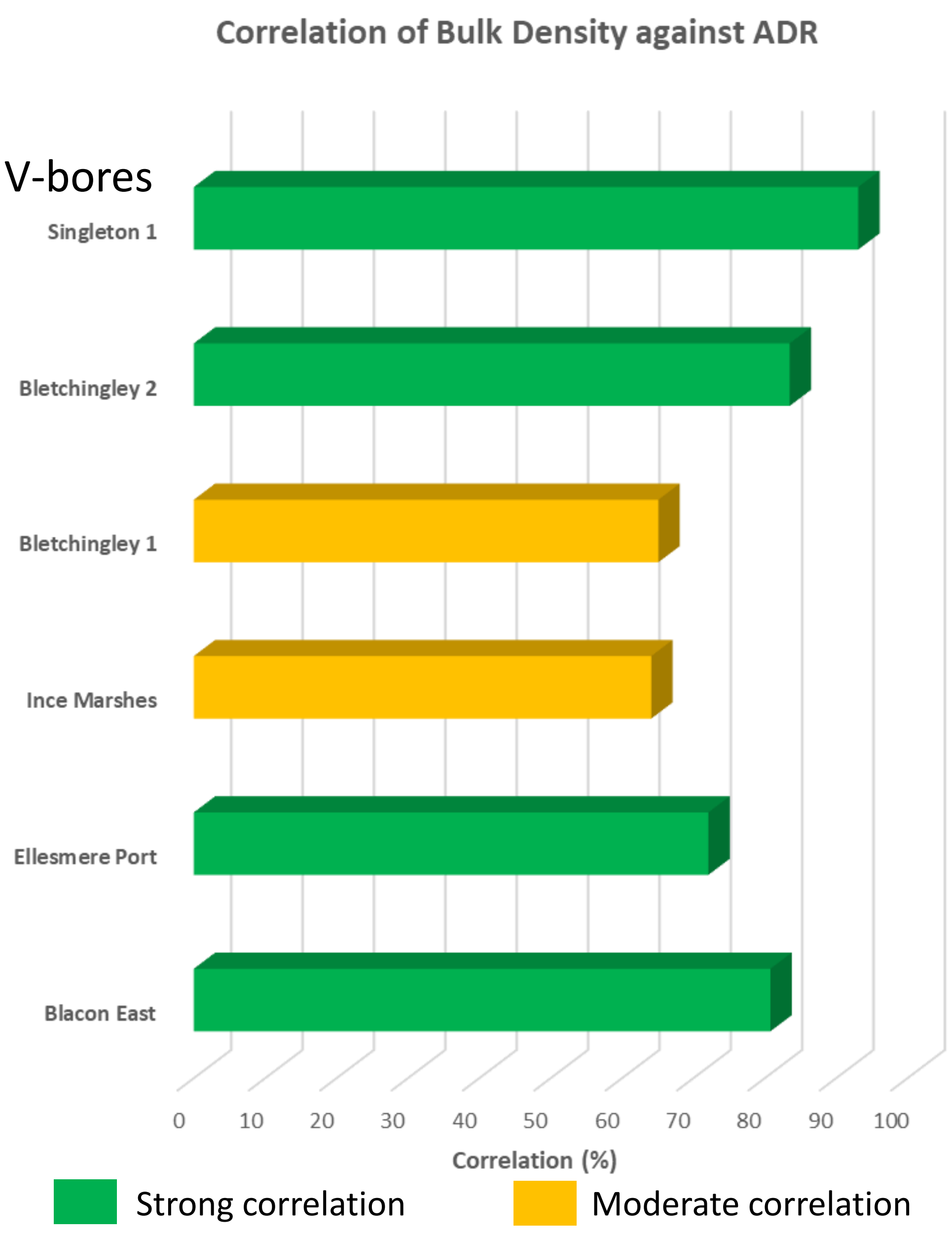
Adrok Subsurface Bulk Density Proxy Tests

Executive Summary

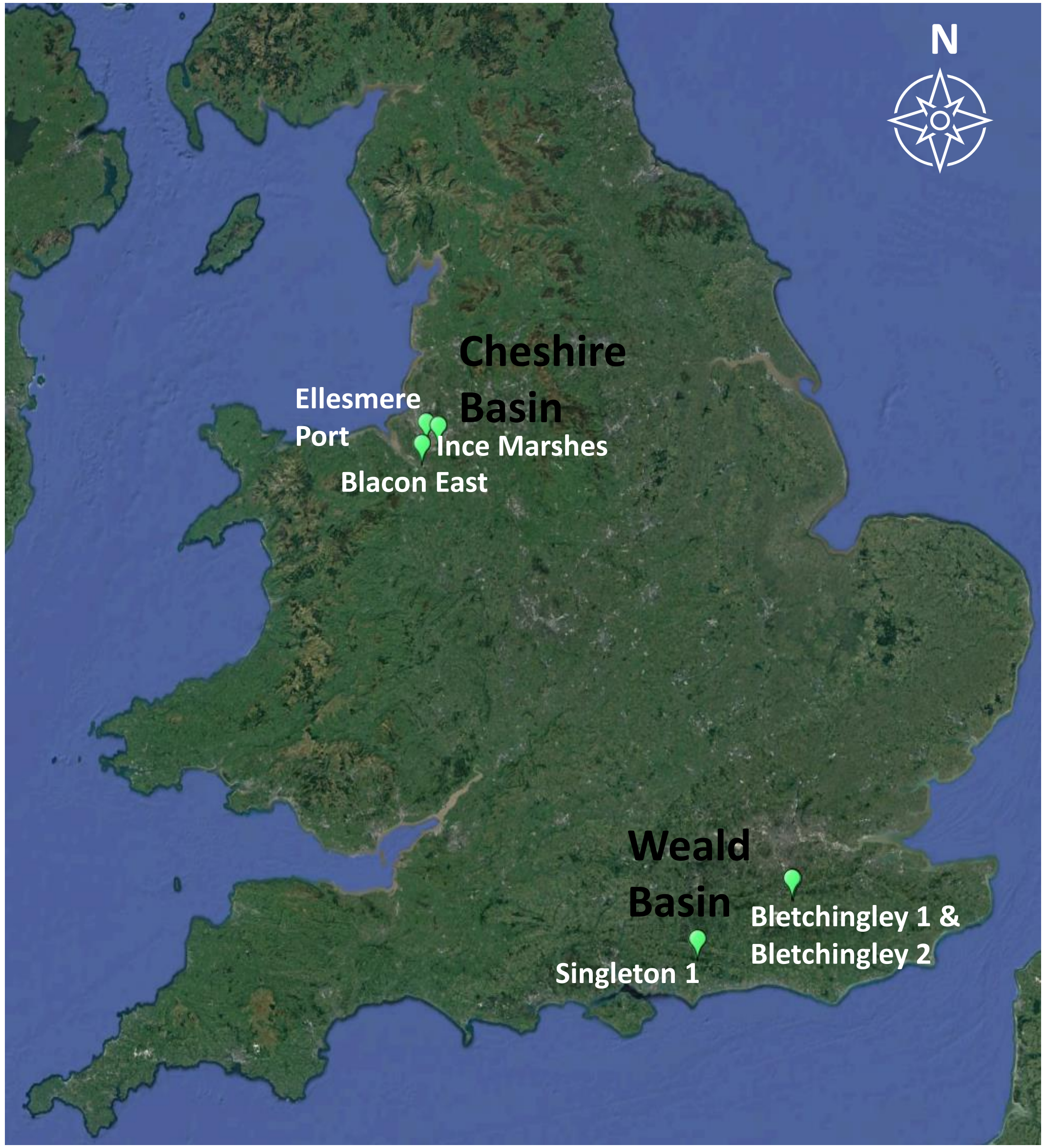
Using six Adrok virtual boreholes (V-bores) scanned at drill locations in two English sedimentary basins, Adrok has developed a new tool which could identify areas of high bulk density without the need for drilling.

The correlation of bulk density training data against ADR exceeds 70% in four out of six V-bores indicative of strong correlation. The average correlation of 76.45% is also strong. An excellent result. To develop the tool further the following steps are recommended.



Version 1: 19th December 2023

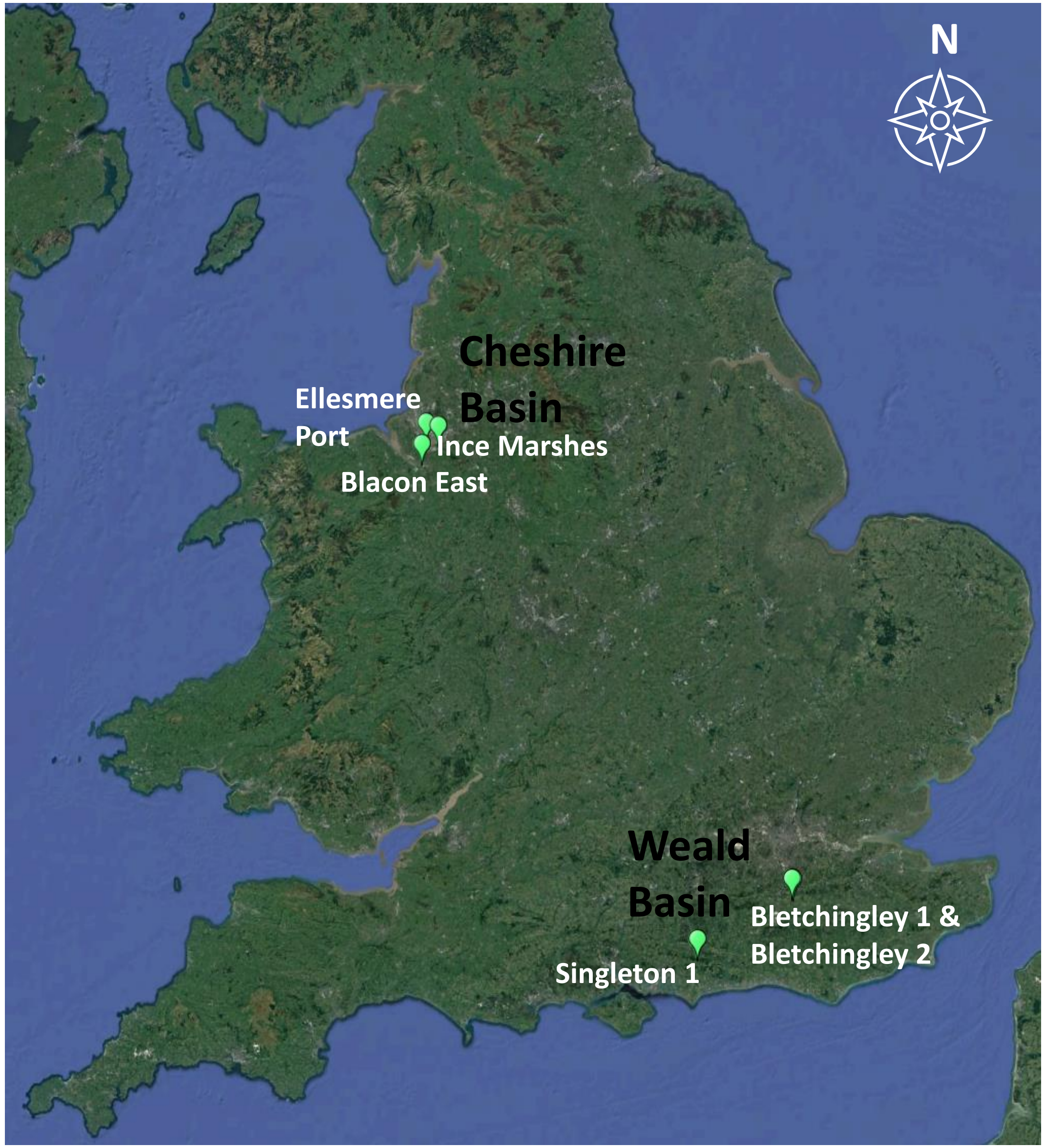
1) Drill hole Location & Data Range



Drill Hole	Date drilled	Training Data Depth Range (m)
Blacon East	10/11/1981	407-1207
Ellesmere Port	06/03/2015	857-1911
Ince Marshes	28/12/2011	368-1450
Bletchingley 1	16/12/1965	182.88-1857
Bletchingley 2	16/6/1966	161.54-1066
Singleton 1	13/1/1989	1964-2115

- The six sites were drilled in England in two separate basins.
- Some of the drill logs are much older than others but all contain down hole tool logs and have V-bores scanned nearby.
- All six V-bores were originally processed by Adrok between March & May 2017.

