Adrok Validation Evidence at United Downs, Cornwall, UK.

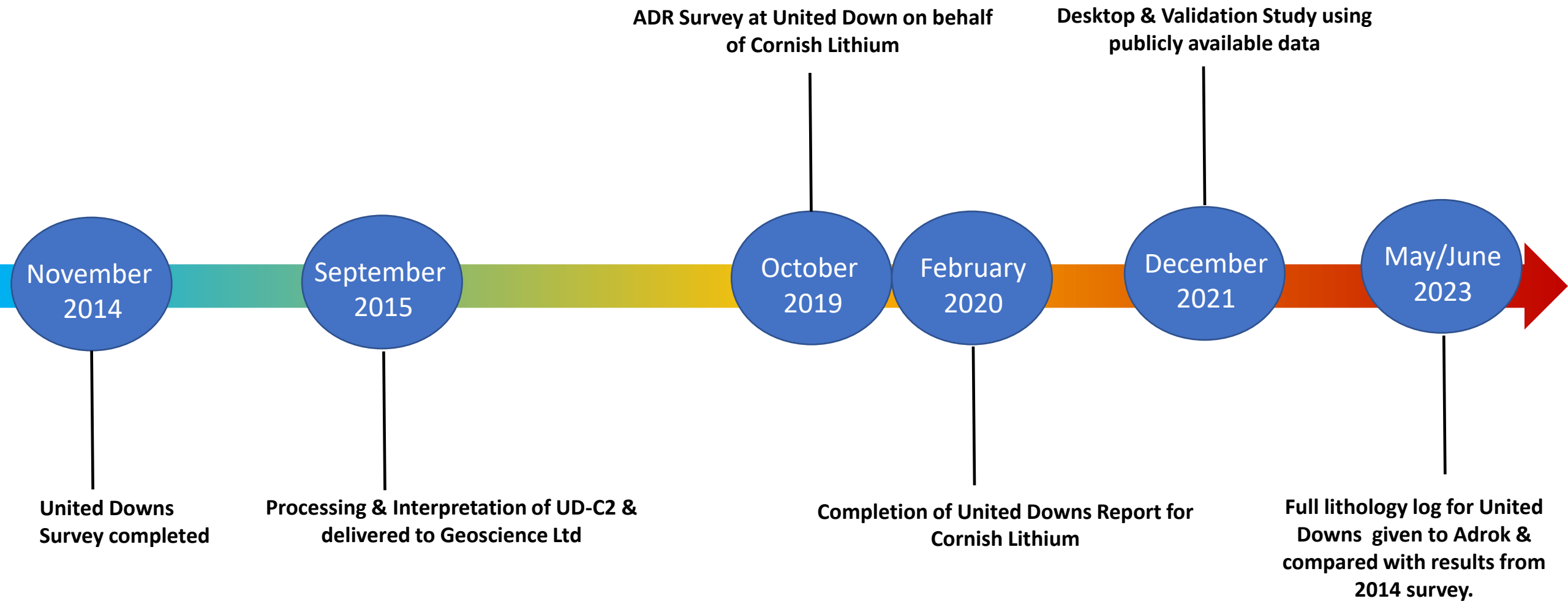
8th June 2023

Introduction

- This report is 100% funded by Adrok and outlines the latest validation of Adrok's interpretation against drill log results from a deep borehole at United Downs, Cornwall United Kingdom with the specific target being deep geothermal resources.
- The original V-bore, UD-C2 was scanned in November 2014 & report submitted in September 2015.
- Adrok received new drill log results from United Downs in May 2023 & these have now been cross-checked with the original interpretation.
- Four ADR parameters can be investigated; Dielectric Constant, Energy (%), E-Gamma & Weighted Mean Frequency (WMF).
- By completing this work Adrok will validate the original results increasing confidence in identifying deep geothermal resources.

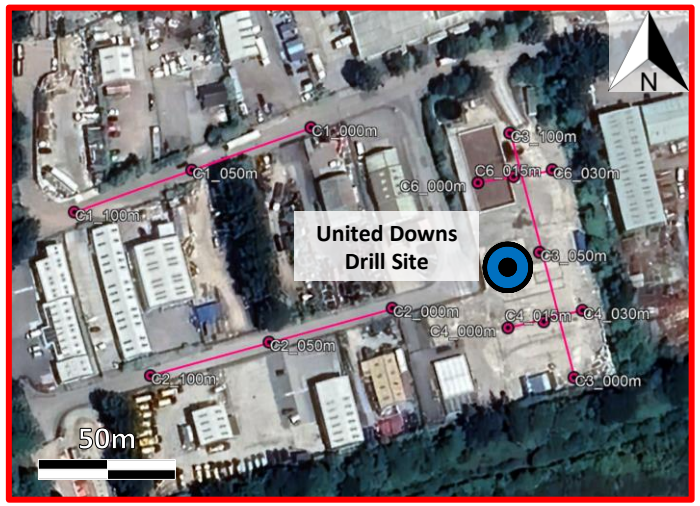
Adroks 00156-3 United Downs Survey, 2014.

