# Derisking Frontier Exploration: a Kenya Case Study

Frontier exploration is a costly endeavor which utilizes 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 of any hydrocarbons that may be present. Ultrasensitive hydrocarbon mapping can be used in conjunction with 2D seismic programs to dramatically derisk exploration in frontier areas and provide critical information towards the understanding of potential petroleum systems to expedite the learning process in unknown areas.

This 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). Only one well had been drilled in the block, the Ria Kalui 1 well. Drilled in 1962, the well was drilled off structure to a depth of 1,538 meters and was plugged and abandoned after encountering oil shows in the Karoo formation.

In early 2013, a 7,064 km line Aerial Gravity & Magnetic (AGM) survey was completed covering the entire block. The AGM results formed the basis of a depth to basement map as seen in Figure 1.

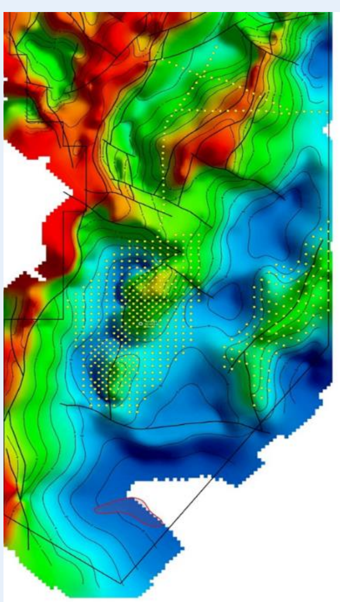

Figure 1.

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 north-west and a second potential structure to the southwest.

Thus, an Amplified Geochemical Imaging (AGI) hydrocarbon survey was implemented to:

- Identify the presence and location of possible hydrocarbons.
- Identify the phase of any potential hydrocarbons present
- Provide hydrocarbon mapping information that could optimize the location of proposed 2-D seismic lines to be conducted in 2014.

Given the proximity to the city of Mombasa, there was infrastructure for oil, but there was not a good infrastructure for gas. Thus, RIFT Energy's primary focus was liquid assets.

As seen in Figure 2, there were three primary areas of interest in the block: a northern section, a central section, and an eastern section. The northern and central sections were connected by a north/south transect. The central section represented approximately 1,350 $km^2$ and was focused on potential closures along a north to south plunging arch using a 2 km sample grid pattern.

Given this was a frontier survey, with 2 – 3 km spacing, it was not possible to determine the structural boundaries for any identified hydrocarbon accumulations due to the lack of sample density.

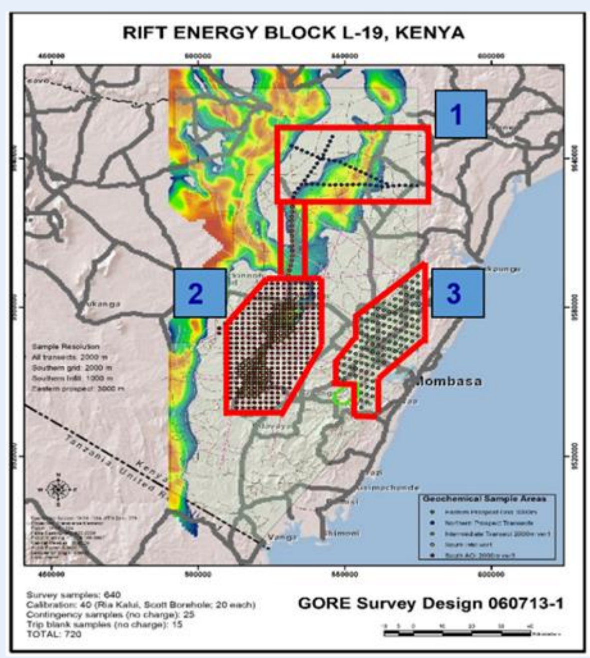


Figure 2.