1) V-bore Location & ADR data

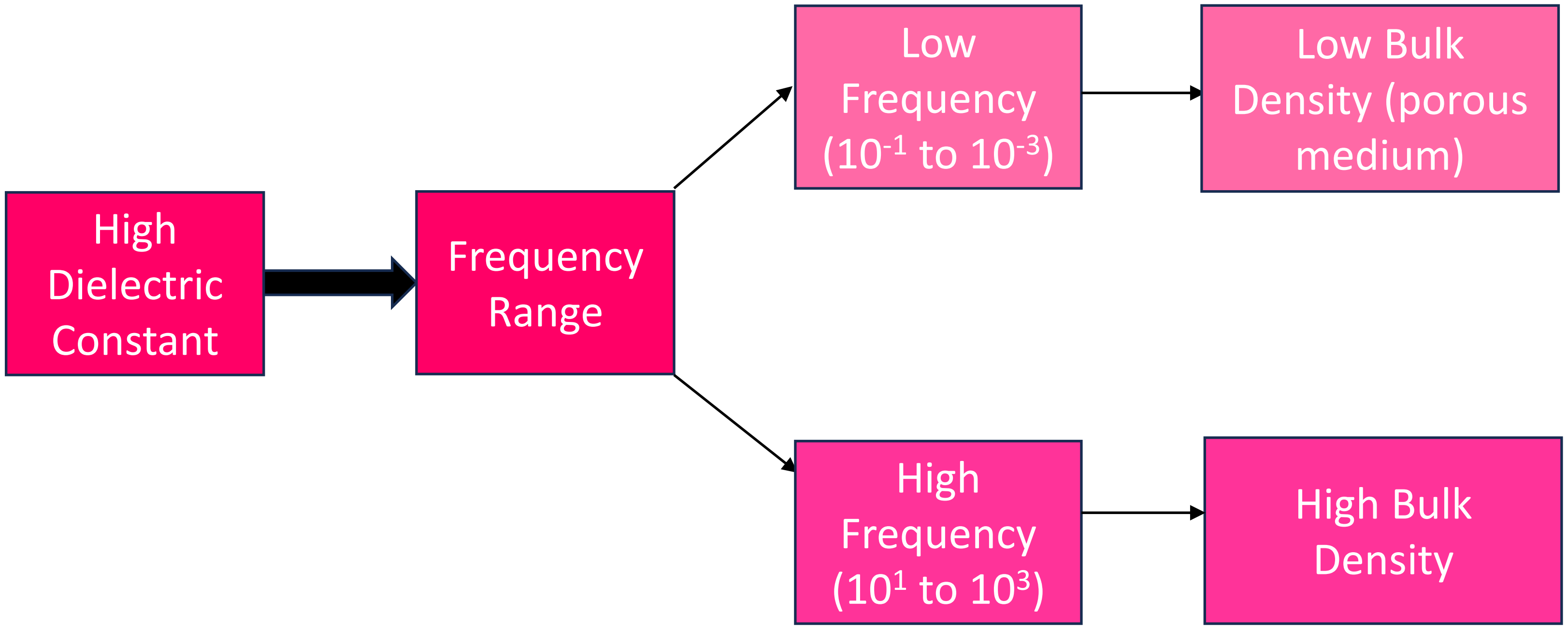


Drill Hole	Date Collected	Depth Processed (m)	Stare Used
Blacon East	7th March 2017	3000	SII8
Ellesmere Port	7th March 2017	3000	SII7
Ince Marshes	7th March 2017	3000	SII4
Bletchingley 1	12th March 2017	3000	SII2
Bletchingley 2	13th March 2017	3000	SII8
Singleton 1	14th March 2017	3000	SII3

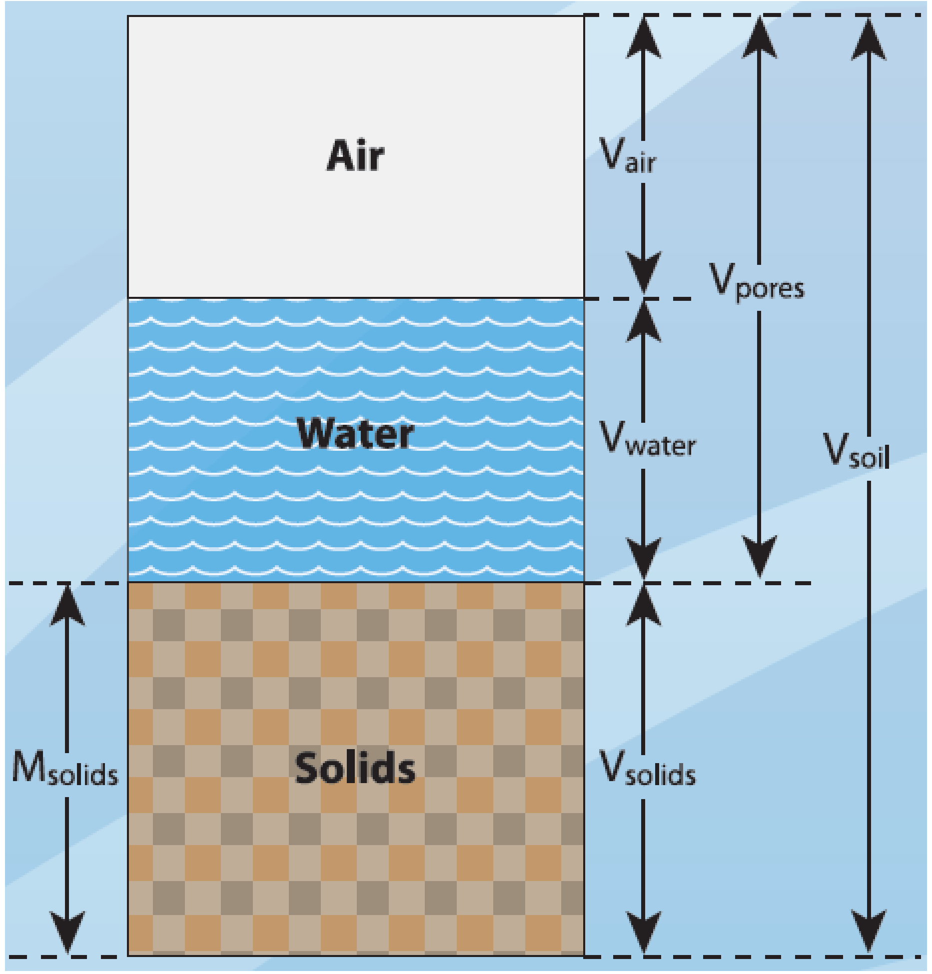
- The six V-bores were scanned in March .
- The following parameters were then extracted down to 3000m E-ADR, E-Gamma, E-Mean, E-SD, F-ADR, F-Gamma, F-Mean, F-SD, E-log, WMF (using a single stare shown above).
- The quality of this data is assessed in the following slide

2) Hypothesis

- In dry materials there is a positive relationship between bulk density & dielectrics. In wet materials this relationship is determined by the medium filling the pores due to their more anisotropic nature.
- To differentiate between high dielectrics associated with high bulk density and high dielectrics associated with water saturated pore space, we need to look at the frequencies. Both **<u>high frequency & high dielectrics are associated with high bulk density.</u>** But low frequency associated with high dielectrics probably indicates a saturated porous medium.



Subsurface Density



Subsurface density is typically measured using several techniques, each suitable for different contexts and scales, from geological surveys to civil engineering projects. These techniques include:

Borehole Logging – using a gamma-gamma density log;

Seismic Methods - by analysing travel times and wave amplitudes from controlled seismic sources to receivers, geophysicists can infer changes in density.

Gravity Surveying – by measuring variations in the Earth's gravitational field at different locations.

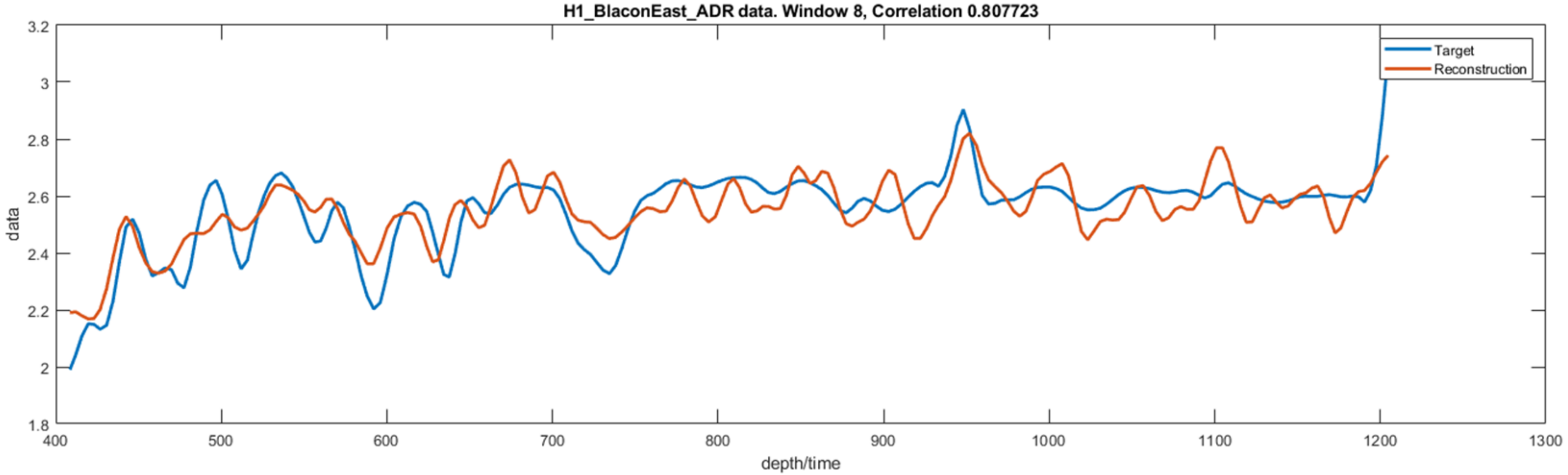
Cone Penetration Testing (CPT) – by measuring resistance to penetration. The resistance is related to the density and other mechanical properties of the soil.

Electrical Resistivity Tomography (ERT) – by measuring the electrical resistivity of the subsurface, which can be indirectly related to density.

