GEO EXPLORATION TECHNOLOGIES
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HYDROSCAN

# Airborne Seismo-Electromagnetics for Detection and Imaging of Hydrocarbon Reservoirs

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# 1 Introduction

HYDROSCAN® is an innovative airborne helicopter-based passive seismo-electromagnetic exploration technology which is used to detect hydrocarbon (HC) accumulations up to depths of more than 4,000 m.

The development of the proprietary system is based on research results obtained over oil and gas fields, where it is found that specific low-frequency (LF) electromagnetic (EM) power spectra are largely raised as compared to dry and tight rock mass (Fig. 1).

Thus, a HYDROSCAN survey enables the discrimination between presence and absence of HC content in transmissible (productive) geological structures.

It opens a wide range of highly beneficial usage, from frontier exploration to field extensions, from prospect de-risking to seismic interpretation support, and from optimization of well placement to reservoir time-lapse monitoring.
For all tasks the HC reservoir identification capability includes conventional (anticlinal) traps as well as unconventional non-structural related traps, like occurrences in stratigraphic closures, fault zones, sub-salt and sub-basalt.

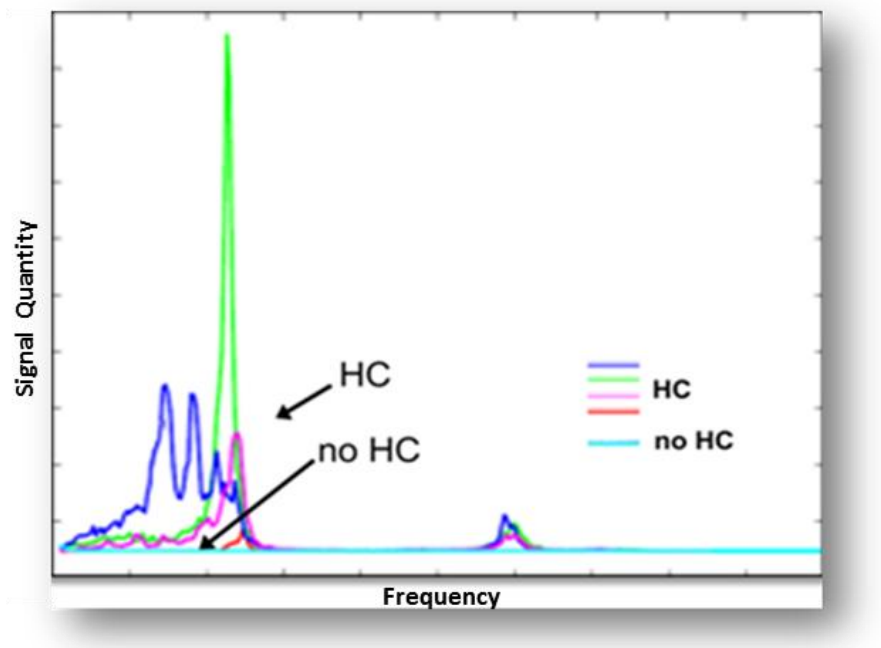


***Fig. 1: Typical frequency spectra indicating no-HC and HC reservoir zones***

## 2 Case Example: Salt Dome Onshore

Previously to a license claiming an onshore concession area of about 550 square kilometer was investigated by a fast and cost-effective helicopter-borne HYDROSCAN survey.

From the geological point of view it is a very interesting prospective acreage because source rocks and reservoir plays within a trough are present as well as salt domes and salt pillows comprising potential oil traps within the overburden and dragging flank structures (Fig. 5).