# Frontier Exploration

The Amplified Geochemical Imaging passive sampler contains a specially engineered oleophilic (i.e. oil loving) adsorbent encased in a microporous membrane. The membrane pores are small enough to prevent soil particles and water from entering, but large enough to allow hydrocarbon molecules to pass through. Thus, the semipermeable membrane provides a concentration affect that results in an ultrasensitive technology that is approximately 1,000 times more sensitive than traditional methods. Additionally, the passive sorbers measure ~85 compounds ranging from $C_2 – C_{20}$.

The AGI data identified two potential petroleum systems separated into distinct sub-basins on each side of a structural high running through the prospect. Figure 3 shows the hydrocarbon probability contour map for light oil, or a condensate-type hydrocarbons, 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.

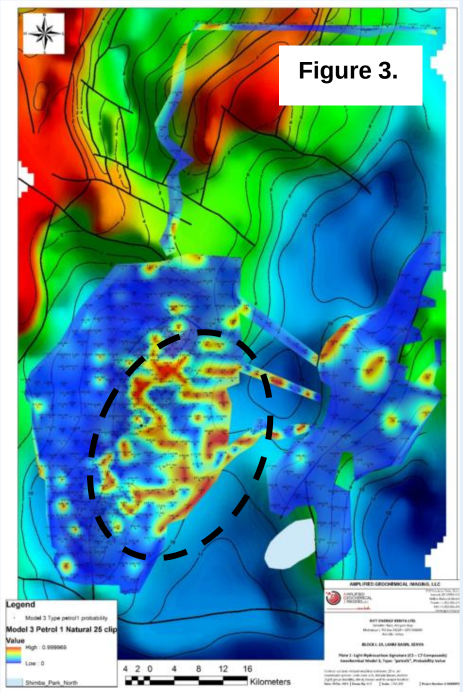

Figure 3.

The light hydrocarbon anomaly map indicated a series of sinuous geochemical features extending above the central basement high and in the trough areas to the south and east, suggesting channels or structurally controlled dip closures. Additionally, the western, northern, and eastern sections of the block were not particularly prospective.

The northern and intermediate transects were also largely uninteresting, although it is not advisable to discount a region based on the sparse sample density applied to this area.

This second anomaly map, as seen in Figure 4, contours a heavier oil, more like a normal API oil. Note the condensate map oriented more towards the eastern part of the central basin, while the heavier oil is predominately 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. One west of Ria Kalui well in the northwestern corner of the black dashed ellipse approximately 12 km long. The second was in the southwest section and was approx.-imately 9 km long.

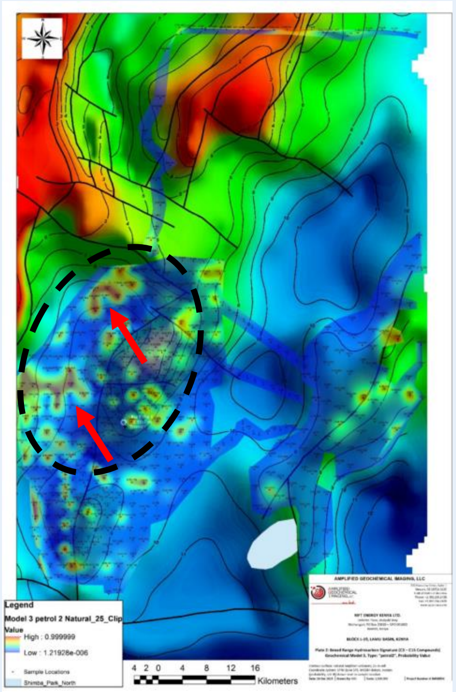

Figure 4.

The geochemical data was then used to fine-tune the 2D seismic program. Based on the lack of hydrocarbon detection in the northern section, these seismic lines were relocated to the central basin area.

When the AGI hydrocarbon anomalies were incorporated with the 2D seismic data a strong correlation was noted. As seen in Figure 5, the geochemical anomalies coincided with 7 structures identified on this seismic line. The yellow circles infer light oil anomalies and the black indicates a heavier oil.

Figure 5.