The choice of method depends on factors such as the depth of interest, the scale of the area to be surveyed, the nature of the subsurface materials, and the required resolution and accuracy of the measurements. Often, multiple techniques are used in combination to achieve a more comprehensive understanding of subsurface conditions.

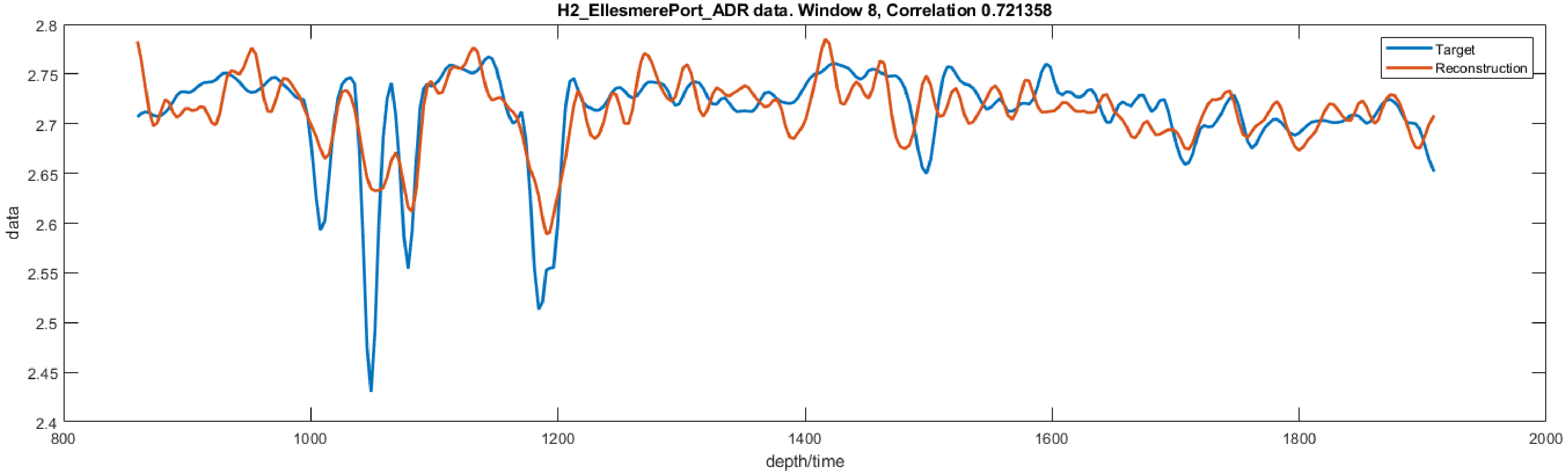
4) Results

4) Results Blacon East



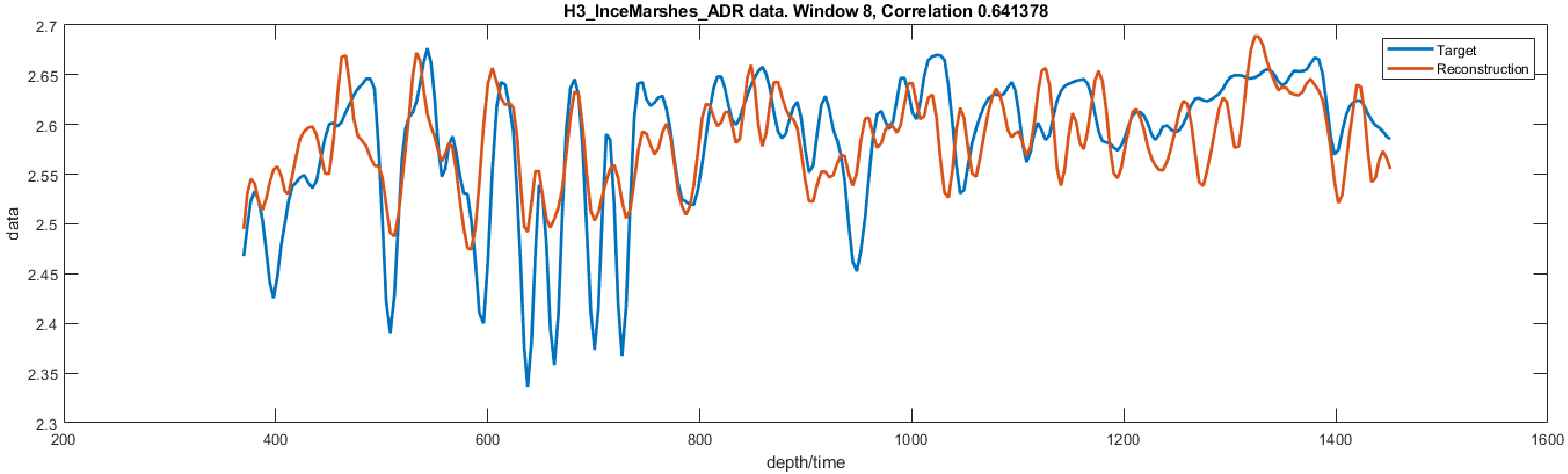
- The bulk density results for Blacon East are shown in blue against the reconstruction in orange.
- The reconstruction shows excellent matches between 400-475m, 520-550m, 930m-950m.
- For the rest of the data the patterns match well but reconstruction results produces a narrower range of data than the target.
- The 80% correlation between the reconstruction and target data indicates strong correlatio.

4) Results Ellesmere Port 1



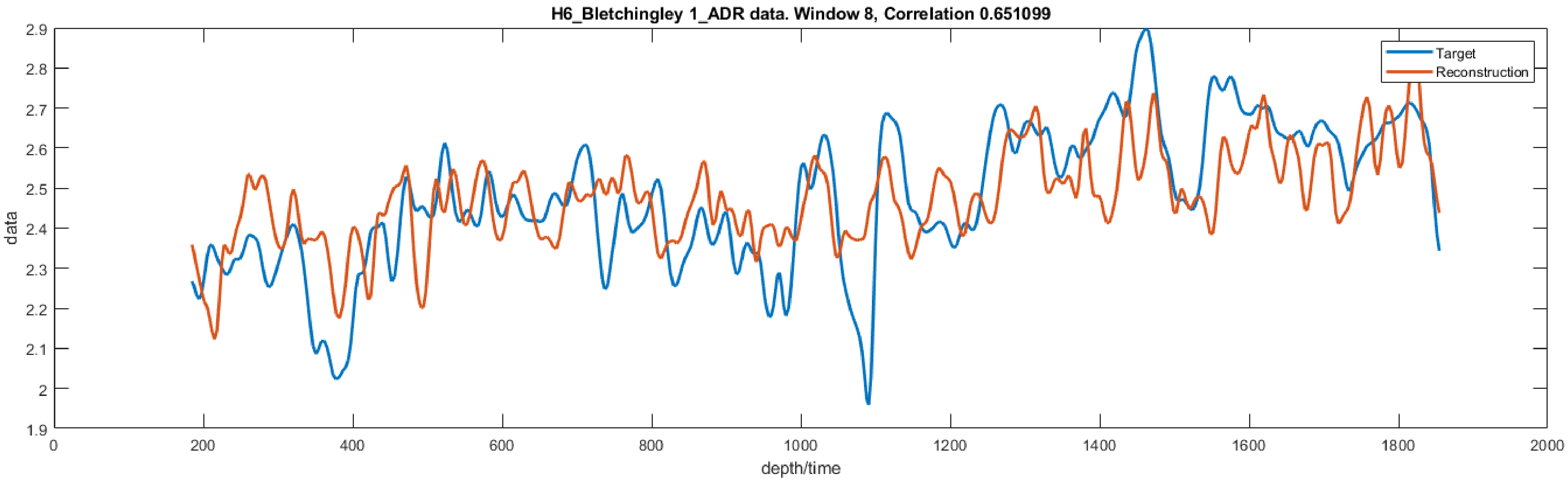
- The bulk density results for Ellesmere Port are shown in blue against the reconstruction in orange.
- The reconstruction shows excellent matches between 1020m-1060m, 1160m-1200m, 1700m-1710m, 1860m-1900m.
- For the rest of the data there are some trends that match well e.g. 1000m-1250m. However, there are some mis matches e.g. 900m-990m & 1500m.
- The correlation value of 72% is considered a strong correlation.

4) Results Ince Marshes



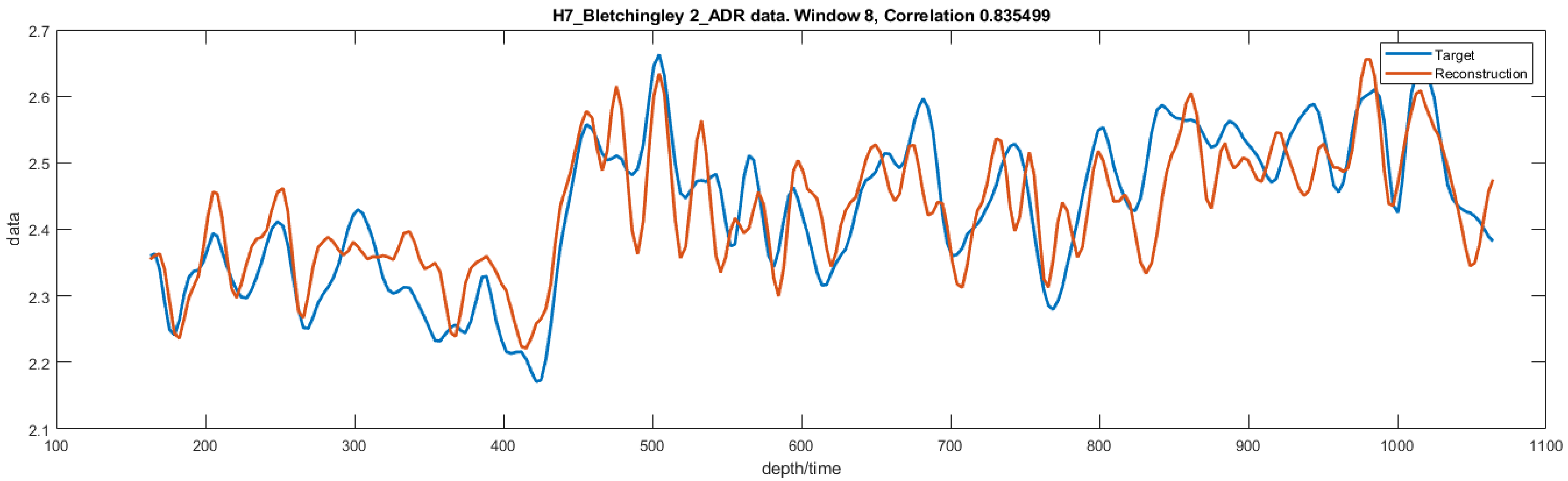
- The bulk density results for Ince Marshes are shown in blue against the reconstruction in orange.
- The reconstruction shows matches in values at 500-600m, 700m, 800m, 1100m.
- For the rest of the data there are some trends that match well e.g 610m, 900m. However, there are some mis matches e.g. 900m-990m & 1500m. The rest of the data there is little correlation between the data.
- The correlation value of 64% is moderate.