Timeline: Adrok events at United Downs



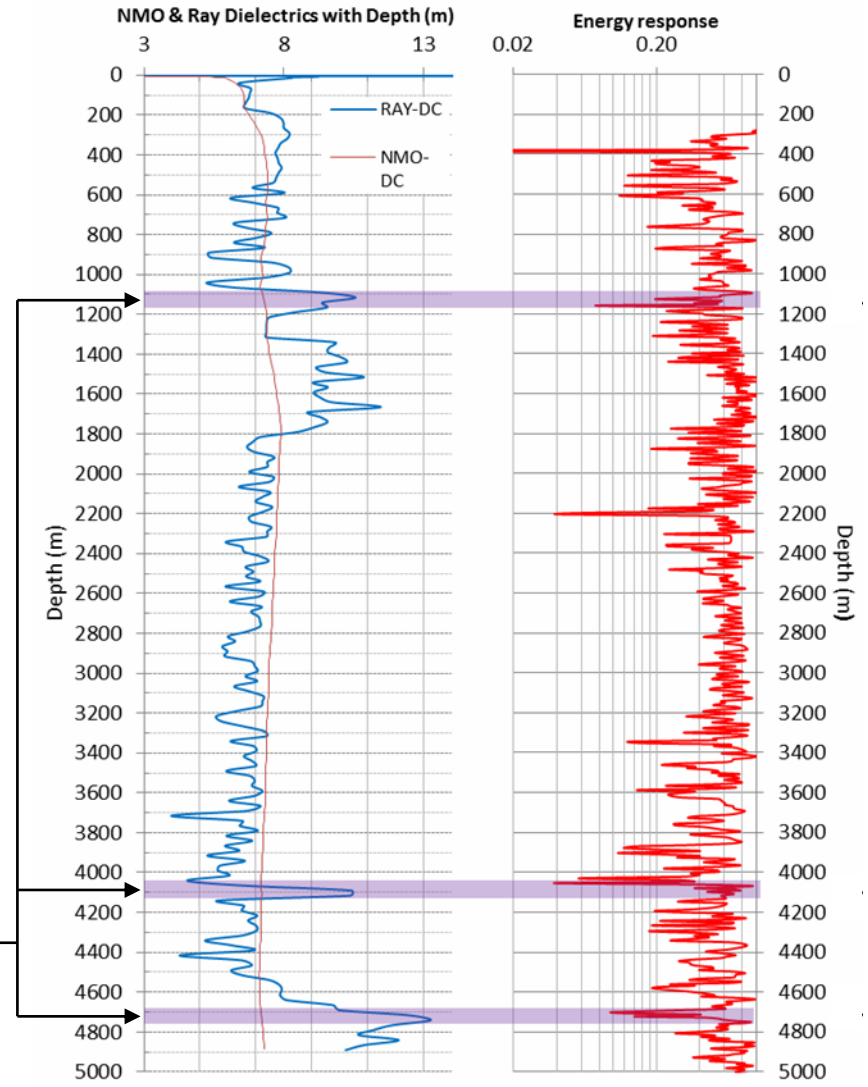
United Downs: Adrok survey 2014-2015

- Adrok completed a geophysical survey at United Downs on 07/11/2014 after gaining site access permission from GeoScience Ltd.
- The survey was designed as research to test the application and capabilities of ADR, in the context of Hot Dry Rock (HDR) geothermal resource classification.
- Adrok collected 15 Stares, 5 WARRs and 5 P-Scans in the United Downs industrial estate. Only 1 V-Bore (C2) was processed.
- The primary conclusions are that within the granite pluton itself, two areas have been identified as possible permeable zones, which are at the depths of 4100m and 4700m. At 1100m depth there is one more area of interest as a possible permeable zone, which could be heavily fractured and saturated.
- This report was delivered to GeoScience Ltd on 14/09/2015, however, no feedback was ever received back.



