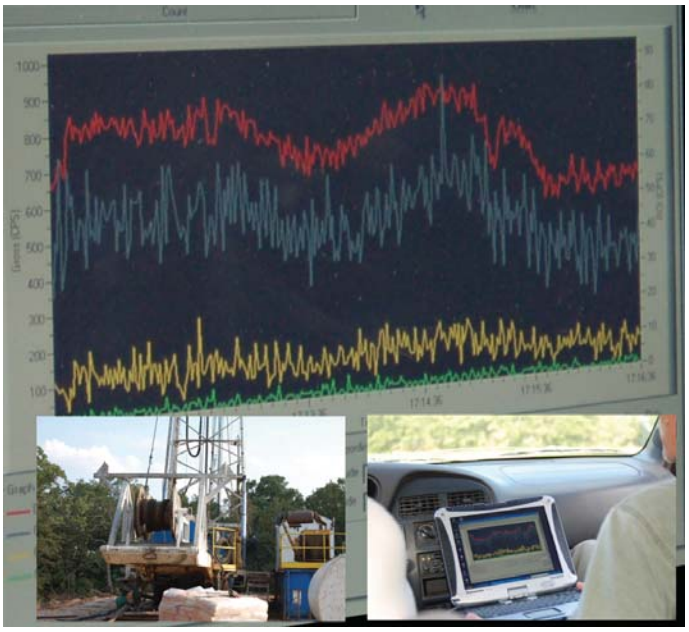
Radiation Detection for a Safer World

The Ludlum Geo Explorer

Model 4404-16 Article **October 2008**

Radiological Surveying Can Be Fun & Prosperous!

It was while bouncing wildly in the back seat of an older Nissan Pathfinder that was making its way across open fields in the middle of Oklahoma on a hot summer afternoon that I had my epiphany. Surveying was not only fun, it could also be extremely profitable! But this was not your garden variety radiological survey; this was oil prospecting where high tech and years of experience came together in hopes of discovering that next fountain of wealth deposited below the surface in the form of oil and natural gas.



Geologists have known since the 1950's that subsurface oil and natural gas deposits often created anomalies in terrestrial background radiation levels. These radiometric anomalies typically appear as nonrandom reductions in the flux below those of the surrounding natural background. These anomalies have been well documented, although the reasons for them are still being debated. The US Bureau of Mines published a review of 237 papers back in 1973 wherein 85% of them reported that such a relationship existed. Recognizing this phenomenon, the US Department of Energy conducted a 5 year long aerial map survey of the entire USA using large gamma scintillators. Completed in 1982, the Natural Uranium Resource Evaluation Program (NURE), as it was called, collected gamma measurement of the uranium and thorium decay series plus K-40. In one 6 state region, the study revealed a 72.6% correlation of radiation anomalies above 706 known oil and gas fields.

The owner of the new Ludlum Model 4404-16 Geo Explorer instrument and not so new Nissan exploration vehicle where-in I had my epiphany was Mr. Wayne Ingram, President of Ingram Exploration. Wayne is one of those hospitable and talkative southern individuals who generously shared with us his vast exploration experience. A lawyer by profession who taught himself to become a successful oil exploration entrepreneur after blindly following experts to very costly dry wells is just one of many interesting stories for which there are neither the time nor space to recount.

And so after hand delivering the new 4404-16 instrument to Wayne, getting to know one another and a brief overview of the instrument, we were off in his well traveled 4 wheel drive vehicle to try out this new tool. For this first run, Wayne chose known areas with existing oil wells and other previously identified prospects to see how well the new Geo Explorer compared to instruments he'd used in the past.

Ludlum Measurements, Inc.

Wayne has successfully utilized radiometry for many years as a cost-effective reconnaissance tool in identifying prospective oil drilling sites. He is the first one to tell you that radiometry is not the only tool for the job, but that it does offer an excellent and very cost-effective screening tool. He emphasizes the importance of correlating radiometry results with known geological formations, seismic test results and well data collected from the surrounding region to really know if a site holds true promise. Given the cost of land leases and building roads into unimproved areas for conducting high priced seismic tests, Wayne noted that the cost of the Ludlum Geo Explorer is easily justified and pays for itself quickly.