4) Results Bletchingley 1



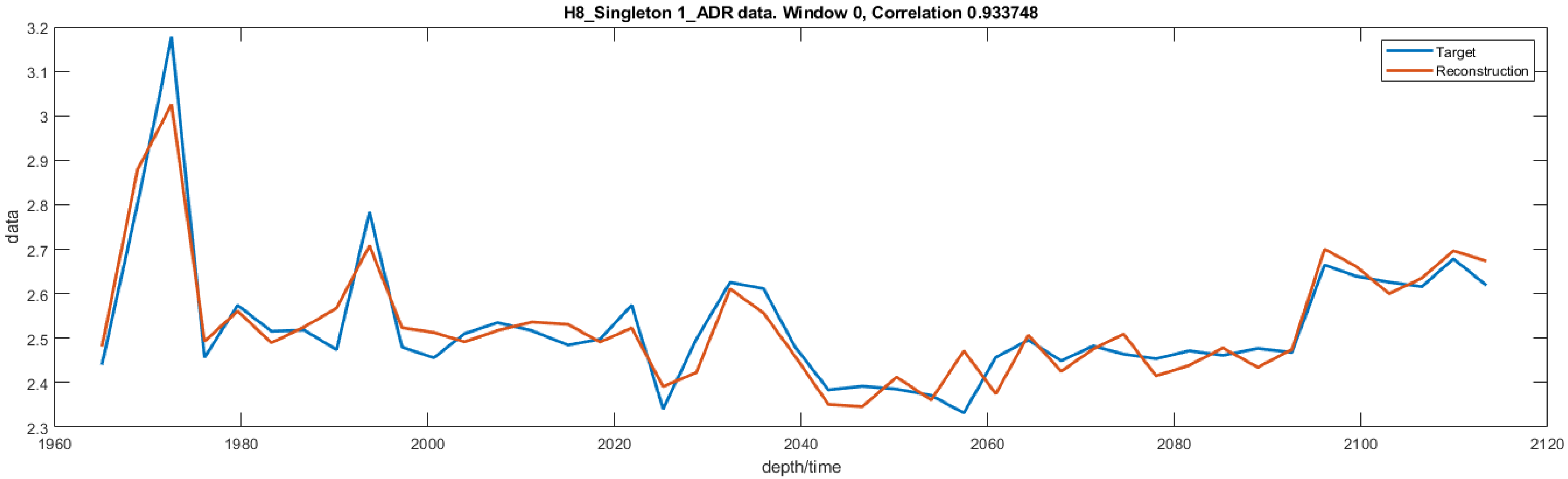
- The bulk density results for Bletchingley 1 are shown in blue against the reconstruction in orange.
- The reconstruction shows matches in values at 500-550m 950m-1100m, 1300m.
- For the rest of the data there are some trends that match well e.g 300m-700m and 1500m-1800m. However, there are some mis matches e.g. 200m-240m, 700m,1300m-1500m. The rest of the data there is little correlation between the data.
- The correlation value of 65% is considered moderate.

4) Results Bletchingley 2



- The bulk density results for Bletchingley 2 are shown in blue against the reconstruction in orange.
- The reconstruction shows excellent matches between 400-475m, 520-550m, 580m-690m, 950m-1050m.
- For the rest of the data the patterns match well but reconstruction results produces a broader range of values then the target.
- This 83% value indicates strong correlation between the reconstruction and target data.

4) Results Singleton 1



- The bulk density results for Singleton 1 are shown in blue against the reconstruction in orange.
- The reconstruction shows an almost identical match throughout 260m section and the data values are almost identical.
- 93% indicates there is strong correlation between the reconstruction and target data.

5) Assessment of Results

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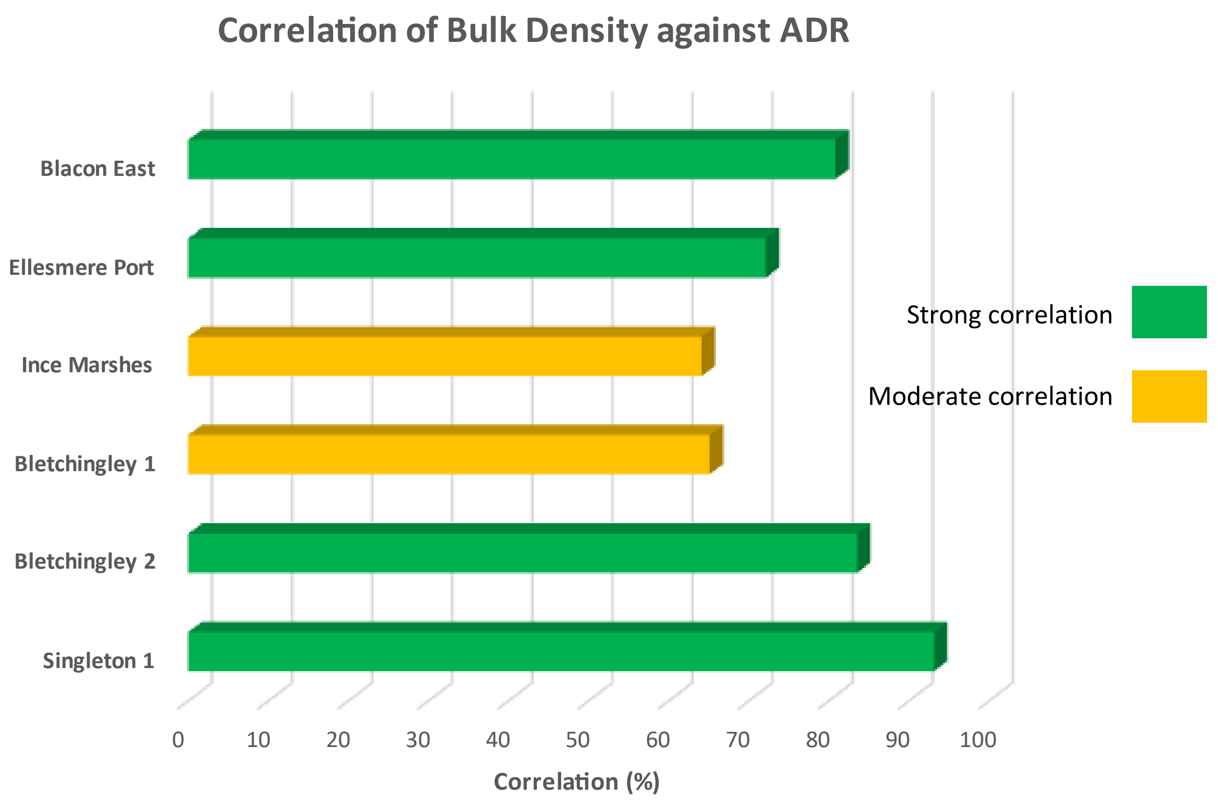
V-Bore/Drill Log	Correlation (%)	Data Range (m)
Blacon East	80.8	407-1207
Ellesmere Port	72.1	857-1911
Ince Marshes	64.1	368-1450
Bletchingley 1	65.1	182.88-1857
Bletchingley 2	83.5	161.54-1066
Singleton 1	93.1	1964-2115



- The table above shows the percentage correlation between the training data & coefficient calculated by Adrok. The graph shows whether correlation is considered strong or moderate for each V-bore.
- Four out of six V-bores have correlations exceeding 70% indicating strong correlation while the remaining two V-bores show moderate correlation. **The average correlation is 76.45% again considered strong correlation**.

6) Survey design options

Survey deliverables designed to meet your needs

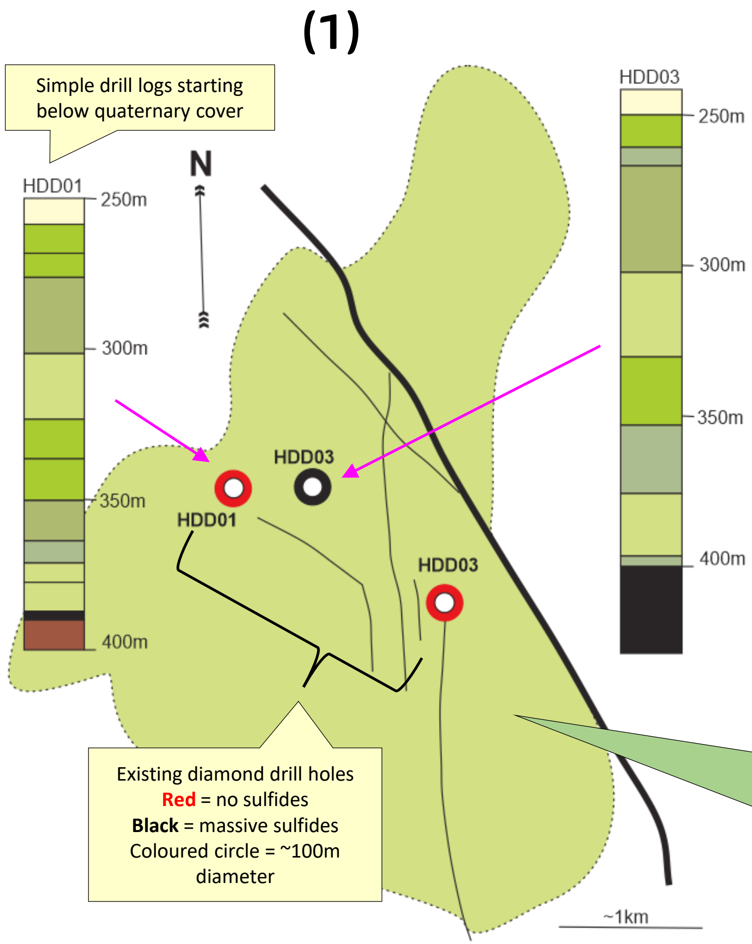
For each site, processed data will be delivered as a series of excel or text files (we can usually send in any you require) and can contain a selection (or all) of the measurements from the list below:

1) Dielectric curves
2) Energy Reflectivity curve (E%)
3) Weighted mean frequency (WMF)
4) Four Energy derivatives (E-gamma, E-mean, E-ADR, E-SD)
5) Four Frequency derivatives (F-gamma, F-mean, F-ADR, F-SD)
6) E-absolute (E-abs)
7) Trained direct mineralisation indicators
8) Bulk density proxy
9) Temperature proxy

A comprehensive 3D model will be generated for each site containing all or selected datasets (once processing is complete). The model will be made in Geoscience Analyst Pro and sent to the client for either integration into their own 3D modelling software or the models can be opened and basic manipulation in Geoscience Analyst reader.

A final powerpoint presentation summarising key findings is delivered to the client.

Survey Workflows: Typical mineral exploration project



3 x diamond drill holes 500m EOH
AUD $300/m $540,000
preliminary drilling program.

PREXISTING KNOWLEDGE

In the hypothetical scenario presented here, the project represents an immature Greenfields exploration project where just three diamond drill holes have confirmed geological evidence of sulfides present at over 400m depth.