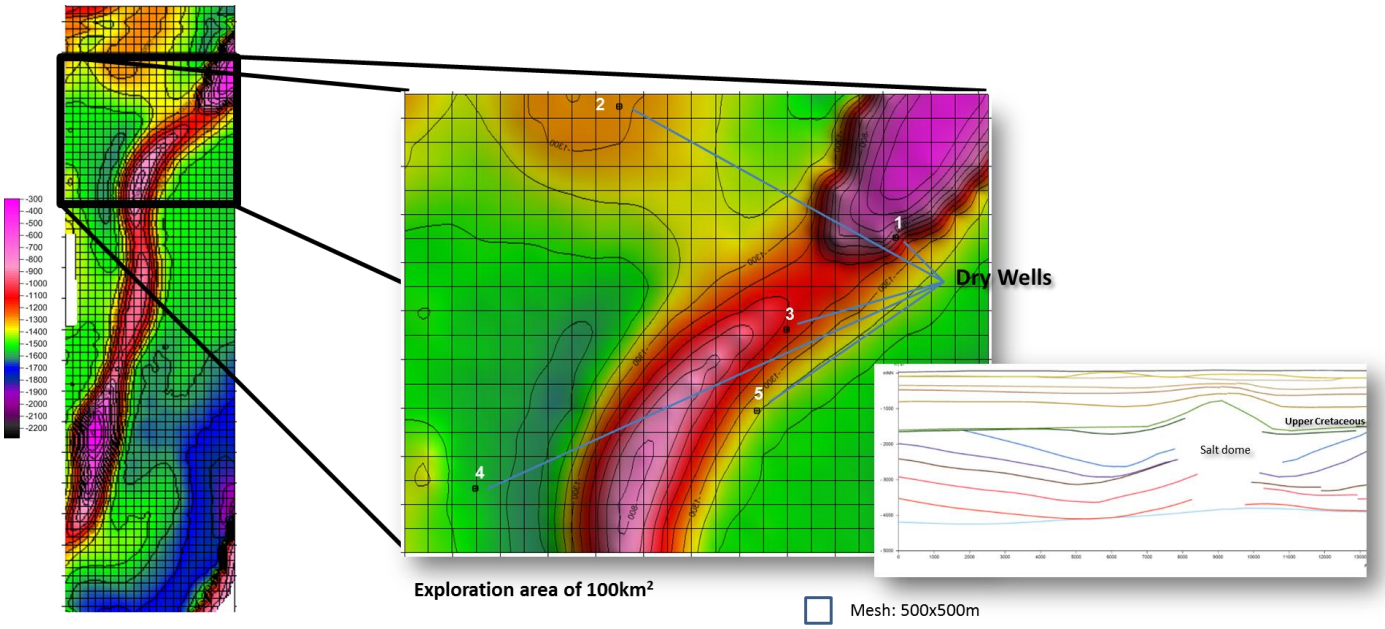


***Fig. 5: Contour plot presenting depth of basis Upper-Cretaceous obtained from 2D reflection seismics indicating upwarp structures within the whole 550 sq.km investigation area and a zoomed area of about 100 sq.km***

On the other hand several decades of exploration work performed by different international petroleum companies failed which is documented by 18 dry wells and not even one productive well.

These unsuccessful results are inherent in the traditional exploration approach which comprises in general the following procedure:

In a first step anticlinal and upwarp structures are identified based on reflection seismics. In a subsequent step such defined conventional traps are drilled by chance when complex geology is predominant. In case of the treated example (zoomed area) the 5 wells unfortunately did not reveal any oil charge (Fig. 5).

The reason is obvious when compared to the seismo-electromagnetic HYDROSCAN results (Fig. 6).