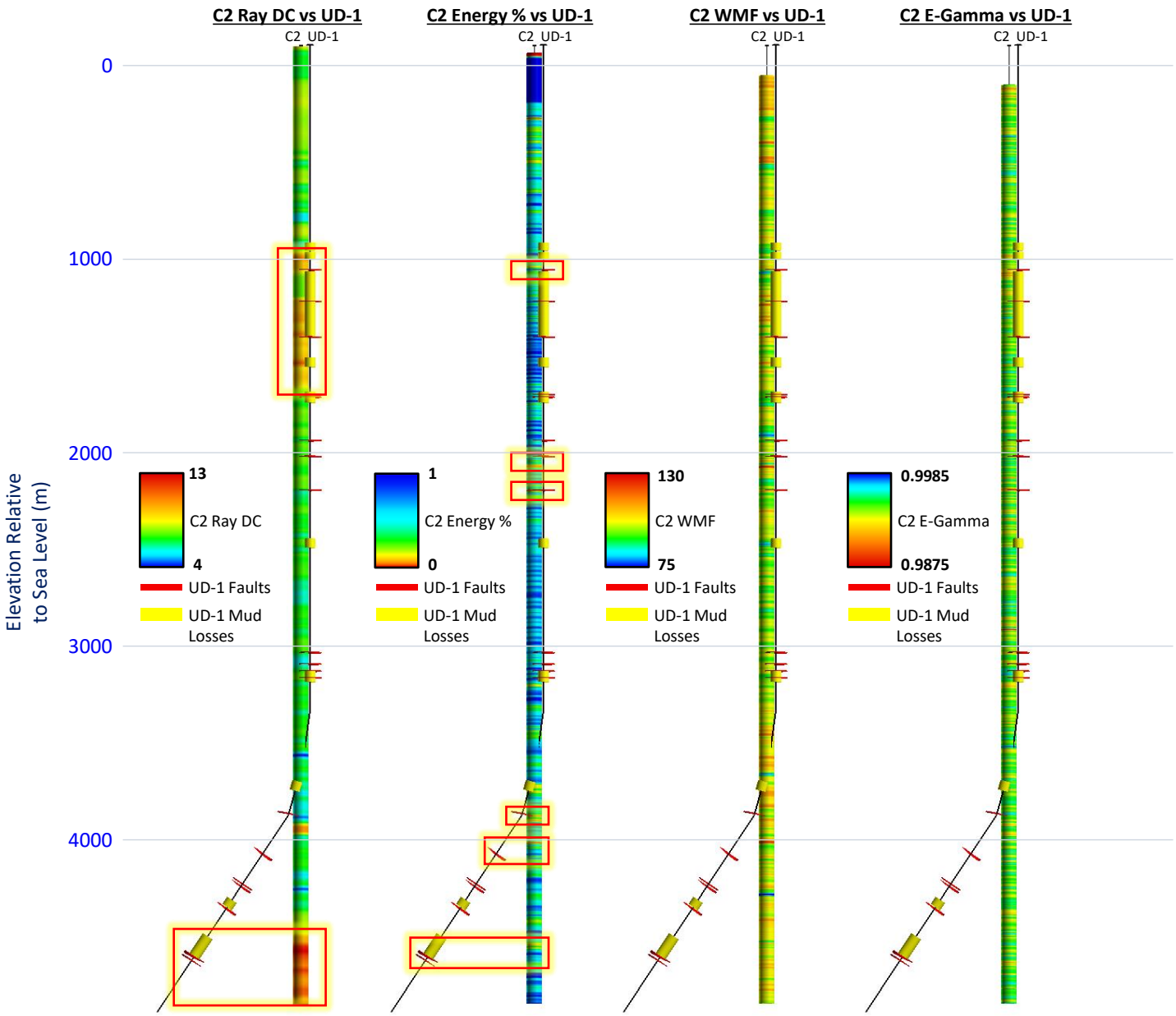
Adroks 00156-3 United Downs Survey, 2014.

Areas of highly increased RDP and low energy response are together interpreted as possible zones of secondary permeability in the subsurface host structure. These are located at approximately 1100m, 4100m and 4700m.

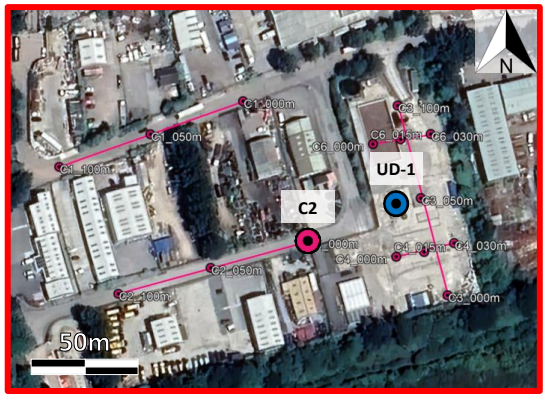


Adrok 00156-3 United Downs Geothermal Results. From Adrok (2015).