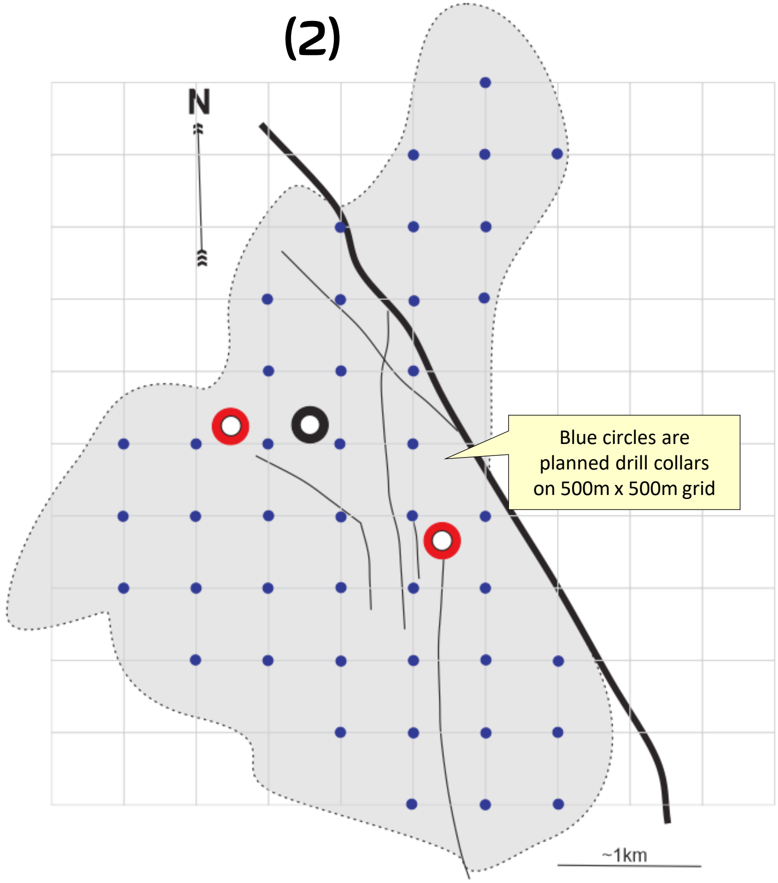
The three drill holes, two logs presented here, show various intrusive phases ranging from Dolerites to Gabbros. Disseminated sulfides occur within some layers, however, the target massive sulfide is found near the base of the intrusive sequence.

The approximate boundary of the intrusive has been mapped according to existing high-resolution magnetics and it has been proven that the top of the intrusive sequence lies at around 250m depth below thick quaternary cover rocks.

EXAMPLE TARGET

~4 x 6 km layered mafic intrusive containing massive sulfides (PGE, Ni, Cu, Co) as irregularly distributed lenses near base (>350m deep) of intrusive complex.

~250m Quaternary sedimentary cover



ADR SURVEY DESIGN

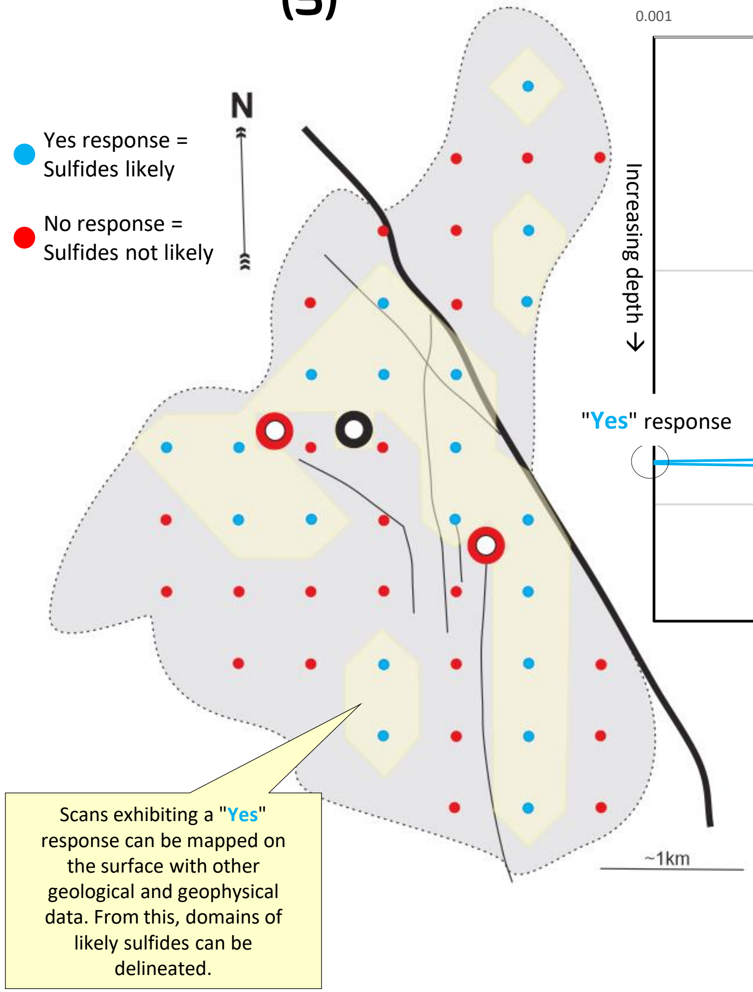
A 500m x 500m drilling grid is been established (blue points on map **(2)**. 44 drill holes.

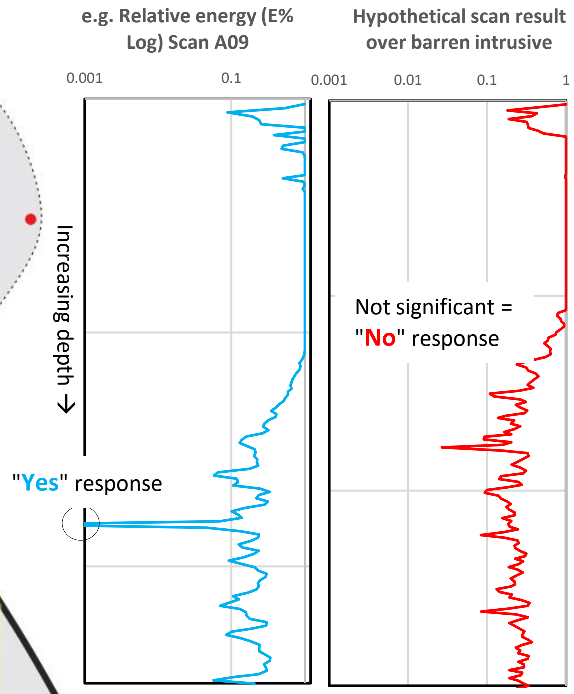
The plan for an ADR survey is very similar to that of a drill program. Because this is a surface-based low-impact geophysical technique, no special permits such as land clearance, vegetation surveys or rehabilitation surveys are required. The equipment is portable and once set up, can be carried to "collar" locations. The entire setup fits within the back of a regular field vehicle.

The ADR survey scans would likely take place at the same planned drill hole collar locations. Approximately 4-8 scans can be carried out per day depending on access from site-to site. Data is collected to over 1000m depth but can be reduced if time is critical. Data acquisition for 44 scans will take approximately 2 weeks.

Survey Workflows: Typical mineral exploration project

(3)





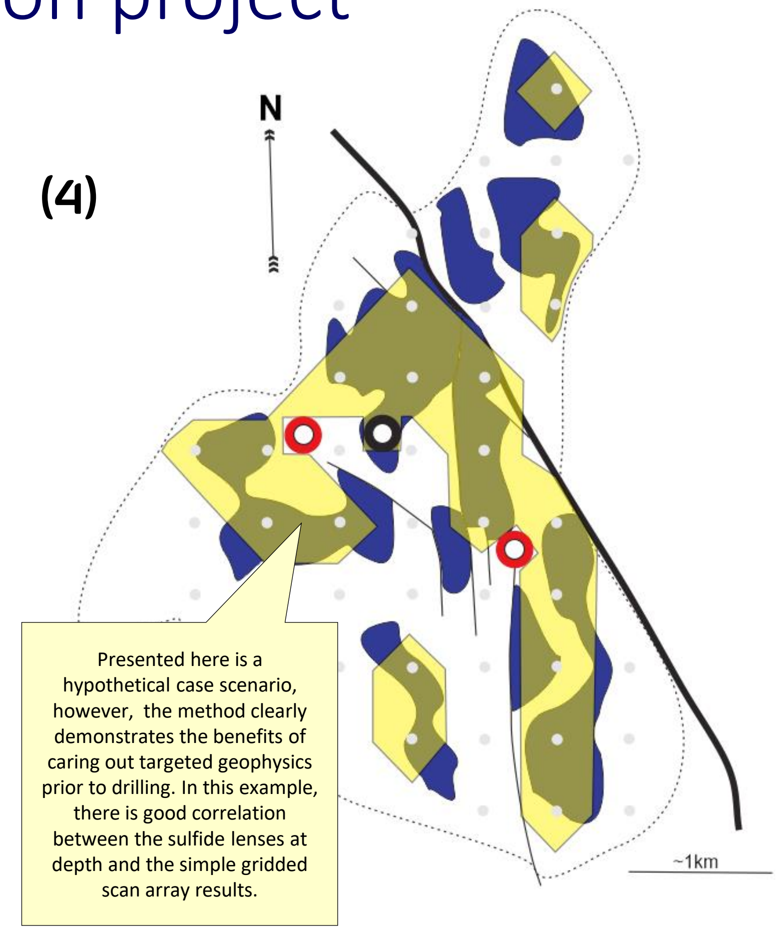
THE RESULTS

Once collected, the data is initially processed to a total depth of 500m (independent of the total amount of data recorded). Total processing time will be approximately 2-working days per scan.

Once the results pare processed, the un-interpreted results are sent to the client for review. Processed data includes, Relative Energy (shown here), Dielectrics, Frequency…….

Many other results are obtained during the scan survey, however, only energy values are shown here for simplicity

(4)



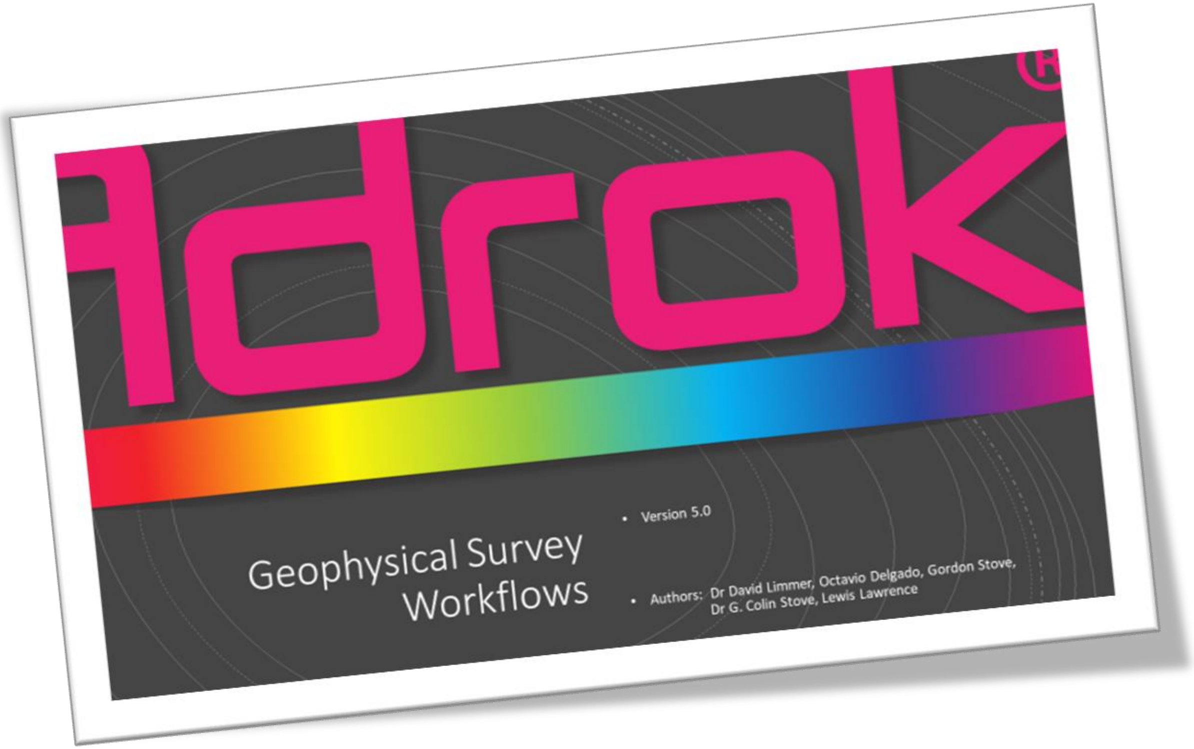
FINAL TARGETING AND DRILLING

Once a map has been generated, large domains containing "yes" or "no" responses can be ranked as high- and low-priority areas respectively.