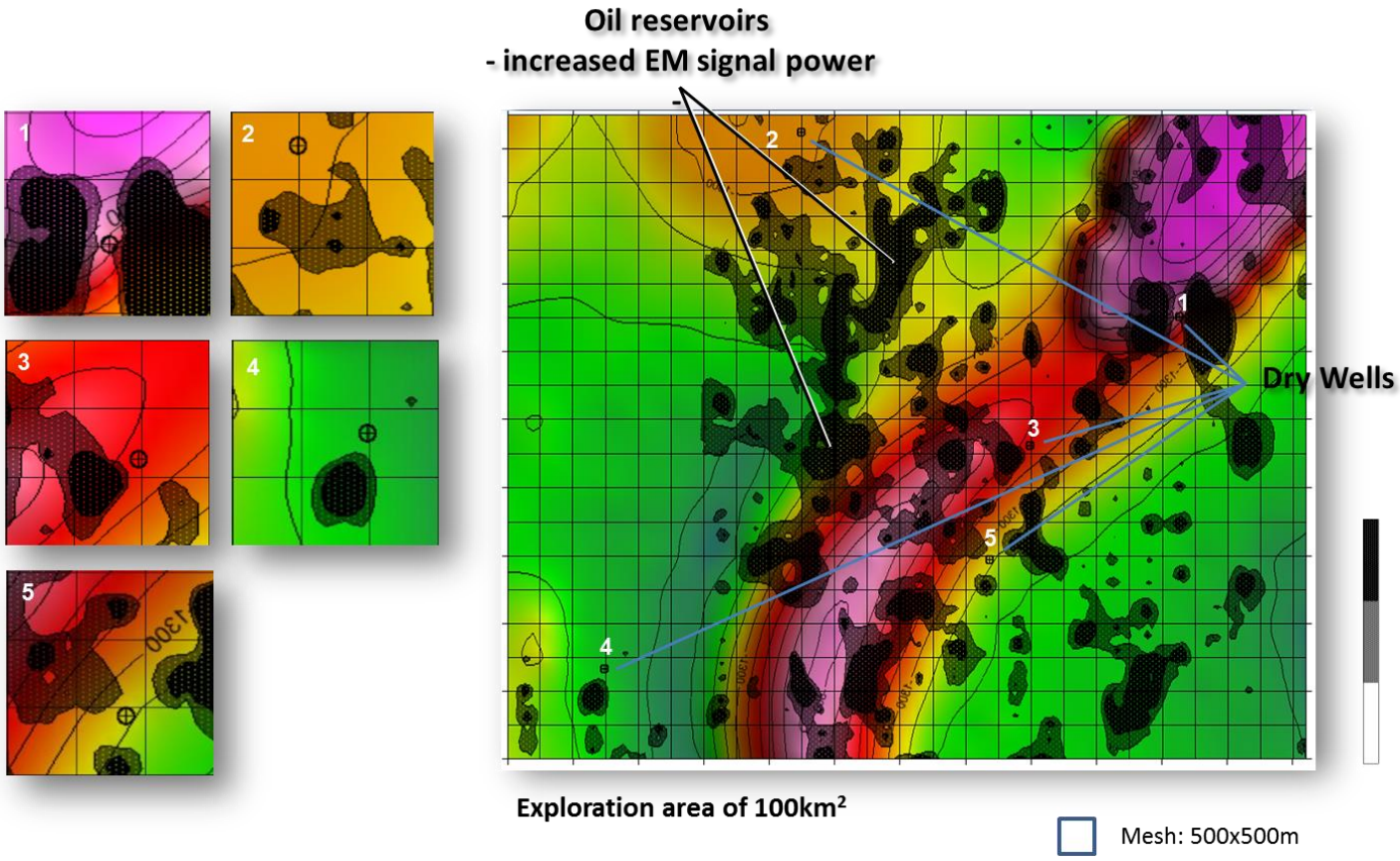


***Fig. 6: HYDROSCAN and seismic results of zoomed area and details of dry well sites***

The projection of the EM signal power distribution onto the depth contour plot of Upper-Cretaceous bottom surface images the anomaly outcrop pattern of transmissible (permeable) oil-bearing reservoir zones. Thereby indicating that all dry vertical wells missed the anomaly cores (black) in off target distances of 100 - 500m.

Furthermore the HYDROSCAN survey provided additional anomaly zones outside the anticlinal areas which are not visible in the seismic data (Fig. 7).

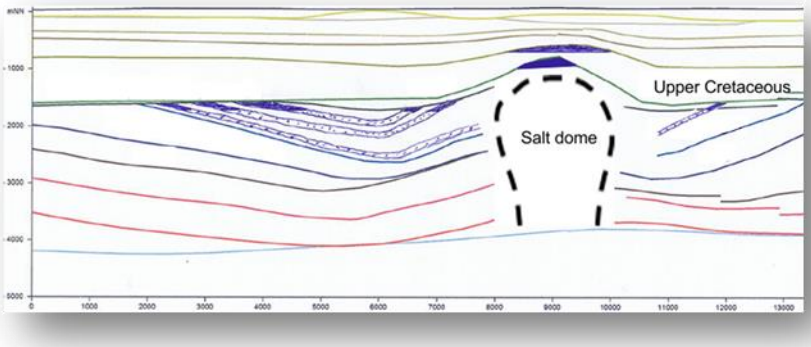


***Fig. 7: Geological interpretation of 2D seismic reflection and seismo-EM HYDROSCAN results denoting multiple pay layers and multi-trap structures within a cross-section***

Based on the HYDROSCAN results a new precise well location within an anomaly core could be defined. Ongoing drilling operation discovered end of 2012 first oil evidence, thus stating a distinguished success rate of 100% (Fig. 8).