United Downs: Existing ADR results vs Validation of publicly available data (Reineker *et al.* 2021)

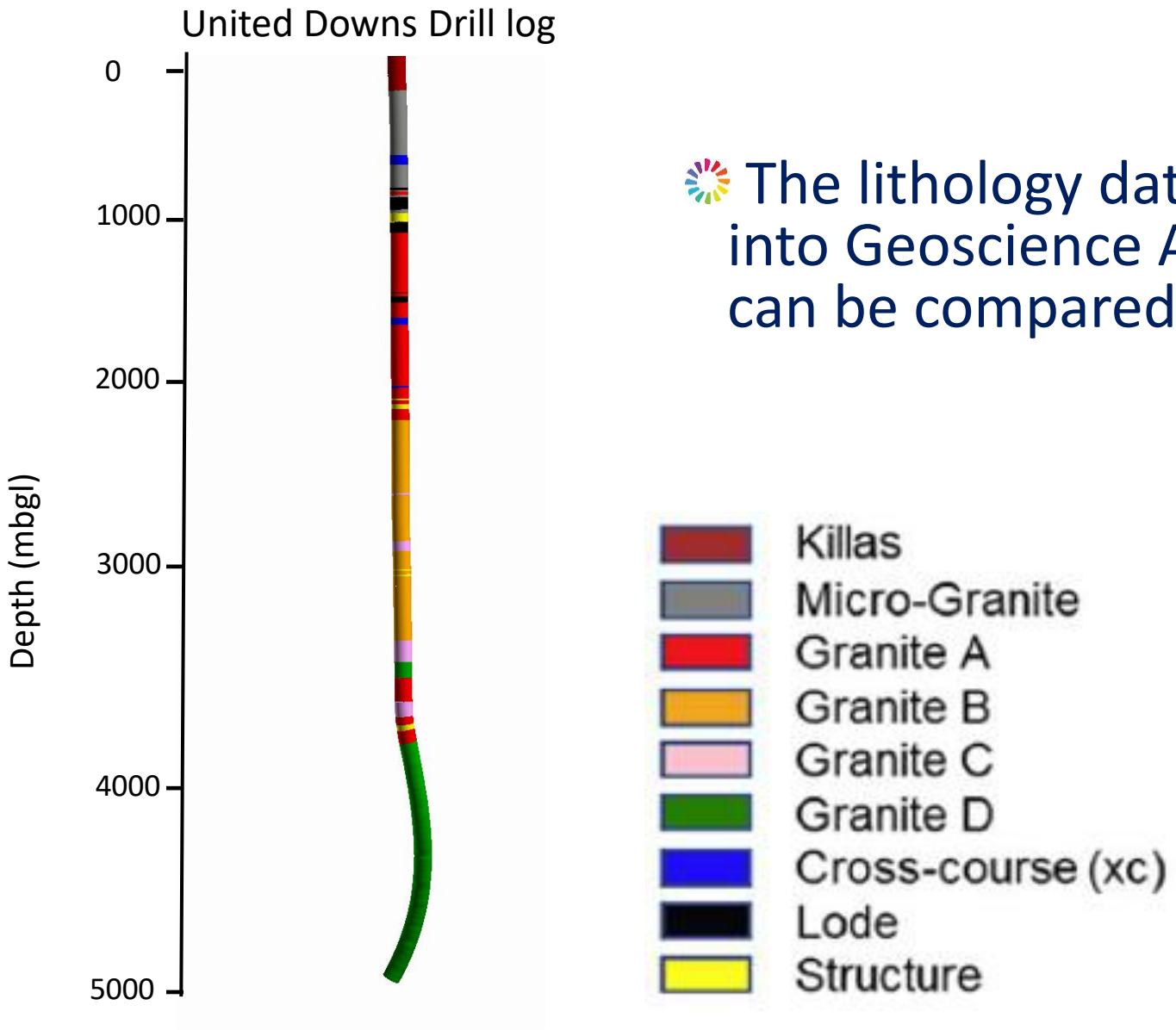


- Only 1 V-bore in United Downs has been processed. This was hole C2 in project 00156-3 that was processed and used as a case study in 2014.
- Ray DC, Energy %, WMF and E-Gamma logs are available down to 5000m TVD depth. These can be compared with the vertical section of the UD-1 well from 0-4000m TVD depth.
- There is some good correlation between high DC in C2 and significant mud losses in UD-1, in particular at 1070-1800m and 4540-5010m TVD where DC is highest.
- The most significant Energy % troughs also correlate well with some of the measured faults in UD-1, as highlighted in the adjacent figures.
- The WMF and E-Gamma logs do not show as good correlation with the training data. It should be noted that the windowing size for E-Gamma processing is unknown, so this may not be using the 8192px that we typically use for temperature processing.



