmISO and 20nT/m for 2.75"R
- IVS targeting accuracy was 0.22m avg using a 0.25m grid cell

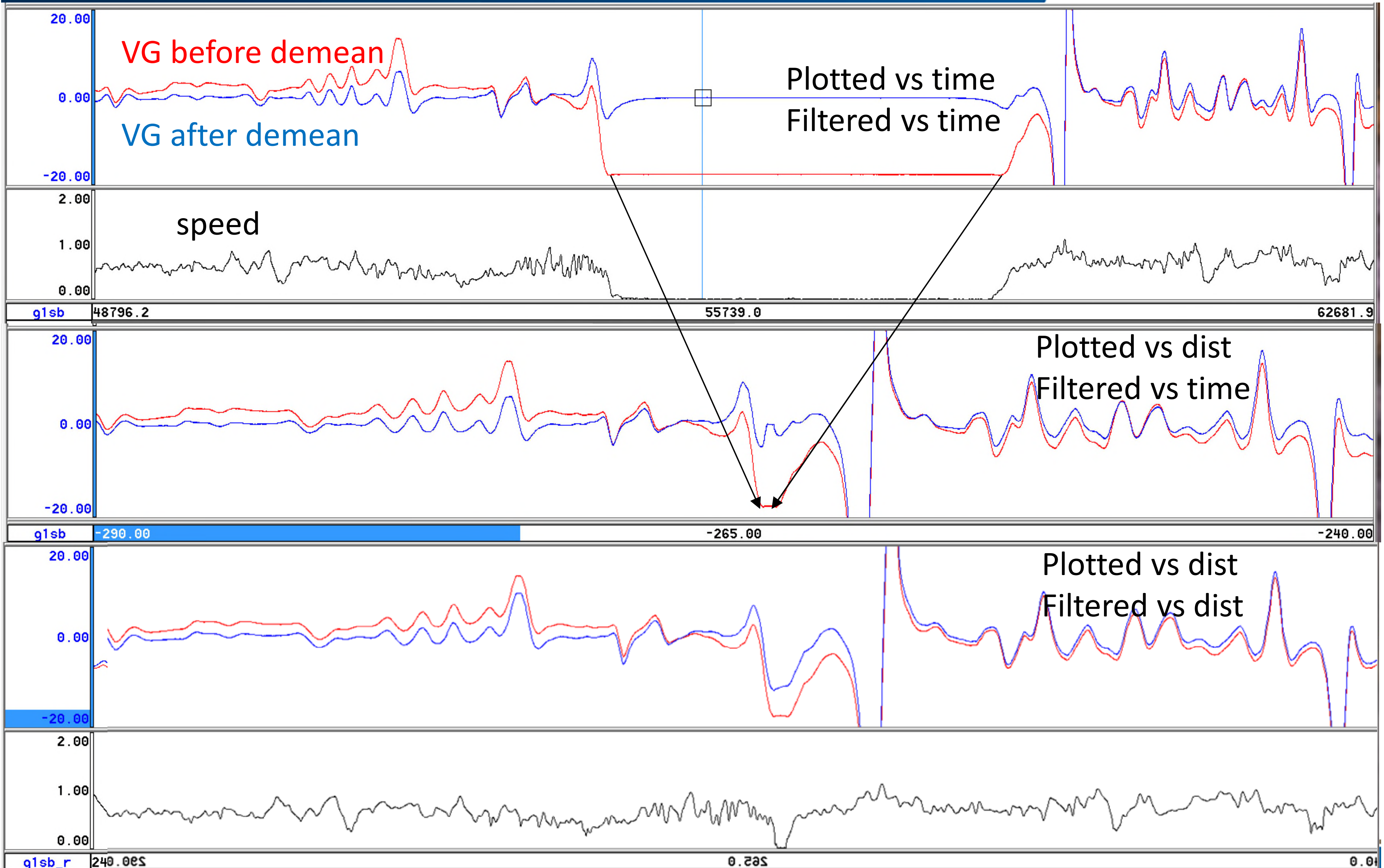
Survey Results

- Data collection ran 7 days (Sept 30 – Oct 10) with time off for hurricanes
- Site had been graded and upturned numerous roots, branches and construction debris
- This caused problems for platform height (optimized at 0.53m) and several flat tires (some additional debris removal, greater effort at avoidance and reduced tire pressure)
- Processing problems included:
  - Effects of variable speed on demeaning
  - Effects of very large responses on AS calculations

