A Novel Technology for Identifying Subsurface Rocks, Rock Sequences & Hydrocarbons

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Maps - Locates - Identifies

deep subsurface

Oil - Gas - Water

with precision and confidence

Introduction

The Atomic Dielectric Resonance (ADR) Scanner is a new entrant in the subsurface imaging market for the oil and gas industry. It is a subsurface imaging and material classification system developed by Adrok Ltd in Scotland to directly and precisely log subsurface lithology and the presence of Hydrocarbons at depths of up to 5km from the ground surface. The imaging technology is based on the principles of Atomic Dielectric Resonance (ADR) established over 30 years research and development by Adrok's founder.

The ADR Scanner is a patented investigated technique. It utilises imaging technology that identifies subsurface materials by typecasting and automated mathematical comparisons, rather than solely visual interpretation. The system measures atomic permittivity non-invasively and generates a virtual wellbore log of lithology from the ground surface to depths which are normally experienced during oil and gas operations. Adrok has deployed the technology for a number of independent onshore case studies. This fieldwork concluded that ADR successfully identifies subsurface oil and gas horizons and the presence of minerals at depth. Vertical and horizontal target resolution achieved by ADR was better than 5m over a 2km subsurface depth range.

In essence, Adrok provides the end user with enough depth and lithological information to help drill position decision making and help reduce the requirement for appraisal drilling. The ADR Scanner is presently being used as an appraisal technique and will soon also be qualified as a small-scale exploration tool.

ADR provides user-friendly and direct-depth log outputs for immediate input to geological models and petro-physical analysis. The 3 primary output formats are image, material classification and thematic map.

ADR has demonstrated in trials the ability to

- identify oil / gas / water / rock types;
- penetrate the earth to 4km depth; and
- penetrate highly conductive layers (such as seawater, saturated clays and metallic ores).

The ADR Scanner has been developed over the past decade and is being deployed by Adrok Ltd in subsurface geological and civil engineering applications. ADR has also been successfully deployed by Adrok in mineral exploration, medical, biological, and safety applications. It has been deployed as a non-invasive diagnostic technique to differentiate between blood and tissue samples. ADR could also be applied to homeland security, defence and subsea applications.

Technology

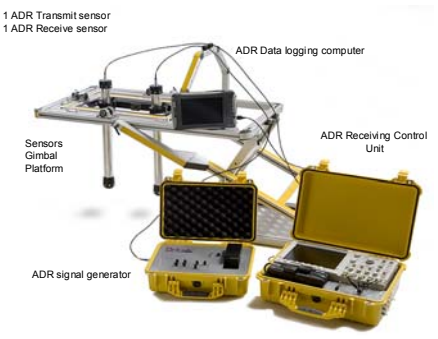
Adrok have conducted a series of field and laboratory demonstrations in which rocks and hydrocarbons of different compositions and textures have been exposed to pulsed beams of ultra-short wave length ADR Scanner lased radiation, producing a range of differing energy responses detectable by suitable ADR Scanner receivers.

Hardware and software has been configured by ADROK to cover a wide band and generate narrow band invisible lased pulses, at a number of centre frequencies between 1MHz and 500MHz. The invisible light laser beam penetrates the rock and as it encounters the component minerals it stimulates the atoms to release energy according to their compositions. The laser pulse of photons passes through the structure of the atom and emerges to encounter more atoms farther along its path. Electrons from each individual atom release energy in all directions, and by timing the first arrival of this burst of low power energy at a position beside the transmitting source enables the distance to the responding atoms encountered to be determined. The nature of the return signal, its frequency and energy levels are determined by the minerals encountered.

In a rock mass the component minerals may vary, but in general sandy rocks are composed principally of quartz (Si02), limestones mainly of calcite (CaCO3), coals largely of Carbon (C), and clays or shales mainly of assemblages of iron- or magnesium-alumino-silicates. Cascading harmonic analysis of the emerging electromagnetic radiations, their energies and frequencies of the signal energies released by the materials differ sufficiently for the rock compositions to be recognized by computer processing.

ADROK have found that by repeated characterization of the signals received from known rocks at known depths in quarries or boreholes it has been possible to characterize the principal rock types of central Scotland, Southern England and parts of Northern Africa and identify them with confidence in blind tests beside logged boreholes.