The Model 4404-16 Geo Explorer instrument utilizes a large 2" x 4" x 16" NaI detector that yields high count rates for excellent statistical accuracy and produces good spectral quality for separating the isotopes of interest. The detector is surrounded by a generous volume of foam to protect it against mechanical and temperature shock. The detector and accompanying electronics are encased in a water-tight, rugged plastic case equipped with wheels to facilitate portability. The multi-channel electronics nestles alongside the large brick of NaI and outputs count data for three energy channels set up for the major sources of gamma radiation found in soil which are:

- Bismuth–214 (061 MeV) Uranium-238 series
- Thallium-208 (2.62 MeV) Thorium-230 series
- Potassium-40 (1.46 MeV)

All three of these channels together with one gross energy channel are all communicated via RS-232 to the supplied rugged laptop PC equipped with a high visibility, sunlight readable display and a built-in GPS receiver. The Ludlum installed Geo Explorer counter software simultaneously displays all 4 channels of count data, controls data logging and provides protected access to setup parameters. The software is simple and straight forward to operate with easily accessed controls for starting and stopping data logging, ability to save data to user-defined file names and performing routine calibration checks. Logged data that is accumulated at one second intervals are stored as a csv type file so it can easily be imported into commonly available spreadsheet programs to facilitate charting to your preferred criteria.

Model 4404-16 Geo Explorer with case opened

A special utility PC program is also supplied that converts the logged data to a Keyhole Markup Language (KML) type file that are compatible for uploading to Google Earth maps. Once viewed on Google Earth, the prospector can quickly get a birds-eye view of the surveyed area and see the radiation profile superimposed over the map to pinpoint any anomalies.

What makes the 4404-16 unique from most prospecting tools Wayne and others have used in the past are the:

1. Much larger detector supplying better sensitivity and accuracy
2. Ability to view and log real-time data simultane ously from four channels
3. Ability to inspect the captured digital data with one or more analytical tools
4. Precise GPS locations accompanying all logged data for pinpointing prospective sites
5. Ability to get a birds-eye view of the surveyed area with the captured radiological profile super imposed on a Google Earth aerial map

After connecting the Geo Explorer to Wayne's vehicle cigarette lighter for power we placed the detector/electronics case in the very rear, ran one cable to the PC laptop in the front passenger seat and powered it up. Randal Stevens, Ludlum's electrical engineer who

performed a lot of the development on this instrument claimed the passenger seat thus becoming the instrument operator. Wayne took to driving behind his entrusted, go anywhere anytime Pathfinder and I took up the rear seat to watch all the action.

As we left Wayne's office and scooted from a gravel road to one surfaced with asphalt, we immediately saw a big increase in the potassium channel. Randal and I had observed this phenomena often times as we drove from our home office in Texas and made our way to Oklahoma while delivering this fascinating instrument. We could also easily see big differences in backgrounds between concrete and asphalt type roads. We could even make out different batches of the same road type while driving at highway speeds.

Wayne had his eyes glued to the laptop screen as we headed down the road and I feared he'd drive us off the road even before we deliberately wanted to do so. Luckily Wayne was the multi-tasking type and remained in control the entire time. Fortunately, he knew his trusted vehicle very well as I would learn later when we traversed some pretty rough terrain while running lines and logging data.

Once at the site, Wayne was all smiles as we drove known lines he'd previously surveyed many times before. These lines had not only been previously etched onto strip charts with inkpens but also deeply into his mind's memory. It was clear that serious explorers like Wayne know the surface and subsurface like the back of their hands. While all I could see were the features on the surface, Wayne described the landscape surrounding us in 3 dimensional terms eagerly pointing to the live data streaming along on the Geo Explorer as confirmation of what he was describing to us neophytes.

It was quite thrilling anytime we witnessed the background levels drop quite significantly and then rise again and overshoot at the end of the deposit as was explained in many of the technical papers I had read and as foretold by Wayne.

Wayne was sold on the system from the onset, but for me, the real validation came as we drove along several operational oil wells where we saw the background suppressed profile each and every time. I must admit, I was hooked and gripped with oil explorer fever. Finding oil appeared all too easy and I decided I just had to get my hands on one of these wealth producing Geo Explorer instruments so that I could tap into the earth's riches for myself.