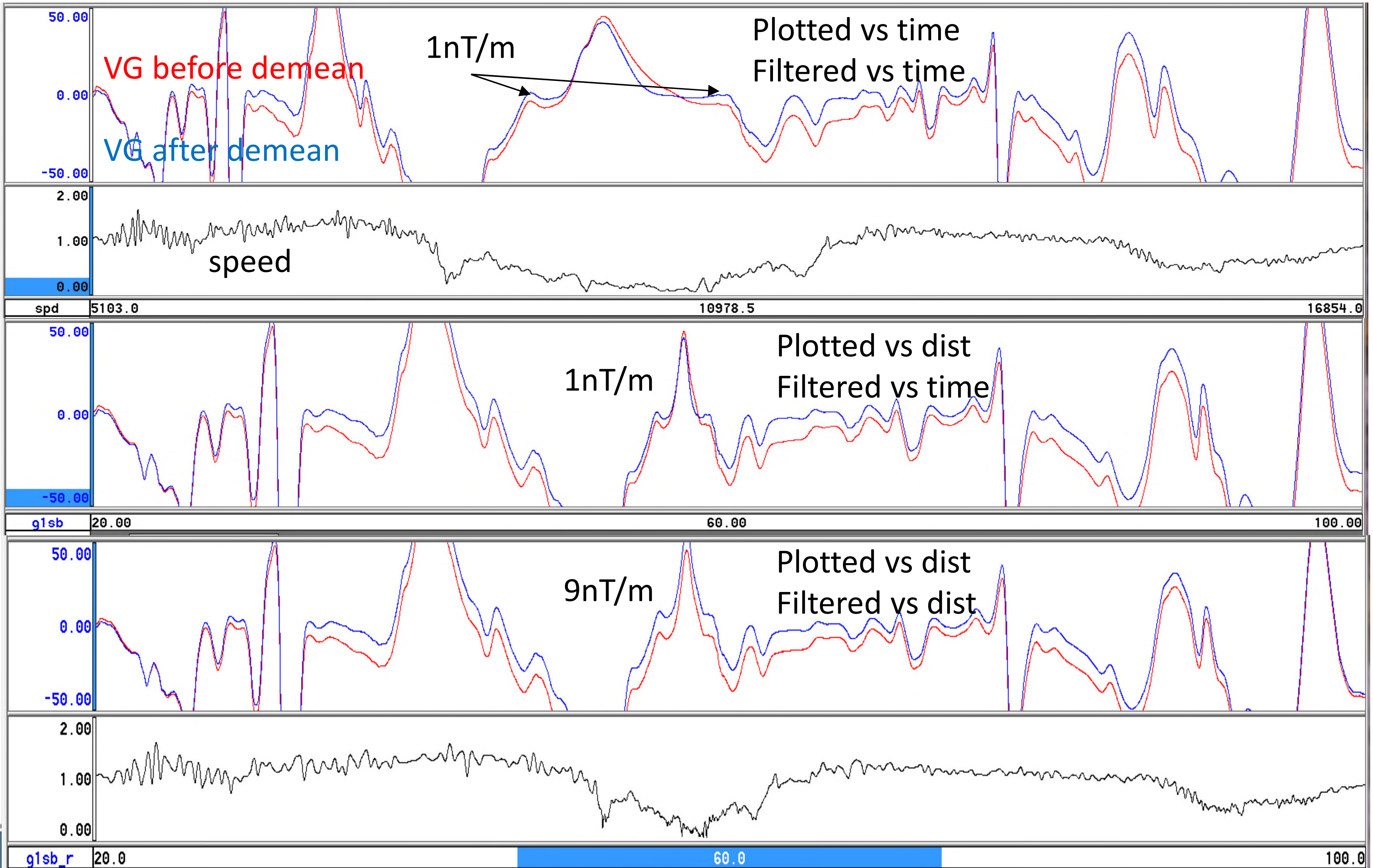
Variable Speed Leveling

- Levelling could be handled in several different ways
- Random line directions meant heading error was not simple
- Heading correction file could not be compiled due to lack of clean background space
- Normal demeaning process hampered by variable speed, including stops in mid-line
- All data were re-fidded to a distance channel at 0.01m interval in order to get a uniform base for filters
- Works best if you have smooth (filtered) positions before, otherwise distance channel will continue to increment even while standing still (if positions jitter around a static point, it still counts as increasing distance)
- Output is a more accurate representation of the anomaly amplitude, and also more consistent from line to line even if speed varies