ADR Scanner



ADR is lightweight, hand portable and can be deployed onshore from a four-wheel-drive vehicle, by foot, or from Adrok's bespoke one-person operable ADR Land Buggy. It is rugged and ready for field use (IP65 weatherproof rated). The ADR survey equipment is readily transportable, contains a built-in rechargeable 12vdc power supply. ADR uses very little power (less than 200watts) and transmits EM signals that are non-ionising and not harmful to humans and the environment (less than 50milliwatts signal power is emitted by an ADR system).

The output is pictorial and shows each and every major subsurface stratigraphic horizon down to several kilometers depth, classified and with thickness. ADR provides the end users with information of rock type, rock sequence, moisture content, dielectric permittivity, and presence of hydrocarbons. The results can be readily configured for and merged into a standard geologic or petrologic software package for further modeling. ADR is presently being used as an appraisal technique and will soon also be qualified as an exploration tool.

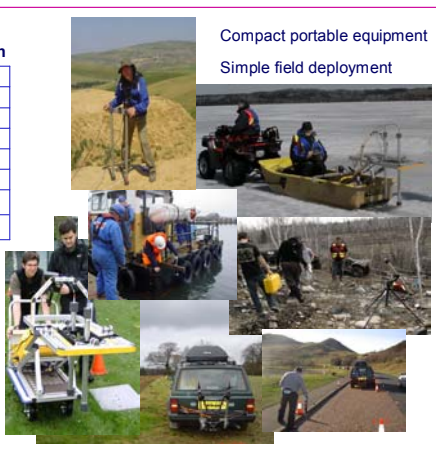
Although the technology's deployment is at an embryonic stage in the Oil and Gas industry, ADROK have provided empirical proof of concept of the recognition of rocks and hydrocarbons using invisible light generated by their proprietary ADR scanner. Further work and trials may be required for the ADR scanner to become accepted as an appraisal and/or exploration tool by the Oil and Gas industry.

Survey Process

- Training on known structure or samples
- On-site survey
- Data transmission
- Analysis & result delivery

ADR Scanner Performance Specification

Depth Limit	proven to 4km
Depth Resolution	> 2 m
Physical size	person-portable
Physical endurance	IP65 weatherproof
Power requirement	< 200 watts
Emitted Power	< 50 milliwatts
Time to survey / 50m survey point	2 hour
Time to deliver result	2 Days per Survey Point



Compact portable equipment

Simple field deployment

For each Survey Point, Adrok collects the following 3 types of ADR Scans along a number of ADR Scan Lines (each scan line is typically around 100m in length):

1. **P-Scan** - Profile Scan of subsurface collected by ADR system at ground level (that produces 2-dimensional cross-sectional image of subsurface from ground level)
2. **WARR** - Wide Angled Reflection and Refraction ADR Scan of subsurface collected by ADR system at ground level (that produces depth calculations)
3. **CMP** – Common Mid-Point Scan of subsurface collected by ADR system at ground level (that produces depth calculations)

The ADR signal generator produces a pulse of energy that is fed to the transmitting antenna. The transmitting antenna conditions the signal for propagation into the ground. Once the signal has been sent to the transmitting antenna a trigger signal is sent to the receiving control unit to synchronise collection of the subsurface reflected data which is collected through the receiving antenna from different subsurface layers and structures. The receiving control unit collects the signal from the receiving antenna and converts it into a digital form that can be stored and read on the data logging computer using Adrok's proprietary software.

The data logged in the field is returned to Adrok's Data Processing Centre in Scotland for analysis. After the signal is quality controlled it is ready for processing. Processing involves several steps. The first is to conduct WARR and CMP analyses to produce depth information from the time registered image. This is then integrated with the P-Scan data to provide a depth correlated image of the sub-surface. Triangulation of each subsurface interface is enabled by ray tracing and Normal Moveout (NMO) computations, similar to the methods used in the seismic industry. This allows Adrok to produce WARR tables listing depths, layer thicknesses and inter-layer dielectric constants for each distinct rock layer (with differing transmission velocities) to be produced.

Adrok build-up material typecasting databases of known target materials (from Survey Points adjacent to known well sites and from physical core samples) and prognostic target situations based on Adrok's human operator interpretation of ADR signal returns from all of the ADR Survey Point locations. These ADR databases enable Adrok to identify sub-surface material types by using Adrok's proprietary typecasting and mathematical comparison techniques.

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