



AIRBORNE GEOPHYSICAL SERVICES

CANADA • SINGAPORE • INDIA

A Neterwala Group Company

# GAMMASENSE



The objective of surveying with a multi-channel, gamma-ray spectrometer system and a large volume gamma-ray sensor is to detect subtle characteristic radiation patterns as indicators of subsurface hydrocarbon accumulations over petroliferous terrain. ISMAP and **GAMMASENSE** techniques may be applied independently of each other, however, it is practical and cost effective to combine them in one multi-sensor, multi-method survey.

Hydrocarbon anomalies can be qualitatively and directly identified from airborne radiometric measurements. It has been repeatedly observed that the subtle anomalous patterns of radiation flux detected over petroleum basins exist over subsurface hydrocarbon accumulations. This we have also determined from **GAMMASENSE** surveys we have conducted in Latin America, in both tropical and desert areas, and in various locations in the USA.

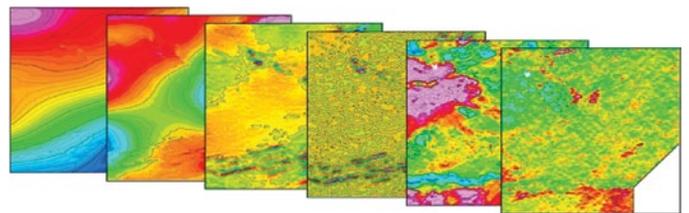


*To learn more about the **GAMMASENSE** method, please contact us. A bibliography of Technical Papers and Case Histories is available.*

## HOW DOES GAMMASENSE WORK?

The earth's crust contains uranium, thorium, and potassium. These primordial radionuclides were randomly laid down during the planet's formation. They and their progeny emit highly energetic gamma rays in the course of radioactive decay. As their half-lives approximate the age of the earth, it is to be expected that all three elements contribute measurably to our natural radiation background. Hundreds of millions of years after the laying down of the radionuclides, hydrocarbon deposits formed.

Uranium is the most mobile of the three radionuclides. Subsurface hydrocarbons, however, through recognized geochemical processes, alter uranium's mobility above hydrocarbon deposits. In its fully oxidized state, the uranium ion is water-soluble, highly mobile, and easily transported by ground water, however, on entering an environment containing organic matter, the ion is reduced becoming insoluble and immobile. Potassium also shows similar characteristic mobility changes. As a consequence, the gamma radiation flux detected over hydrocarbon deposits is noticeably altered by the contributions from uranium and potassium. In addition, the random radiation pattern normally observed has now changed into a characteristic radiation pattern, thereby creating a readily identifiable pathfinder in potentially productive basins.



*Presentation of data acquired from a combined ISMAP and **GAMMASENSE** survey.*



**NEW DIMENSIONS IN EXPLORATION**

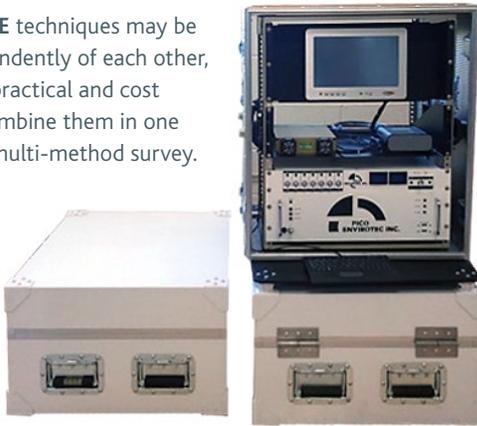


# GAMMASENSE

**GAMMASENSE** is a proven radiometric mapping system that can detect subtle characteristic radiation patterns as indicators of subsurface hydrocarbon accumulations over petroliferous terrain.

**GAMMASENSE** surveys are conducted with a multi-channel gamma-ray spectrometer system and a large volume gamma-ray sensor (33.6 to 50.4 litres of NaI(Tl) detector). ISMAP and **GAMMASENSE** techniques may be applied independently of each other, however, it is practical and cost effective to combine them in one multi-sensor, multi-method survey.

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33.6 litres volume **GAMMARAY SYSTEM** installed in one of our aircraft.

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The following is an abstract of a paper written by Donald F. Saunders and published in Special Publication #3, December 1995 by the Association of Petroleum Explorationists. The paper is entitled "Overview of Radiometrics and Related Surface Methods for Petroleum Exploration" and sums up in few words EASI's GammaSense method of hydrocarbon exploration.

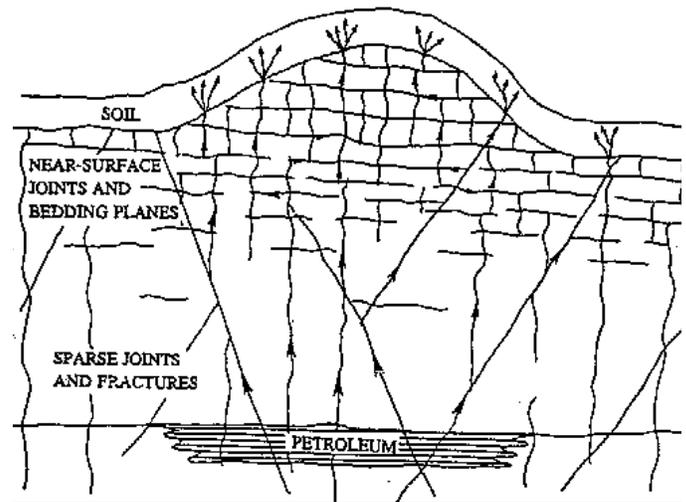
## ABSTRACT

Over the past 25 years there has been progressive development in understanding the relation of aerial and surface radiometric measurements to subsurface petroleum accumulations. The data from many recent gamma-ray spectral surveys have confirmed the presence of characteristic anomalously low potassium and higher uranium gamma-ray levels over a majority of oil and gas fields tested. Similar surveys by the author as parts of integrated exploration programs have yielded several new prospects and at least four new field discoveries.

A single model involving: 1) light hydrocarbons seeping to the surface from petroleum accumulations and 2) the effects of their bacterial consumption and degradation may account for surface and near-surface radiometric, shallow source magnetic, geomorphic and light-hydrocarbon anomalies. The degradation process creates carbon dioxide which forms carbonic acid in groundwater. This can leach potassium from soils to create low-potassium gamma-ray spectral anomalies. The carbonic acid may also react with calcium silicates to form secondary calcium carbonate mineralization which may result in geomorphic tonal or stream drainage anomalies or seismic velocity anomalies.

Hydrogen sulfide is also created by anaerobic bacterial degradation of hydrocarbons and causes a chemically reducing environment, which can concentrate uranium in the region over petroleum. Thus, low-potassium anomalies with simultaneous uranium anomalies higher than those shown by potassium are considered favorable indicators of petroleum. The reducing environment may also convert nonmagnetic iron minerals to magnetic ones to produce shallow surface aeromagnetic anomalies and soil or drill cuttings magnetic susceptibility anomalies.

Surface soil type or lithology, soil moisture content, variable vegetation shielding and topographic variations in counting geometry are known to cause serious errors in the use of total count radiometrics and single channel gamma-ray spectral potassium measurements in petroleum prospecting. These effects may all be suppressed by measuring the natural radioelements individually by multi-channel gamma-ray spectrometry and using methods of thorium normalization.



Possible microseepage paths up through the network of fractures, joints and bedding planes

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