The map shown in **(4)** demonstrates the usefulness of defining zone of high probability prior to drilling. It is apparent that some areas have been missed by the grid and, therefore, ADR, however, if drilling was completed on the same grid pattern, drilling would have also missed these locations, including the zone in the north-west of the complex.

Stage-gated Workflows

1. Project Management
2. Pre-survey field modelling
3. On-site Survey Data Acquisition
4. Data Processing
5. Analysis & results Delivery
6. Interpretation and Report Writing
7. Integration to other data sets



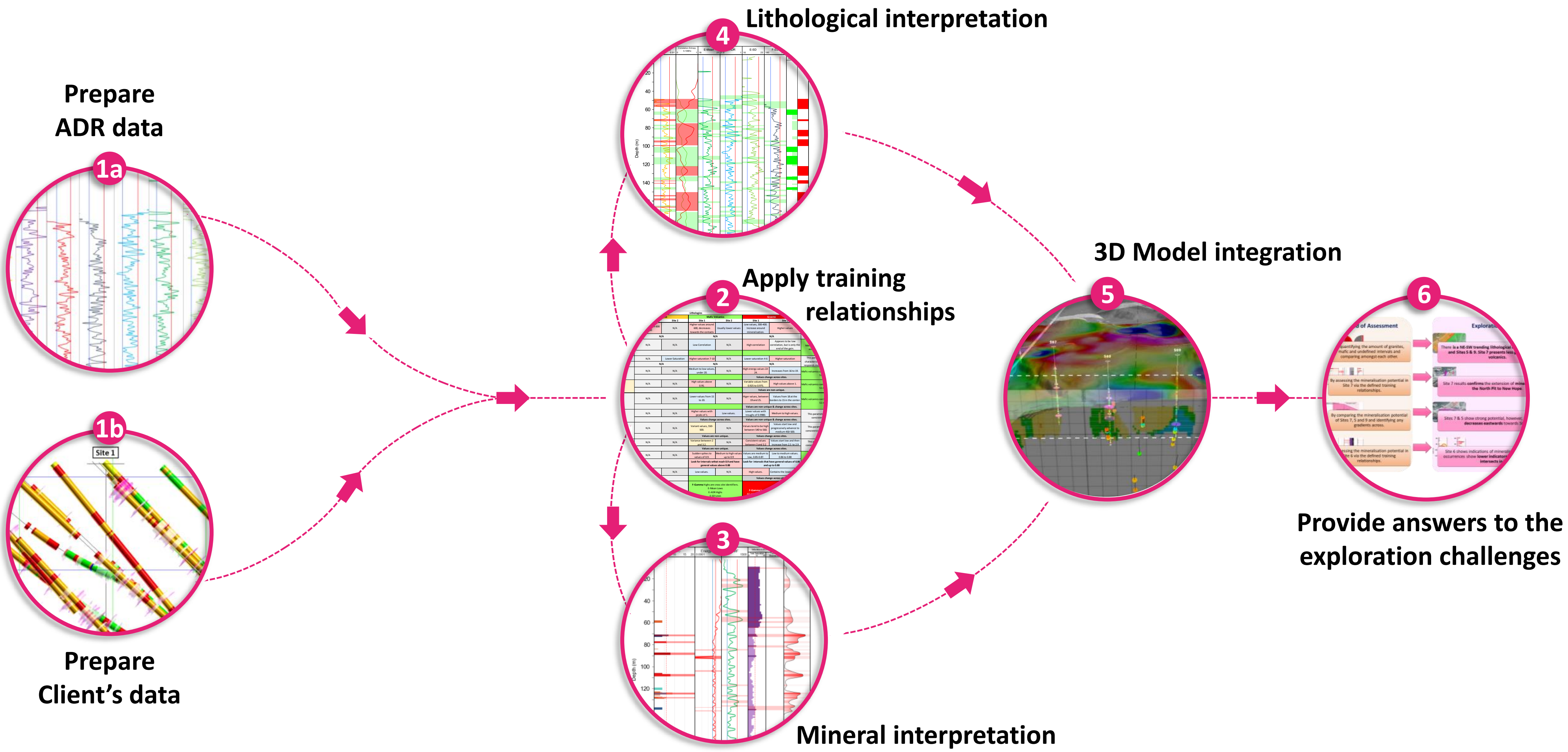
- The Geophysical Survey Workflows describe which process will be performed in each stage of the project to ensure quality, repeatability and a successful completion.

British Assessment Bureau – UKAS Management Systems 8289 – ISO 9001 QUALITY MANAGEMENT

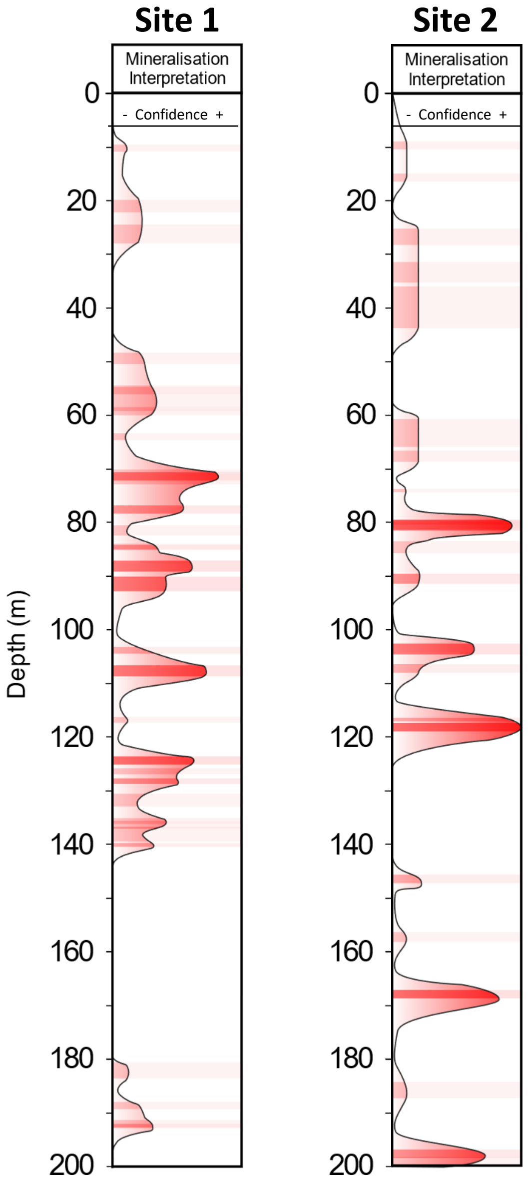
British Assessment Bureau – UKAS Management Systems 8289 – ISO 27001 INFORMATION SECURITY MANAGEMENT

INVESTORS IN PEOPLE™ We invest in people Gold

Methods: Analysis flow chart



Defined training relationships: mineralisation

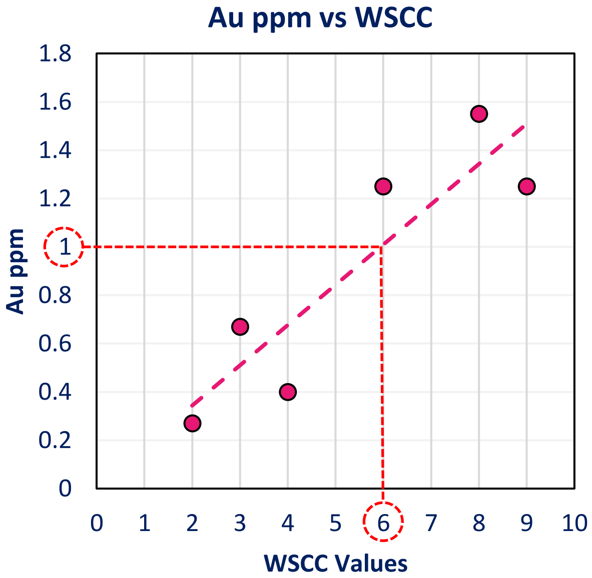


High-confidence Mineralisation identifiers:

- WSCC return of 6 or greater
- Strong Energy % trough

Low/medium-confidence Mineralisation identifiers:

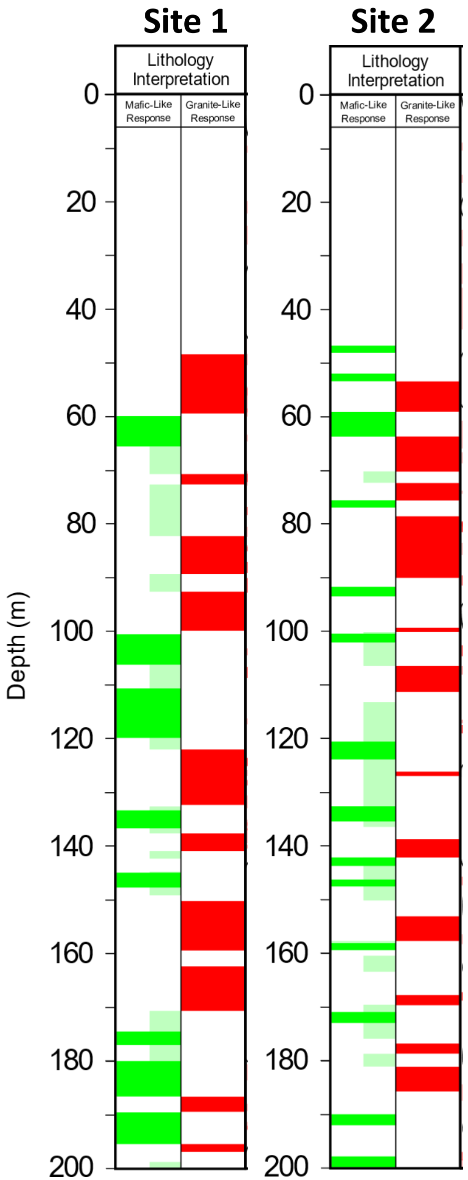
- WSCC return of less than 6
- Weak Energy % trough
- High WMF
- Total-Saturation of 7 or greater, paired with a Two-Line Boundary



6 WSCC values in Site 1 directly correlate to Au occurrences in the drillholes. When compared to the Au ppm, a linear trend is formed.

Although this is a small sample size, we can predict that WSCC values of 6 or greater are indicative of >1 Au ppm.