Variable Speed Leveling



Variable Speed Leveling

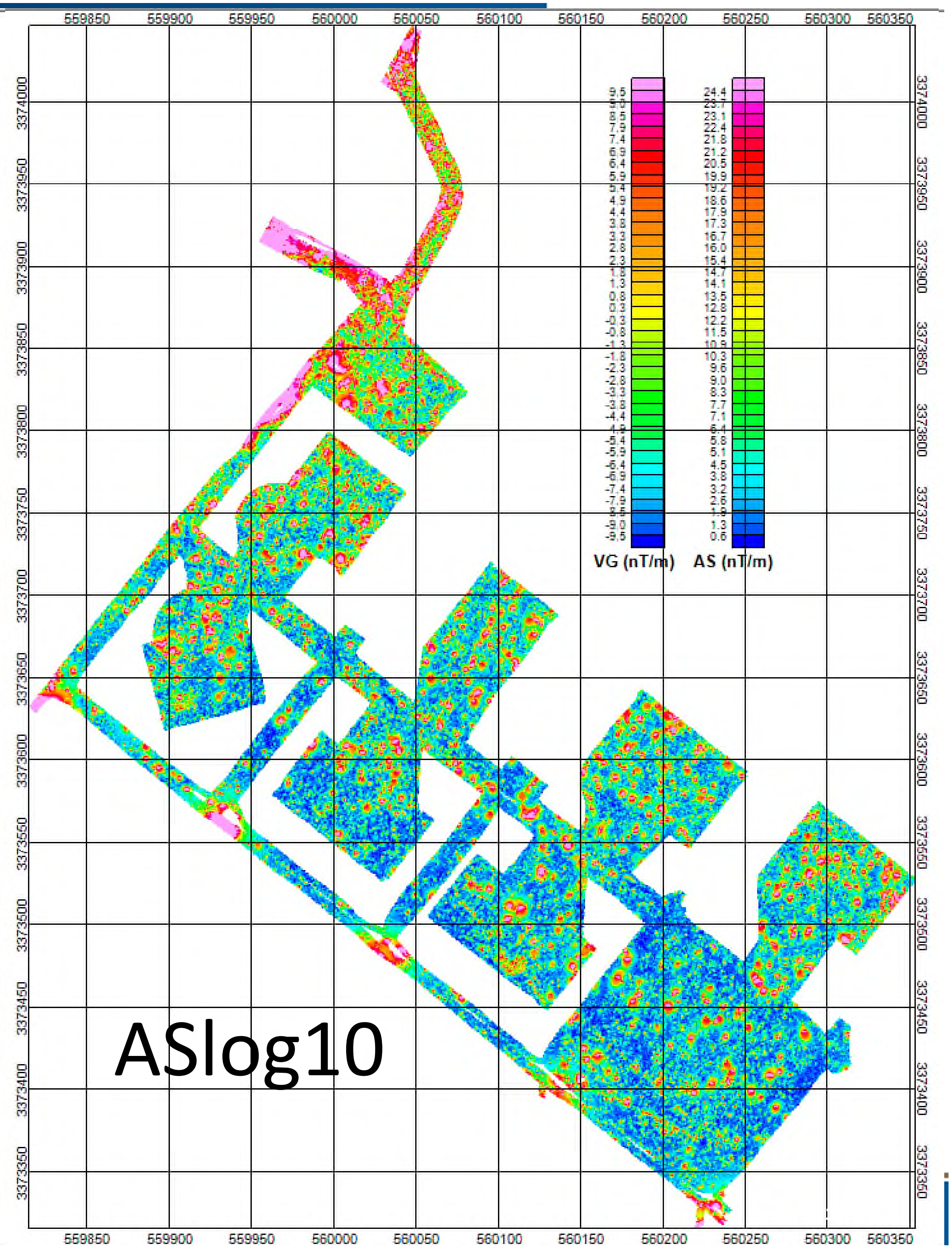


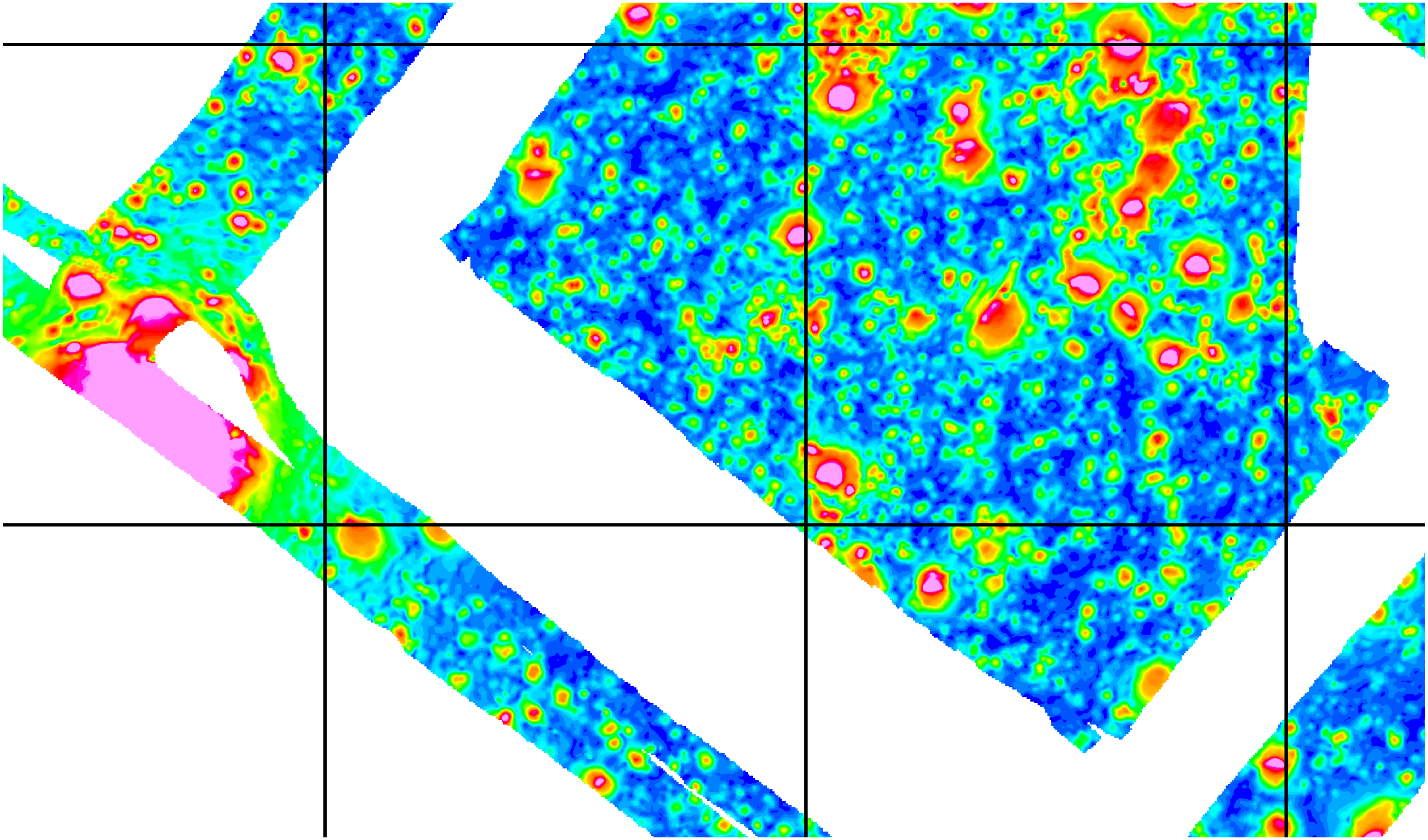
AS Processing

- Very wide and high amplitude responses around power relays, concrete pads etc had significant bleed over into rest of the grid
- This artificially raised the amplitude of responses, making it difficult to get a consistent dig sheet across the project
- Clipping or masking will retain neighboring amplitudes, but loses the actual anomaly
- Used the "*log/linear, save as log*" option in the VG grid
- Rounds off and flattens high amplitudes – reduces halo
- This retains the texture of the AS in high amplitude areas, but sacrifices the amplitude values
- Responses below 10nT/m remained unchanged
- Peak amplitudes could not be compared to theoretical curves, but were still proportionate to the size of the response