For comparison: the long-term oil finding rate based on conventional exploration is about 17%.

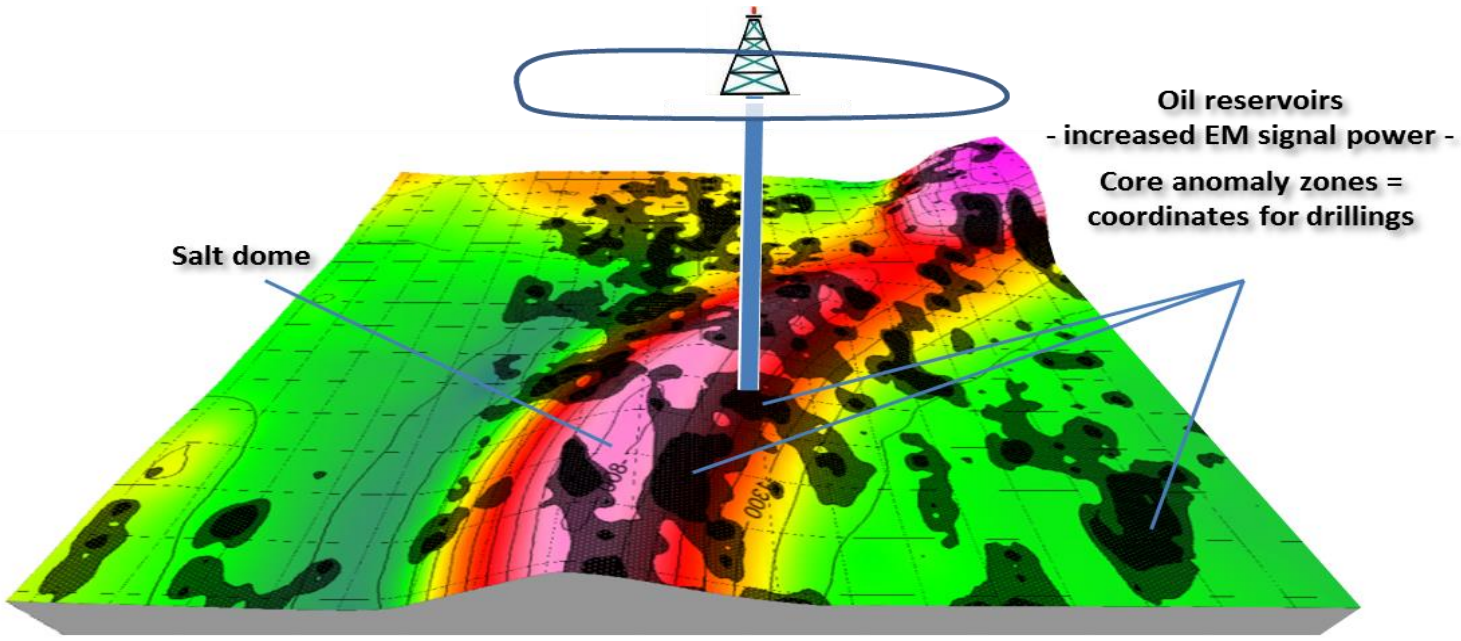


***Fig. 8: Successful oil finding***

# 3 Benefits

A HYDROSCAN survey provides considerably advantageous and efficient features, such as

- discrimination between presence and absence oil & gas reservoirs
- lateral distribution of transmissible (productive) HC reservoir zones
- 3D Inverse Modeling for depth estimation and multiple pay layer indication
- efficient de-risking and seismic supporting tool, thus providing added-value information for geologists and geophysicists
- quick turn-around from preparation through data acquisition and processing to result delivery with final report,
- no geographical / surface / infrastructure related constraints,
- no environmental limitations,
- no need for ground permitting,
- no need for extensive time-consuming ground-based measurement setups including transportation of equipment and cables.