AMPLIFIED GEOCHEMICAL IMAGING LLC

Virtually Eliminate
Dry Wells

Using Ultrasensitive Hydrocarbon Mapping to Derisk Exploration & Optimize Field Development

Both frontier exploration and field development are costly endeavors that utilize seismic data to evaluate subsurface structures. However, seismic imaging does not address the critical question of hydrocarbon presence. New technologies need to be implemented to determine the presence of petroleum systems and define the phase and boundaries of any hydrocarbons that may be present. Ultrasensitive hydrocarbon mapping can be used in conjunction with seismic programs to dramatically derisk exploration in frontier areas as well as field development efforts to provide critical information towards the understanding of the petroleum systems.

Amplified Geochemical Imaging's (AGI's) hydrocarbon mapping technology is unique among surface technologies in that it uses passive monitoring to detect hydrocarbons at parts per billion (ppb) levels **which is 1,000 time more sensitive than traditional methods**.

The AGI passive sampler, see **Figure 1**, contains a specially engineered oleophilic (i.e. oil loving) adsorbent encased in a microporous membrane. These membrane pores are small enough to prevent soil particles and water from entering, but are large enough to allow hydrocarbon molecules to pass through and concentrate on the adsorbent material. Additionally, the AGI method measures ~ 85 compounds, from C_2 – C_{20}, which provides the unique ability to clearly define and differentiate multiple gas, gas condensate, or oil signatures.

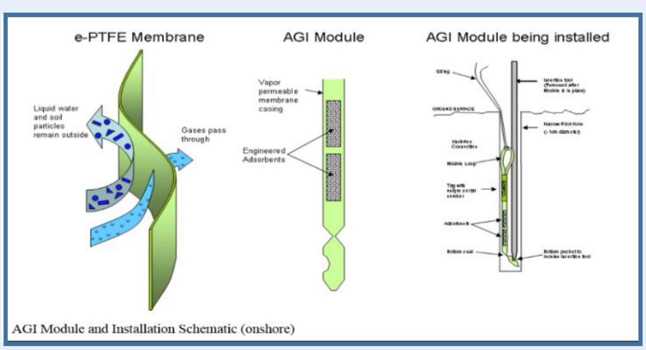

Figure 1.

This exploration case study took place in southern Kenya near the Tanzanian border in Block L19. The block, owned by RIFT Energy, encompassed approximately 12,000 km^2 (2.9 million acres). In early 2013, a 7,064 km line Aerial Gravity & Magnetic (AGM) survey was completed covering the entire block. The AGM survey indicated a large basement structure, over 50 km in length, traversing the block with several separate prospective structural closures, including a large potential structure to the northwest and a second potential structure to the southwest.

Given this was a frontier survey, with 2 – 3 km spacing, it was not possible to determine the structural boundaries for any hydrocarbon accumulations due to the lack of sample density. The AGI data, however, did identify two potential petroleum systems separated into distinct sub-basins on each side of a structural high running through the prospect. **Figure 2** shows the hydrocarbon probability contour map for a condensate-type hydrocarbon within the black dashed ellipse. The red anomalies indicate areas with an 85%-95% probability of finding a condensate while the blue areas indicate areas with only a 25% probability.

This second anomaly map, see **Figure 3**, contours a heavier oil, more like a normal API oil. Note the condensate map is predominantly focused to the western part of the central basin. The difference in hydrocarbon fingerprints and the difference in locality tend to indicate the probability of two distinct petroleum systems.

The normal API signature showed two prominent leads as indicated by the red arrows. One lead was approximately 12 km long and the second was approximately 9 km long.
When the AGI hydrocarbon anomalies were incorporated with the 2D seismic data a strong correlation was noted. The geochemical anomalies coincided with 7 structures found along a single seismic line.

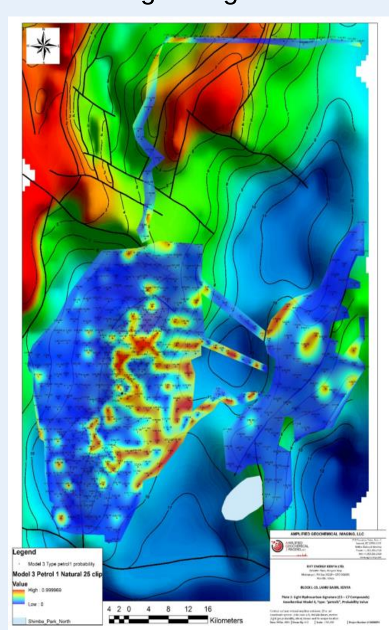

Figure 2.

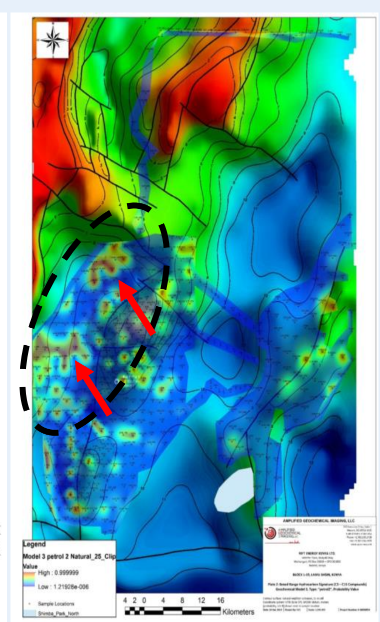

Figure 3.