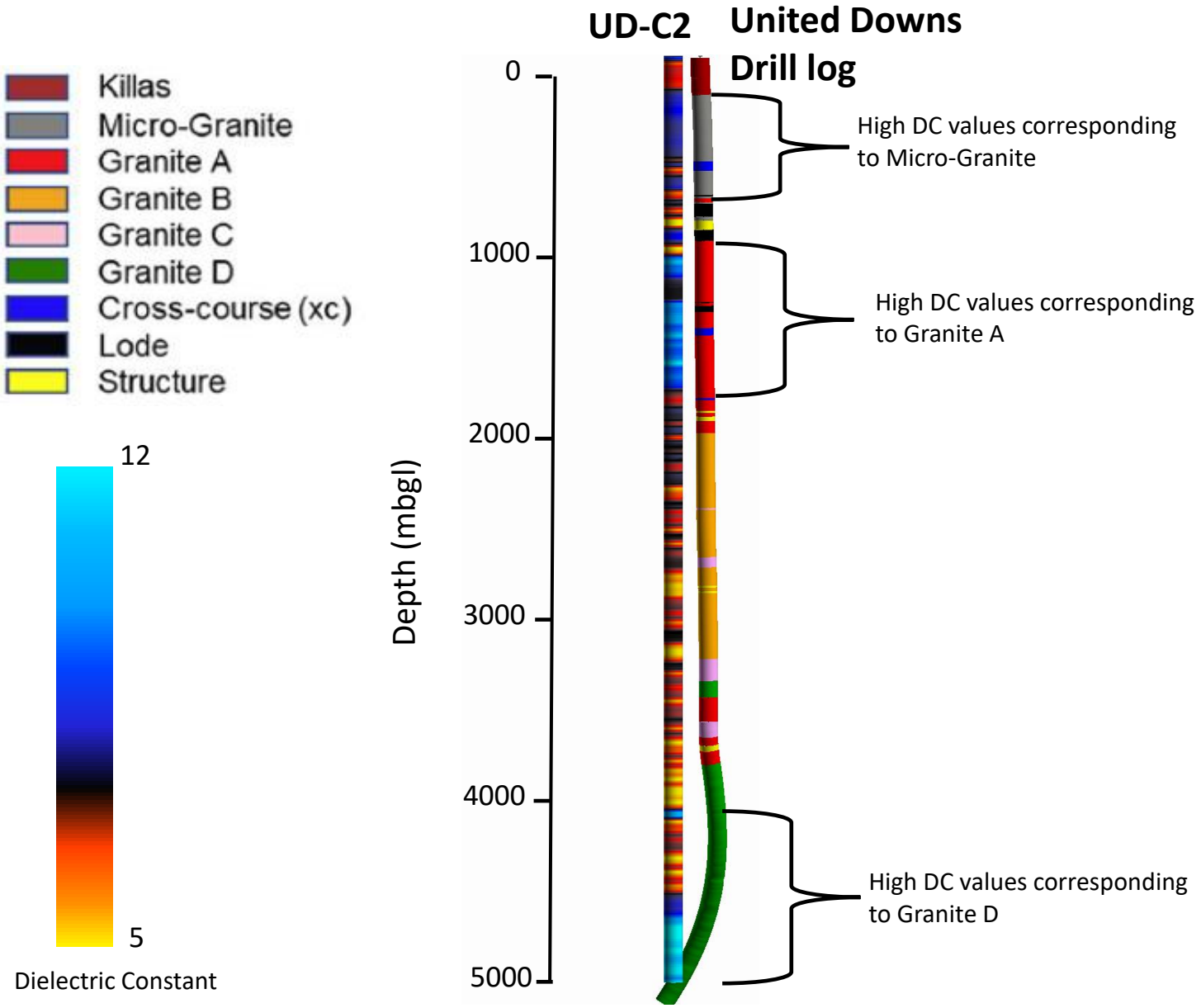
Reinecker et al. (2021) Geothermal Exploration & Reservoir modelling of the United Downs deep Geothermal Project, Cornwall (UK) Geothermics (97), 102226