But reality came about all too quickly when we drove up to another previously drilled well site, where once again, we witnessed the characteristic background drop off but were informed that it had turned up to be dry. The radiometry we gathered as we drove up to that well was the most ideal we'd seen all day; in fact it was as near perfect as you could get. Contrary to the highly repeatable radiometry results, the well was nothing more than a quarter million dollar bust. Wayne is still convinced oil lies beneath that spot and believes the drill was deflected off of its vertical course and narrowly missed hitting the oil.

"In this business, you're only as good as the success you had on your last hole," said Wayne. "If you go by radiometry alone, you'll drill yourself into bankruptcy very quickly." Wayne goes on to explain that as an initial exploration tool, the Geo Explorer will lead you to a lot more opportunities at far less cost. It's one great tool which when taken together with all the other exploration methods increases your chances of success.

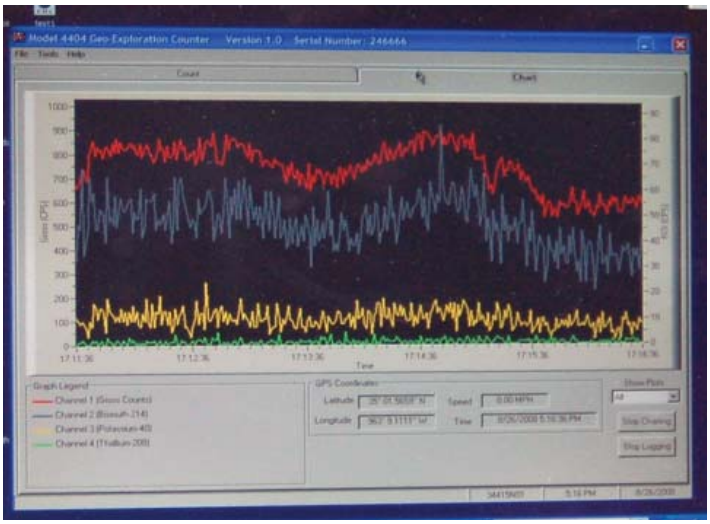
That's experience talking straight talk gained over many years and expense chalked up with more successes than failures. As for me, I've concluded that I'll just continue on buying my high priced oil and gas from those with the experience and the guts to put their money where their mouth is.

Ron Ulbrich
Marketing Manager
Ludlum Measurements, Inc.

Characteristic Radiological Profile of Oil & Gas Deposits

While the exact scientific explanation why radiation anomalies are manifested over oil and gas deposits is still being debated, most seem to agree radiometry yields good results and is an effective tool.

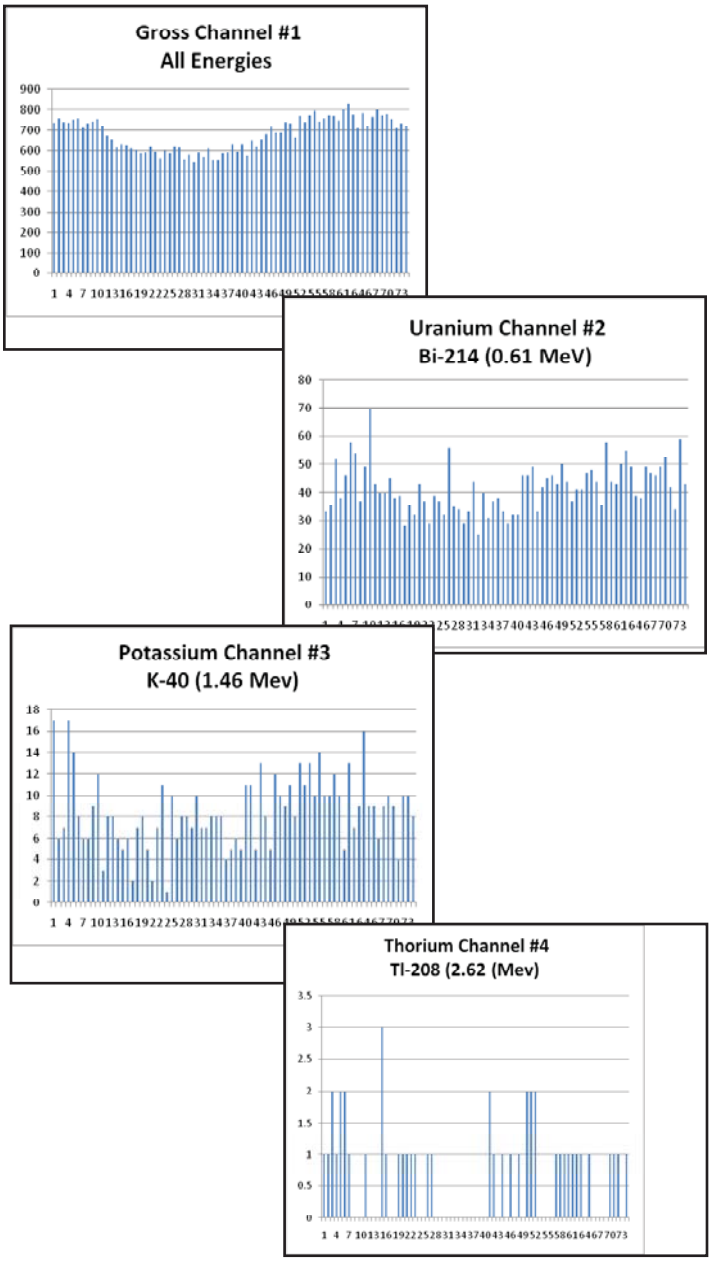
The characteristic repeatable pattern, independent of the local background levels, appears as a negative gamma-ray anomaly in the background. This characteristic is attributed to a depletion in potassium and uranium. Potassium and uranium are more mobile than thorium and are believed to be the primary reason for the significantly lower background. Another key characteristic of this radiation pattern is the increased detection levels immediately surrounding the edges of petroleum deposit known as the halo effect. This halo is believed to be increased levels of radon caused by the upward migration of the hydrocarbons.



