

### Case Studies of A Novel Technology for Identifying Subsurface Rocks, Rock Sequences & Hydrocarbons

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## ADR Virtual Wellbore Log Survey Charts showing lithology and depths

The ADR Virtual Wellbore Log output provides 2D areal content using spectral analysis techniques. The ADR Scanner output typically represents subsurface information of Survey Points which are typically 2km deep by 50m wide. Vertical and horizontal target resolution achieved by ADR is usually better than 2m.

When the 2D logs are integrated together spatially then ADR provides 3D volumetric content of the subsurface lithology. ADR provides 3 outputs (image, material classification and thematic map). The output is pictorial and shows each and every major subsurface stratigraphic horizon down to total depth, classified and with thickness measured.

ADR classifies the type of rock at any depth with a high degree of certainty (e.g., Sandstone, limestone, clay). ADR provides a measure of moisture content of the rock at all depths where dielectrics have been evaluated.

Thresholds are set by training ADR signals on core samples and hydrocarbon samples either in our laboratory, in core stores or at remote locations. Thresholds are set for frequency, energy, phase and permittivity relationships. Field training (or typecasting) is conducted in a similar manner, but by training on borehole data live.

The ADR scanner produces information of rock type, rock sequence, moisture content, dielectric permittivity, and presence of hydrocarbons

The ADR scanner measures atomic permittivity non-invasively and generates a virtual wellbore log of lithology from the ground surface to depths as normally experienced during oil and gas operations

# Case Studies of ADR Experience

- 1. Onshore UK, oil reservoir mapped at 1000m depth.
- 2. Onshore North Africa, gas horizons at varying depths between 500m and 4000m depth delineated
- Onshore UK coal bed identification, at shallow (30m) and deep (1500m) subsurface ranges at four separate sites. Also, Offshore based geological mapping trial completed in the UK Firth of Forth. Four layers of marine sediments were mapped, limestone beds and coal measures dipping at 45 degrees were charted to 1000m. 3.

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## Case Study 1 - Onshore UK, oil reservoir mapped

WEALDEN BEDS

- Site discovered by BP in 1980s
- Located in Weald basin of SE England
- Surface terrain comprised farmland
- Jurassic: shallow shelf. sub-tropical sea under subsidence. Drowned by marine transgression (Kimmeridge Clay)
- Portland Sst reservoir shallow marine shelf -general upward shallowing
- Stratified reservoir
- Adrok trained on 1 drilled well location



ADR Prognosis depths to top of res	ervoir

Top Corallian

Top Cornbe

Middle Lios

]	Image	ADR Scan Line Chainage	ADR Prognosis of Depths for Top Portland (m)
	D_P01	0m	623.0
		20m	624.5
		40m	630.8
		60m	632.8
		75m	635.4
	D_P03	0m	635.6
		20m	637.4
		40m	639.0
		60m	640.6
		80m	646.8
		100m	648.4
		120m	652.2
		140m	657.2
		160m	660.4
		180m	662.8
		200m	663.4
		220m	663.6
		225m	663.8

Results of ADR Scanner (ground-truth from actual well)



### ADR Conclusions:

- •Oil Reservoir recognised at 636m depth from ground level
- Typecasting differentiation of different rock types
- Fault recognised Accurate borehole type
- ADR Log to 1km depth Data Collection was quick



- Survey Area located in North Africa
- Adrok trained on 3 drilled well locations
- Surface terrain comprised low lying hills and scrubland
- Tortonian sand reservoirs
- Gas horizons were very thin (less than 1m thick).
- Prospect site was 42km offset from training well location
- The results of the ADR survey were compared to the actual drilling results (Adrok presented ADR results before drilling commenced).
- Adrok produced ADR virtual borehole log charts
- No HSE accidents









### esults of ADR Scanne (ground-truth with drilled well)

Composite Log comparing ADR Scanner results with Seismic AVO, & down hole tools showed that ADR gas layer findings (red dots) were more accurately identified than AVO (green dots).

### ADR Conclusions:

 Thin gas horizons accurately identified and confirmed by drilling

•Typecasting differentiation of different rock types



easy and operationa •No HSE incidents



curate borehole type ADR Log to 1km depth

 Data Collection was quick, easy and operational

No HSE incidents

# Case Study 3 - Onshore/Offshore UK, coal

During a technical due diligence exercise, independently corroborated by Prof. J. McManus, Adrok demonstrated that the ADR technique was able to accurately image and classify subsurface stratigraphy at four separate onshore sites and one offshore location in central Scotland. At each location, the ADR Scanner signal returns repeatedly showed consistent similarities between the limestones, between the mudrocks, between the coals and between the sandstones at known depths determined from the exposed quarry face

From this work preliminary databases have been established for the principal igneous, metamorphic and sedimentary rock types of Scotland. These databases, which have been confirmed, by comparison with new scanned sections and driven boreholes, offer considerable potential for future geological exploration.



ADR Sub-layer Classification 
 Base
 ADR Scamer Propositie

 Delectric Depth
 -Code and Possible-Rock Type

 6.6
 0.21
 AA1 Topicit

 7.46
 0.32
 AA1 Topicit

 11.15
 5.12
 AC2 Sol-C horizon

 9.56
 1.22
 AC2 Sol-C horizon
 626 7.02 7.66 8.14 8.72 9.07 9.74 10.01 5.02 10.68 7.05 16.04 3.22 0.76 0.64 0.40 0.59 0.34 
 0.2
 25.58
 18.19
 20. Charlest

 0.47
 17.89
 15.64
 32. Charlest

 0.31
 35.53
 15.97
 20. Charlest

 0.36
 4.59
 15.24
 82. Charlest

 0.38
 18.61
 16.92
 Charlest

 0.38
 18.61
 16.92
 Charlest

 0.43
 22.23
 26.05
 CO. Shale at



## Adrok Hydrocarbons Mapping Services

#### **NOW - ONSHORE**

- Appraisal
- Field delineation and gross volumetrics Infill drilling location identification and confirmation
- 2D structural surveying
- Small scale Exploration (ADR Virtual Wellbore logs)

### SHORT TERM – OFFSHORE & AIRBORNE

- Requires development and construction of stabilised platform for marine applications. Airborne surveys will also require platform
- development & further testing

#### FUTURE

- Large scale Exploration requires increased application database and ADR sensor training to increase confidence levels
- Reservoir monitoring & management requires deployment of fixed multiple sensors with lower unit cost base



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0.39 22.95 20.91 C2 fasured wet 557 0.31 29.94 21.12 C2 fasured very wet

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