Drill log digitisation comparison with ADR predrill results



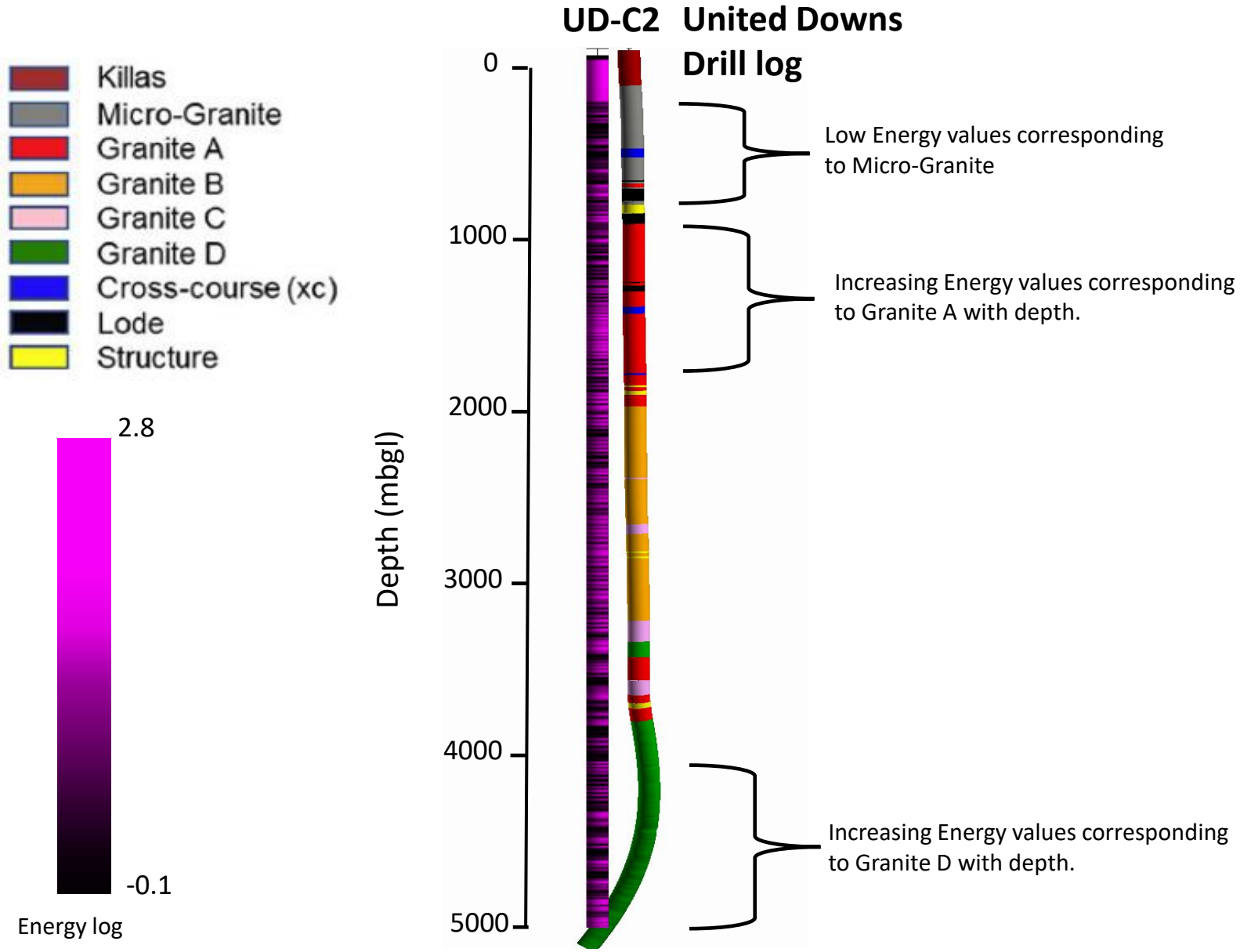
- The lithology data for UD-1 has now been digitised into Geoscience Analyst so the original ADR results can be compared to this drill log.