To facilitate detecting these radiological patterns, Ludlum has designed the Geo Explorer screen such that it presents all four energy channels streaming live data simultaneously. In this manner, one can easily detect this characteristic pattern visually without necessitating sophisticated post analysis.

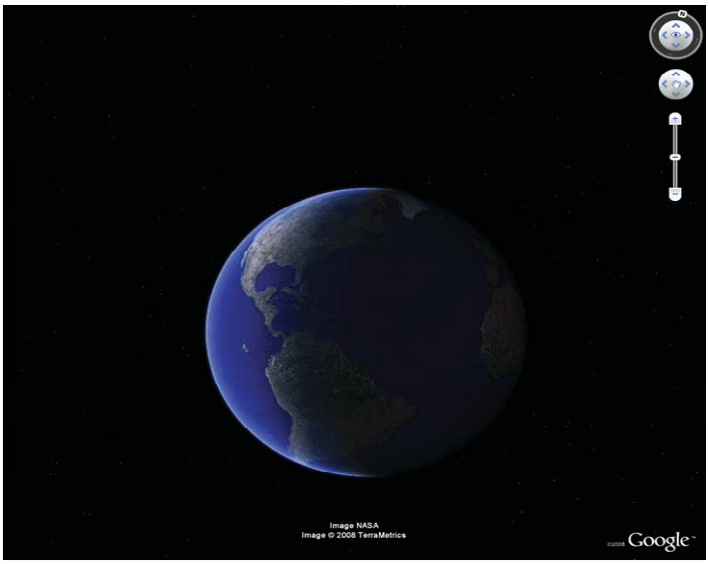
The upper red line represents the gross channel which includes all counts across the energy range beginning from a few keV to about 5 MeV. The blue line is the Bismuth-214 and the yellow line is Potassium-40. Anytime all three of these three forementioned lines drop simultaneously for a sustained period you're onto a possible find and it gets your attention immediately. Due to the low number of counts in the thorium channel represented by the green line, we never saw any significant deviations, as was expected for this less mobile radionuclide.

The figures below present snapshots of raw data logged over one prospective geological site that supported the characteristic radiological anomaly concepts described herein. As can be seen in the charted data below, the gross channel presents the most visible evidence of a background anomaly where the average background dropped from approximately 750 cps (counts per second) down to a low of 552 cps and then stabilized once more around 750 cps. The uranium and potassium channels followed a similar pattern but with far fewer counts. As can be seen in the last graph, the high energy thorium channel received very few counts and was relatively stable throughout the entire cycle.