AS Processing

- VG, AS and ASlog10
- Problem points visible as somewhat discrete targets in VG
- Often too numerous to mask out, would not leave any remaining data
- AS shows bleed into neighboring data
- ASlog10 shows more consistent peak amplitudes across entire survey





AS Processing

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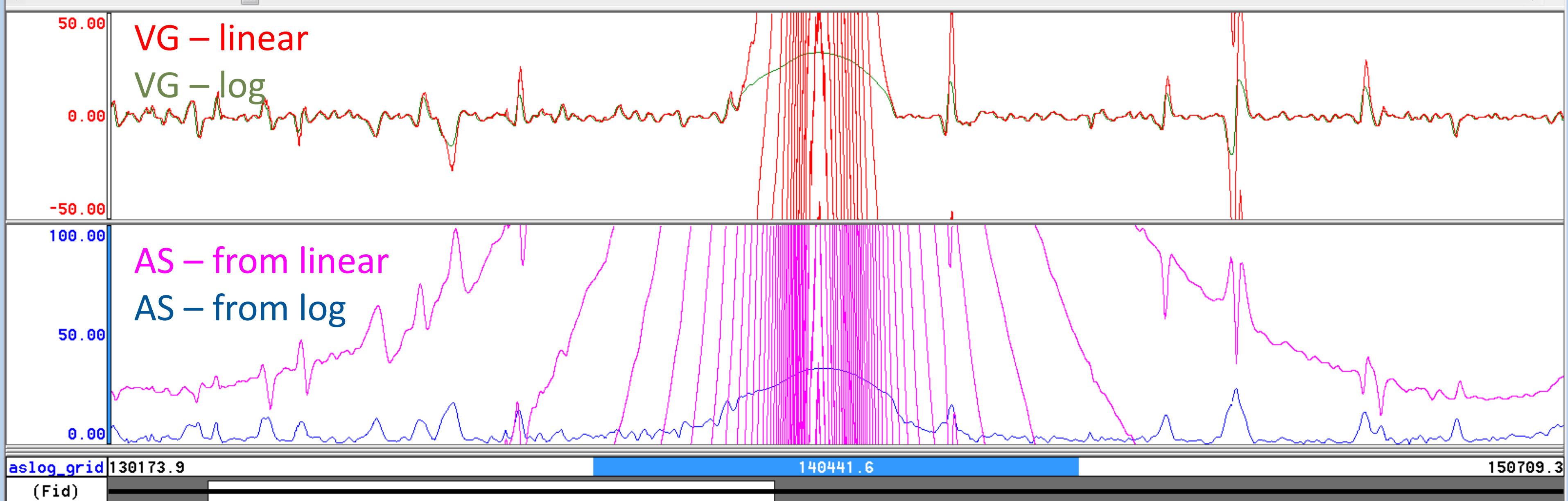
- Profile along the road across a strong response
- AS from log data is slightly broader, but more consistent with expectations (no “negative” or “dipole” AS signatures)
- These artefacts in the linear AS cannot be fixed simply with color scaling or 2D filtering

✔ L505.1:0	vg_grid	vglog_grid	as_grid	aslog_grid
137240.0	-0.14	-0.11	195.76	5.74
137241.0	-0.22	-0.19	195.77	5.74
137242.0	-0.14	-0.11	195.97	5.77
137243.0	-0.14	-0.11	196.18	5.81



Conclusions

- High-density magnetic gradient survey was a success
- Some atypical processing approaches were used to enhance the consistency of the results
- These may be applicable to other projects and can easily be tested on a case-by-case basis
- Excavation of targets is currently underway