Dielectric Constant vs Drill Log



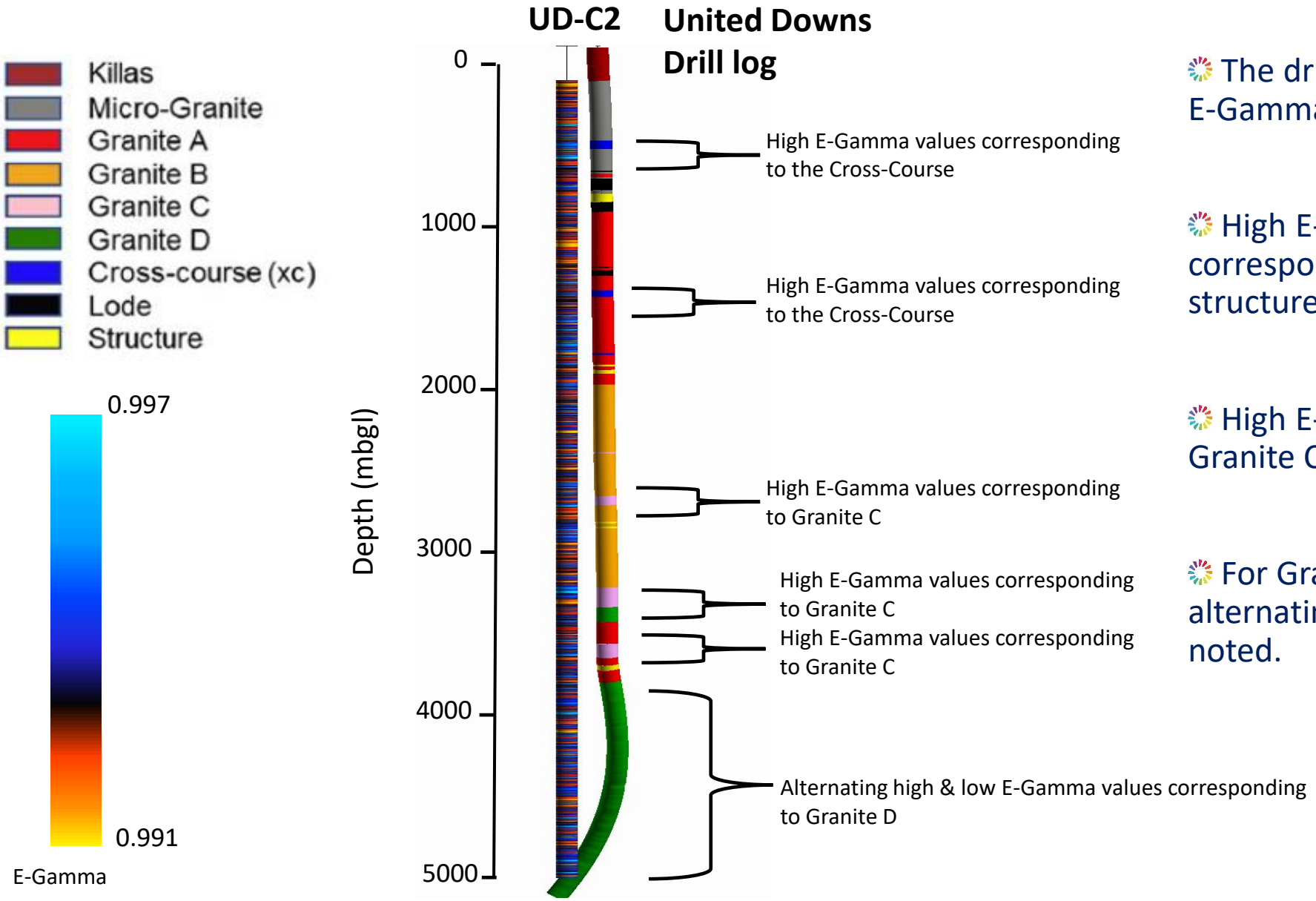
- The drill log results are show against the dielectric constant values from the 2014 survey.
- Regions of high dielectric are seen corresponding to three distinct geological units, Micro-Granite, Cross-course fault, Granite A & Granite D.
- Regions of low dielectric correspond to the other geological units.