Defined training relationships: lithology



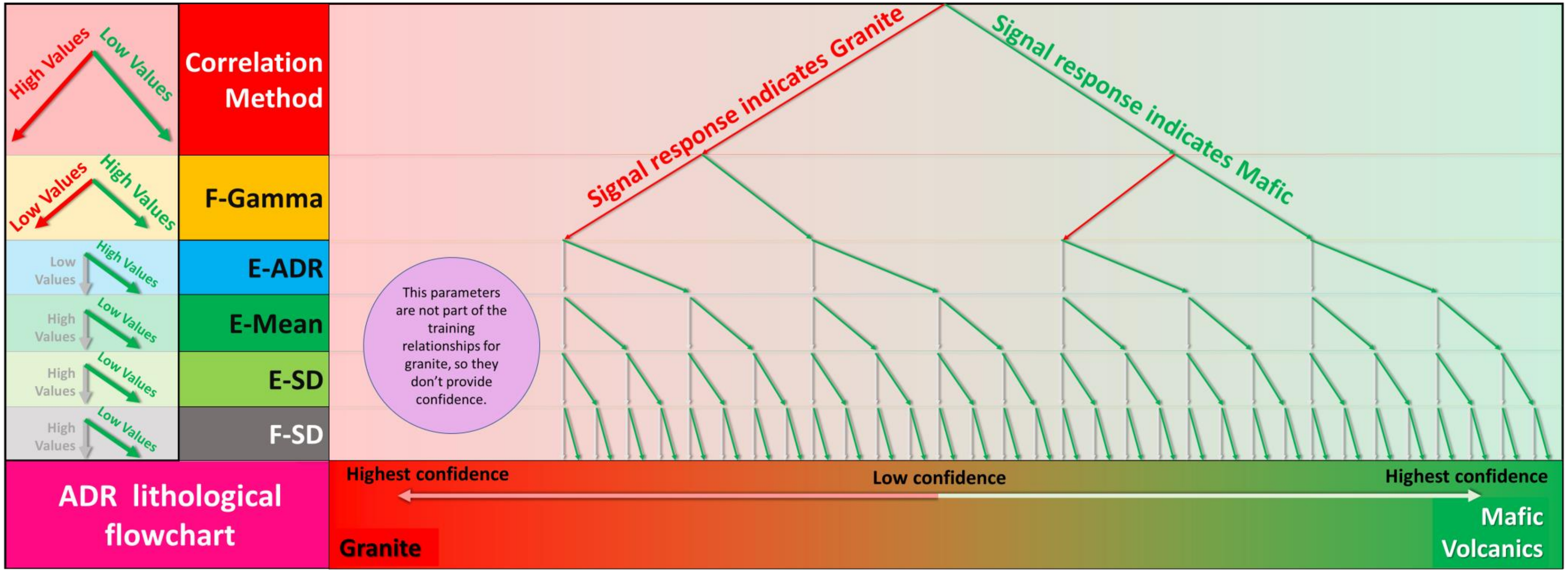
The confidence we have on lithological prognosis between Mafic Volcanics and Granites depends directly on how many ADR parameters behave in a similar manner as in the training sites.

The flowchart below indicates how we make decisions on downhole lithology and with what level of confidence.

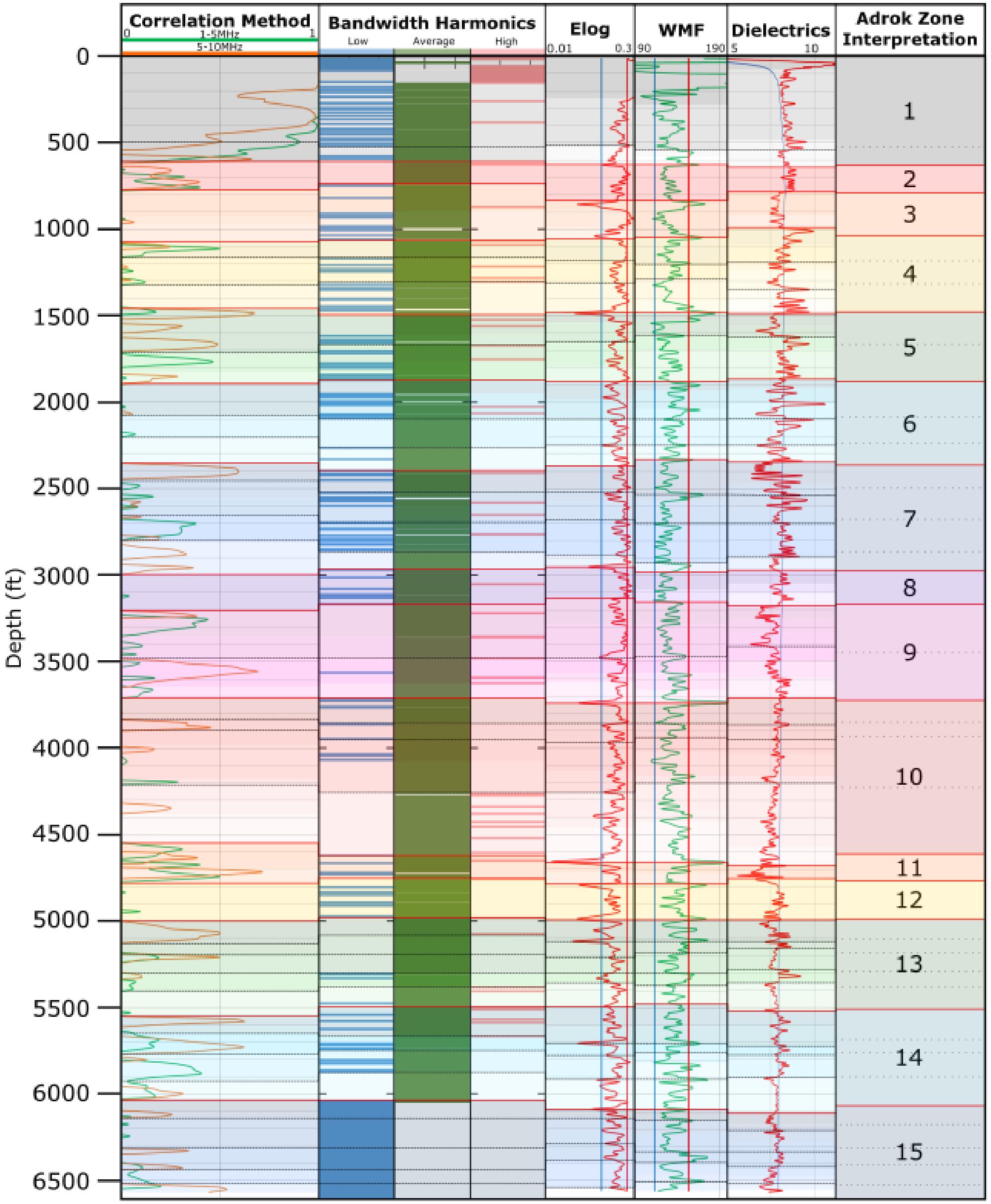
Granite identifiers:
- Low F-Gamma values
- High Entropy Correlation

Lesser Mafic Volcanics identifiers:
- Low E-Mean
- Low E-SD
- High E-ADR
- Low F-SD

Mafic Volcanics identifiers:
- High F-Gamma values
- Low Entropy Correlation

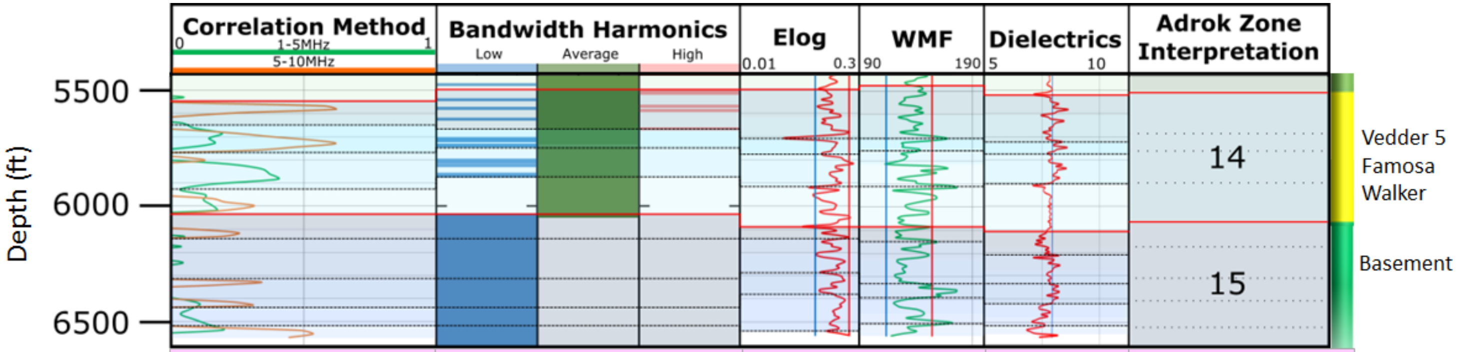


Defined training relationships: Basement deep scan to 6000ft



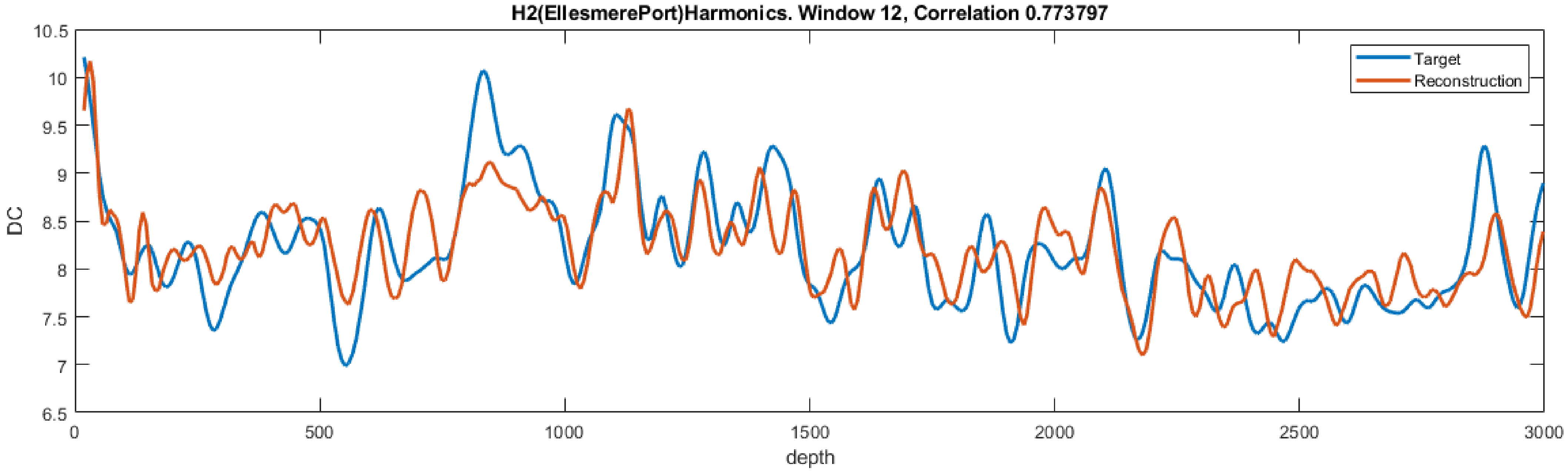
After the ADR zones have been stablished, each Zone is assigned a colour, and each Sub-Zone a subtle variation of that colour. This process is done for each parameter.

- The Correlation Method
- Bandwidth Harmonics
- Energy log
- Weighted Mean Frequency
- Dielectric Constant log
- Lithology zone interpretation



Diminishing 1-5MHz band of correlation.	Bandwidth harmonics lose all high and medium values, only low values remain.	Sharp trough and peak respectively for Elogs and WMF parameters.	Variability for DC picks up in the basement.	Zone 15 top at 6055ft. This depth is calculated by averaging the top of the zone at the rest of the parameters.