Viewing Data On Google Earth

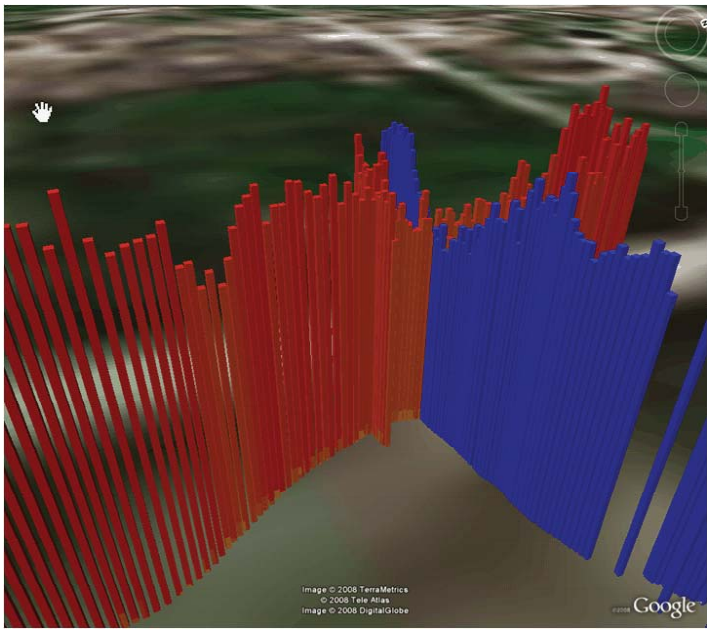
Once the stored csv data file is converted to KML by using Ludlum's utility program, simply click on the new KML file and your PC will automatically open your Web browser and go directly to the Google Earth site. Once on that site, you'll find yourself thousands of miles in outer space staring at the earth in globe form just like an astronaut. Next thing you know, the program automatically rockets you in towards the earth, lands you softly directly on the spot where you performed the survey and superimposes the data in graph form With the KML file in hand your just one click away from seeing your radiological survey graph from a birds-eye view - how cool is that? It not only makes using the program supremely easy but it's fun too!



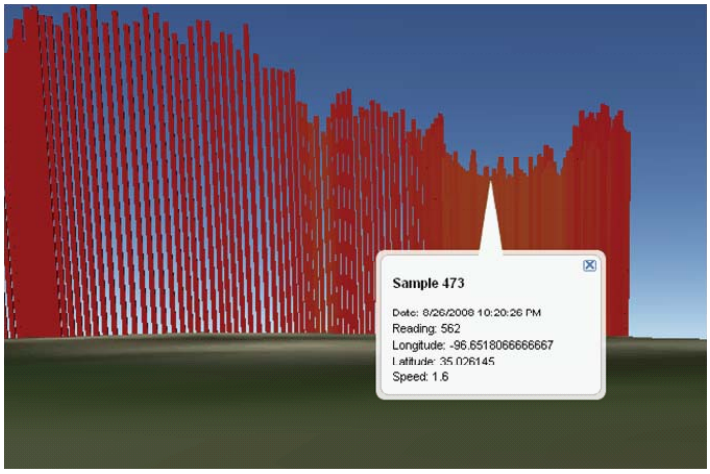
Google Earth readying itself before zooming into your survey location

But wait, there's still more. Overlaying data on the map is just one of the benefits Google Earth delivers. Another benefit is that it allows the user to zoom, rotate and tilt the picture to optimize the view using the controls located on the upper right hand side of the screen.

Another surprising benefit not available using older traditional methods is the ability to superimpose multiple data files simultaneously. The next picture presents two data files (shown as two different colors) superimposed on the map. By tilting and zooming we get a better perspective of the suppressed background area that was not as apparent while collecting the data.



And yet more… Google Earth has an Explorer-like interface panel that permits the user to select which log data files to including any or all of the four isotopic channels within each data file. Through a little trial and error you are able to locate specific points along the displayed graph by picking individual records in the Explorer interface. Once selected, a popup balloon containing the captured record is displayed as shown below. It would be really cool to simply click on the graphic bar directly and extract the data. Hopefully Google will add this capability sometime in the future.



Given the powerful data collection and free graphing capability, prospectors needn't be the ones collecting the data as in the past when using older technologies. People with no prospecting experience could easily be trained to collect data by surveying areas in a grid fashion thereby minimizing the prospector's valuable time and costs even further. With the data in hand, the fun begins with impressive results just a few clicks away.