Adrok Energy Log vs Drill Log



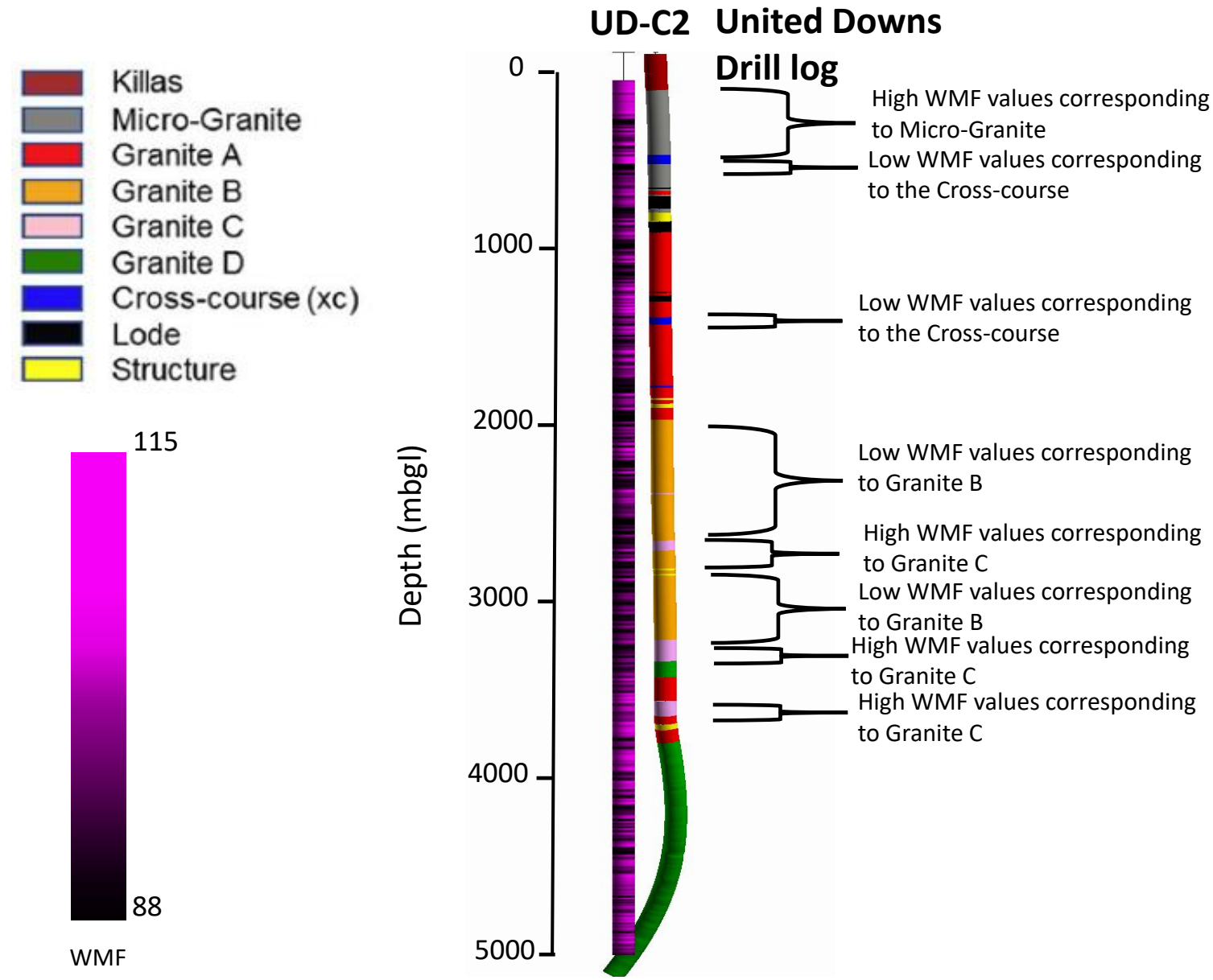
- The drill log results are show against the energy log values from the 2014 survey.
- Low Energy values are seen corresponding to the Micro-Granite, Structure & Cross-course.
- Energy log values are seen increasing with depth through Granite A. Energy logs are also seen increasing with depth through Granite D.
- Some of the lowest values are associated with structures such as at 900m, 1900m & 38000m.

Adrok E-Gamma vs Drill Log



- The drill log results are show against the E-Gamma values from the 2014 survey.
- High E-Gamma values are seen corresponding to the Cross-Course fault structures.
- High E-Gamma values are also seen in Granite C.
- For Granite A & Granite D there are alternating high & low E-Gamma values are noted.

Adrok WMF (Frequency) v Drill Log



- The drill log results are show against the Weighted Mean Frequency (WMF) values from the 2014 survey.
- High WMF values are seen corresponding to the Micro-Granite.
- High WMF values are also seen corresponding to Granite C
- Low WMF values are seen corresponding to the Cross-course fault.
- Low WMF values are also seen corresponding to Granite B.

Conclusions

- When the results from 2014 are compared with the accurate locations of the UD-1 drill log , the following conclusions can be made for lithology.

- For further work we could investigate downhole data against these results in more detail.

- We could also reprocess & re-analyse this data using Adrok's latest processing & analytical techniques for example a zonation study to see if ADR could identify the different granite layers or do a detailed spectral analysis if such a tool is available.

Dielectric Constant

Low values – No correlation with lithology data.

High values- Associated with Micro-Granite, Cross-course, Granite A & Granite D.

Energy Log

Low values – Associated with Micro-Granite, Cross-course & Structures.

High values- Associated with Granite A & Granite D.

E-Gamma

Low values – No correlation with lithology data.

High values- Associated with Cross-course fault & Granite C.

WMF

Low values – Associated with Cross-course fault & Granite B.

High values- Associated with Micro Granite & Granite C.