Reduce Exploration Costs by 58%

Virtually Eliminate Dry Wells

In this Lithuania development case study, presented at the 63rd EAGE Conference & Exhibition by T.M. Haselton of the Lithuania National Oil Company, several fields had been discovered and produced in the region since the 1990s. The fields were located adjacent to a regional sealing fault. The Pietu Siupariai field had produced a total of 0.2 MMBO from 3 wells. Productivity of the old wells varied from no production to 160 BOPD. The G-12 well tested 750 BOPD on a DST but was not completed due to mechanical problems. Although the G-18 and G-7 wells both produced 120 BOPD, the latter well only penetrated the uppermost 15 meters of the reservoir.

As seen in **Figure 4**, the red areas represent an 85%-95% probability of finding oil similar to the producing wells, while the yellow shading indicated a 70% probability, the green 50%, and the blue 25%. The survey identified the reason for the poor production. All of the pre-survey wells were either on the edge of high probability zones or in poor zones. Wells PS-2, PS-3, and PS-4 were drilled post-survey based on the survey results. As a result, **production increased 16-fold** to 6,533 BOPD. Note all of the post-survey wells were drilled in red anomaly areas. Haselton also calculated that the correlation between the geochemical probability

Production Test Data (BOPD)			
Wells drilled before the AGI survey		Wells drilled after the AGI survey	
G6/PS1	160	PS-2	3,350
G7	120	PS-3	2,020
G11	Dry	PS-4	760
G12	------		
G13	Dry		
G14	3		
G18	120		
	403		6,130

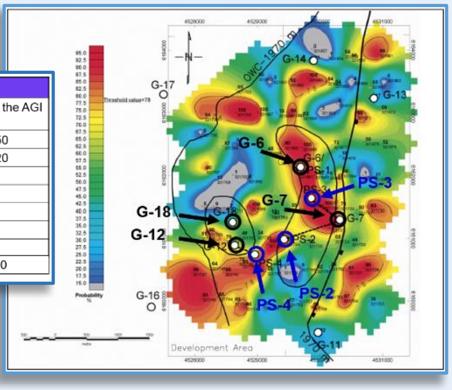

Figure 4.

values and the production field data had an R^2 value of 0.96, see **Figure 5**.

Also, as published in AAPG Memoir 66 by Santa Fe Minerals, AGI surveys were combined with 3D seismic over a seven year period in North, Central, and South America. As seen in **Figure 6,** AGI data correctly predicted 131 of the 141 post-survey wells. So 96% of of the dry wells and 92% of the producing wells were correctly predicted.

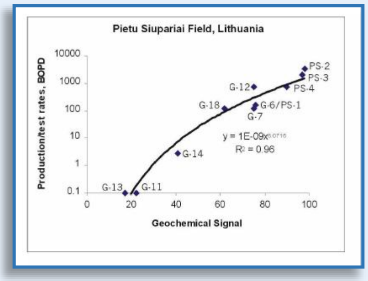

Figure 5.

By the end of the seven year period, Sante Fe Minerals was able to **reduce their exploration costs by 58% by virtually eliminating dry wells** when they combined 3D seismic data with AGI data.

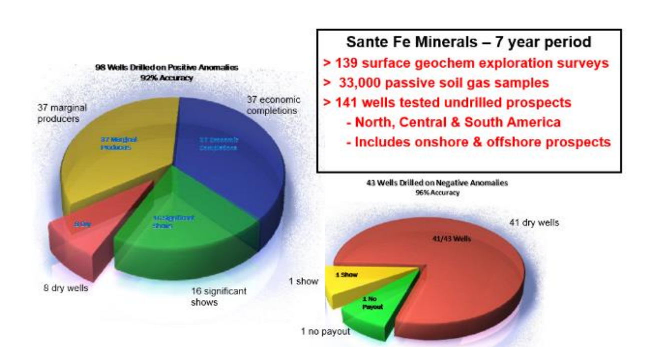

Figure 6.

Summary: Amplified Geochemical Imaging's ultra sensitive hydrocarbon mapping technology can dramatically help exploration and field development efforts. For exploration efforts it can be used to:

- identify charged and noncharged areas in a field,
- identify hydrocarbon phase (gas, condensate, or oil),
- reduce seismic costs by eliminating surveys over nonhydrocarbon prospective areas,
- rank prospects,
- confirm areas for relinquishment.

For field development applications it can be used to:

- identify Sweet Spots with higher reservoir pressure, porosity, and thickness,
- predict areas of higher production when adequate well control is available,
- reduce development costs by minimizing dry holes and noneconomic wells,
- define oil/water contacts and their movement,
- monitoring sweep efficiency in EOR floods and by-passed pays.

Amplified Geochemical Imaging, LLC
210 Executive Drive, Suite 1, Newark, DE 19702, USA
Phone: +1.302.266.2428, Fax: +1.302.266.2429
E-mail: info@agisurveys.net **www.agisurveys.net**

Sales Offices
Houston, TX, USA: Phone: +1.281.782.8914
Germany: Phone: +49.89.638.7927.12
AIPC, AUS/NZ/PNG: Phone: +61.417.659.144
PT Geoservices, Jakarta: Phone: +62.21.830.5555