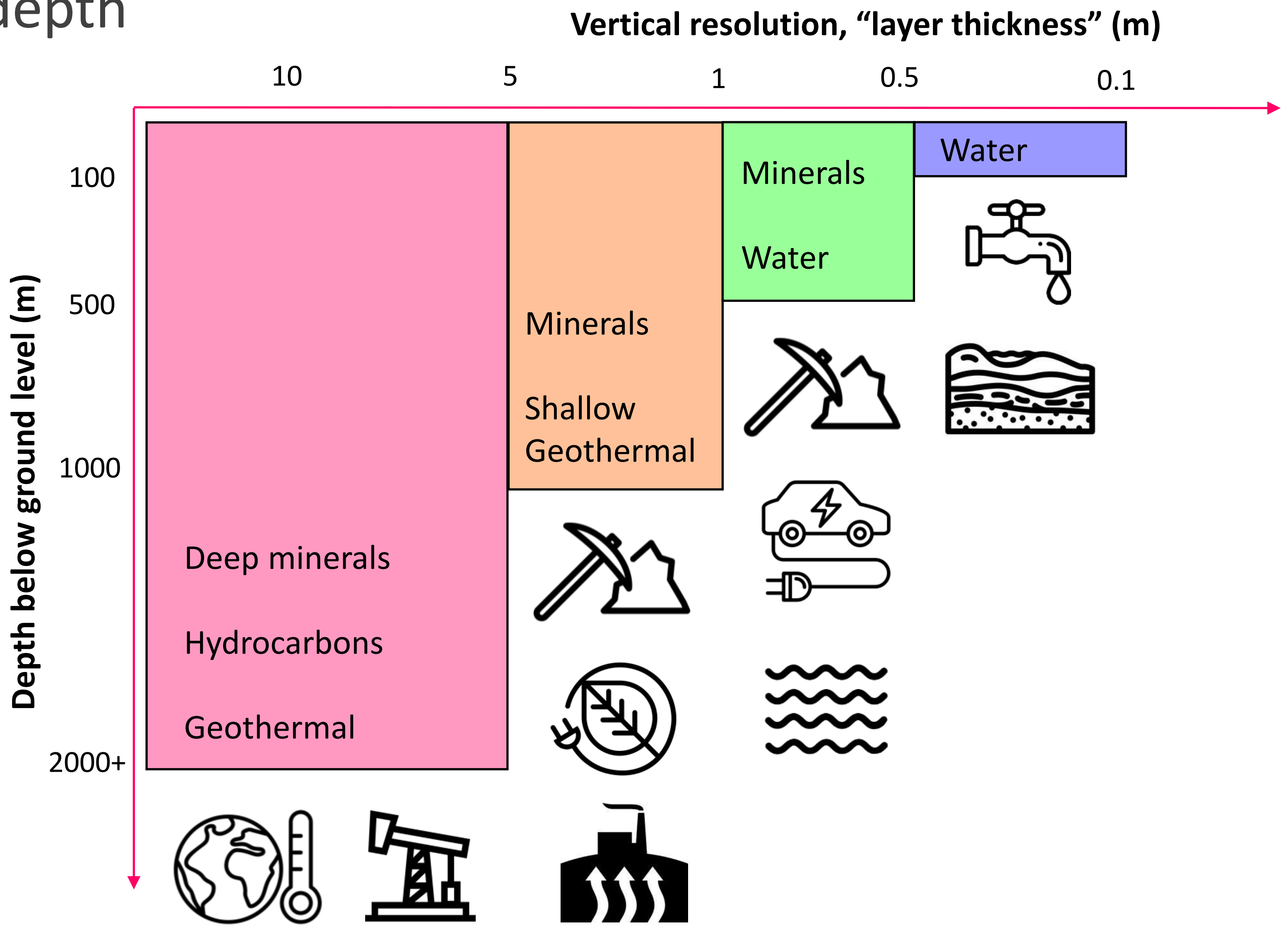
In-field rapid processing



- Measured field ADR dielectrics (DC) for Ellesmere Port 1 are shown in blue against the reconstruction in orange.
- The reconstruction of depth and ADR dielectrics shows good matches with empirical ADR measurement.
- The correlation value of 77% is considered a strong correlation.
- This means that in-field rapid processing can be developed for time-to-depth conversion.

Subsurface Geo-applications

Resolution v depth



At Adrok, we develop fast, cost-effective, environmentally safe and socially accepted technology to explore for natural resources. We power our equipment using compact, rechargeable batteries. The power we emit is less than 5milliwatts, meaning that our carbon footprint is exceptionally low, non-ionising and non-destructive.

Our operations are environmentally harmless.

Case Studies

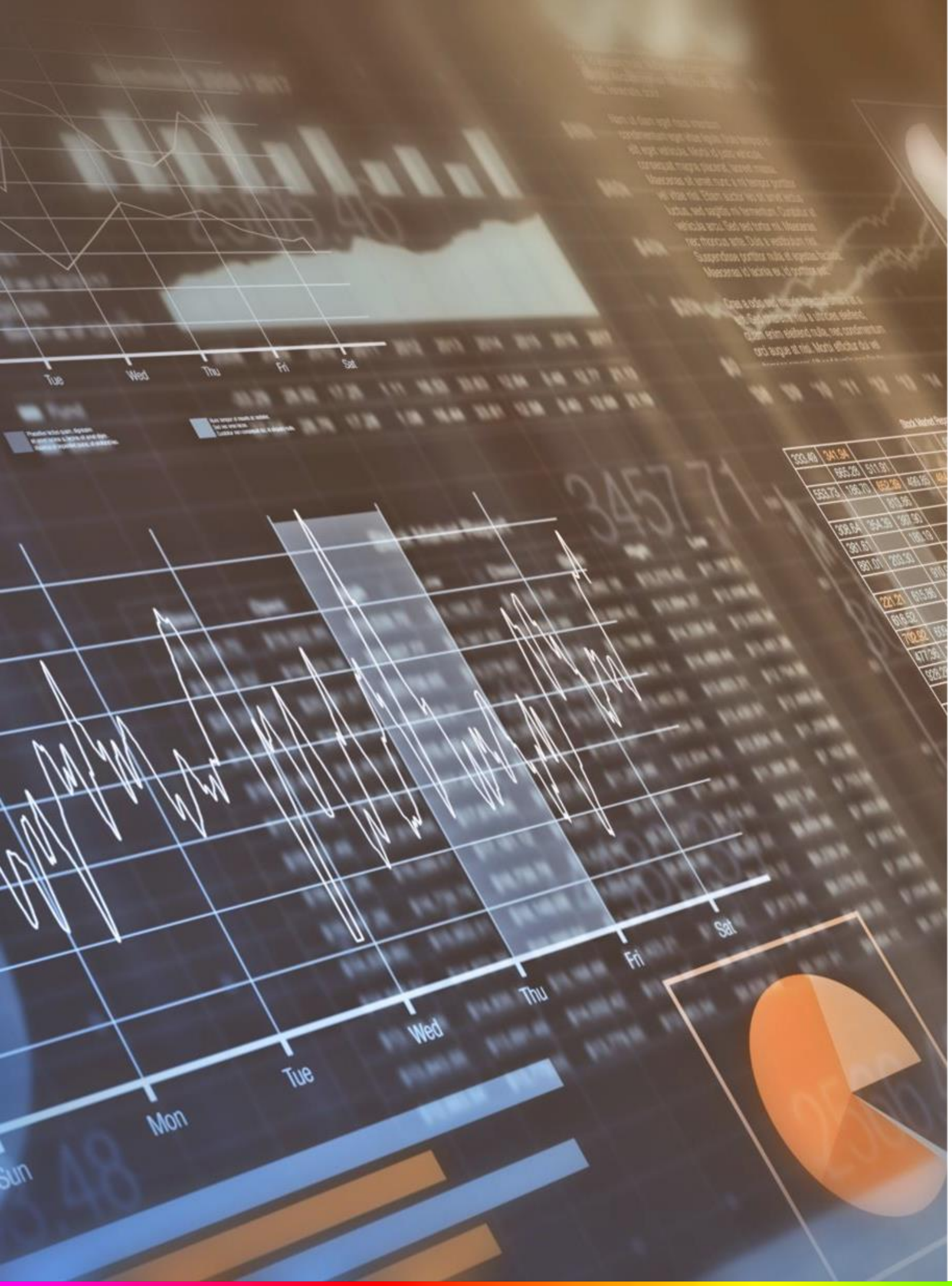
https://www.adrokgroup.com/case-studies/vol-7-together-we-rock

7 Volumes of case studies at www.adrokgroup.com

Selected Publications

https://www.adrokgroup.com/news/published-papers

1. van den Doel, K., Jansen, J., Robinson, M., Stove, G.C. and Stove, G.D.C.,Ground penetrating abilities of broadband pulsed radar in the 1-70MHz range. In: SEG Technical Program Expanded Abstracts 2014, Denver. 1770–1774.
2. van den Doel, K. and Stove, G., Modeling and Simulation of Low Frequency Subsurface Radar Imaging in Permafrost. Computer Science and Information Technology, 2018 6(3), 40–45.
3. Stove, G. and van den Doel, K., Large depth exploration using pulsed radar. In: ASEG-PESA,Technical Program Expanded Abstracts 2015, Perth. 1–4.
4. Stove, G. D. C., Stove, G.C., and Robinson, M., 2018, New method for monitoring steam injection for Enhanced Oil Recovery (EOR) and for finding sources of geothermal heat. Australasian Exploration Geoscience Conference 2018 (AEGC), Sydney.
5. van den Doel, K. and Stove, G., Calculation of Optimal Noise Levels for the Detection of Conductive Lenses in Permafrost with Radar Scans, 81st EAGE Conference and Exhibition 2019 (1), 1-5.
6. van den Doel, K., Modeling and Simulation of a Deeply Penetrating Low Frequency Subsurface Radar System, 78th EAGE Conference and Exhibition 2016.
7. van den Doel, K. and Robinson, M., Numerical Simulation of Aquifer Detection Using Low Frequency Pulsed Radar, PIERS 2015, Prague.
8. Stove, G., 2018, Extending the reach of radio waves for subsurface water detection, CSEG Recorder,Vol. 43 No.06, pp 26-30
9. Stove, G., 2020, Helping De-Risk the Exploration for Suitable Geothermal Drill Targets, Geothermal Rising / Geothermal Resources Council (GRC) 2020 Annual Meeting
10. van den Doel, K, Robinson M, Stove C, Stove G., 2020, Subsurface Temperature Measurement Using Electromagnetic Waves and Machine Learning for Enhanced Oil Recovery, Conference Proceedings, 82nd EAGE Annual Conference & Exhibition, Volume 2020, p.1 – 5



Technology Summary

- High-definition ***m* scale resolution at *km* scale depth** with or without wells or seismic
- **Predrilling Virtual Logging®** for actionable client decisions
- Results give intelligence more akin to **downhole petrophysics** than seismic
- ADR can be applied to measuring subsurface **temperature**
- ADR can be applied to measuring subsurface **fluids**
- **Digitally drilling** into the subsurface is the future of exploration

Our Value Proposition becomes part of the solution

ECONOMICAL

We will be reducing exploration costs by up to 90%

CONVENIENT

Faster solution lessening the need for exploratory drilling

ENVIRONMENTALLY FRIENDLY

Harms the environment in no way

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