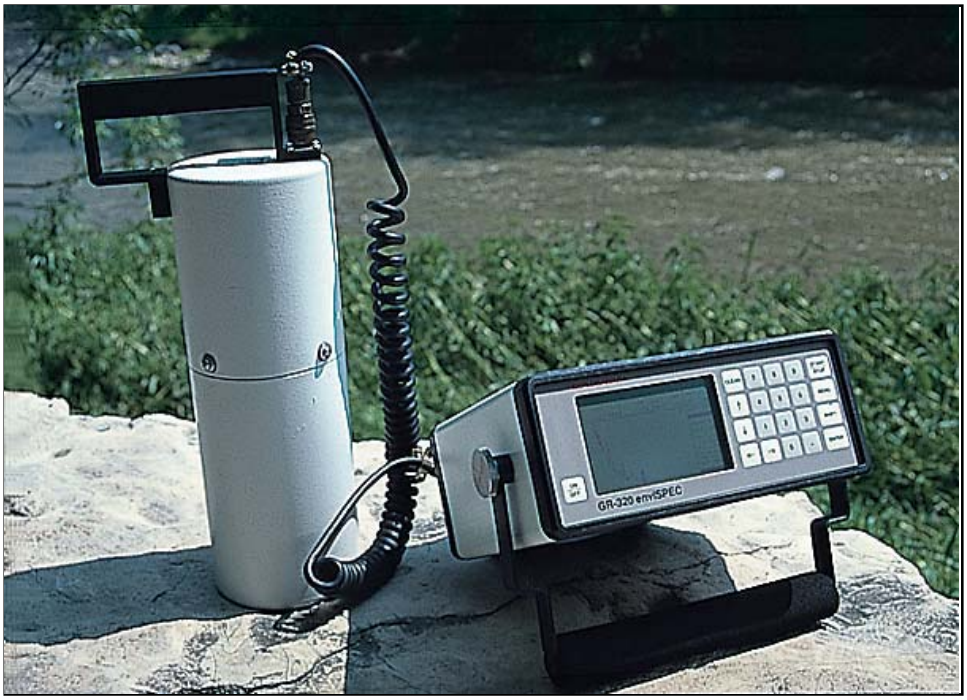
# EXPLORANIUM
RADIATION DETECTION SYSTEMS

FUGRO

attention
- ✔ Exploration Geologists And Geophysicists
- ✔ Mineral Exploration Companies
- ✔ Surficial And Bedrock Mapping Geologists
- ✔ Individual Prospectors

# TO FIND DEPOSITS OF GOLD, SILVER, COPPER, LEAD, ZINC, RARE EARTH ELEMENTS AND MUCH MORE...




## GR-320 enviSPEC

PORTABLE GAMMA RAY SPECTROMETER

# ...USE A POWERFUL NEW GEOLOGICAL MAPPING AND MINERAL EXPLORATION TOOL.

***THE SOPHISTICATED GR-320 PORTABLE GAMMA RAY SPECTROMETER IS A POWERFUL, EASY TO OPERATE AND ACCURATE INSTRUMENT WHICH PROVIDES REAL-TIME RESULTS IN THE FIELD!***

Worldwide, the demand for airborne and ground gamma ray spectrometric data is growing rapidly in direct response to increased awareness of the many practical applications to mapping, exploration and environmental concerns.

To be successful, today's mineral explorationist requires an extensive, and often expensive, exploration tool kit. A standard tool kit may contain many geological, geochemical and geophysical components including bedrock and surficial geology maps, topographic maps, mineral deposit databases, mineral assessment files, remotely sensed data, biogeochemistry, lithogeochemistry, hydrogeochemistry, soil chemistry, airborne and ground magnetic and electromagnetic surveys.

EXPLORANIUM THE WORLD LEADER IN AIRBORNE SPECTROMETERS, IS MAKING IT EASY TO ADD COST-EFFECTIVE GROUND GAMMA RAY SPECTROMETRY TO YOUR MAPPING AND EXPLORATION PROGRAMS.

- Allows you to accurately measure potassium, equivalent uranium and equivalent thorium concentrations in-situ, in real time.
- Minimizes the high costs associated with rock or soil sample collection, shipping, lab preparation and chemical analysis for these elements. The geochemical information provided by the GR-320 can maximize return on your investment.
- As demonstrated worldwide, the use of gamma ray spectrometry increases the likelihood of finding economic deposits of gold, silver, copper, lead, zinc, rare earth elements and many other commodities.

**EXPLORANIUM**
RADIATION DETECTION SYSTEMS

# WHY GR-320 vs. OTHERS

## 1. TECHNICALLY ADVANCED

### Automatic Spectrum Stabilization

The automatic gain stabilization technique implemented in the GR-320 eliminates spectral drift ensuring that the radio-elements are in the correct channels. This eliminates the guesswork associated with manual gain adjustments and ensures the reliability of the data from reading to reading and day to day.

### Internal Calibration Constants

The GR-320 uses constants determined on calibration pads, traceable to the GSC (Geological Survey of Canada), to calculate accurately the concentrations expressed in % potassium, and equivalent uranium and thorium in ppm.

### Large Data Storage

The R.O.I.s as well as the full spectrum for several day's work can be easily stored within the GR-320's internal memory. The data can be later downloaded via the RS-232 port to a computer using the supplied EXPLORE software for additional analysis.

### GPS Position Recording

The GR-320 can automatically record the position from a user's GPS receiver at each station and is included with each spectrometer measurement.

### Zero Dead Time

Using a fast analog-to-digital converter technique, the dead time is virtually reduced to zero.

### Standard Detector

A 21 cu.in. (0.35L) NaI crystal detector is supplied as standard for use in the portable mode. This is the best solution to obtain both good counting statistics and portability.

### Larger Detector Volumes

The GR-320 will accept up to 512 cu.in. (8L) of detector volume which will produce excellent results from land vehicles or light helicopters.

In these applications, the GR-320 can operate at cycle rates of up to once per second with the data being output in real time via the RS-232 port for use with data logging instruments such as the Exploranium GR-650 carborne radiometrics system.

The Exploranium GR-820 Airborne Spectrometer would be used for fixed wing or airborne applications requiring more sensitivity from very large detector volumes (up to 64L).

### LCD Graphic Display System

In addition to the easy to use set-up menus, the large format display provides a full view of the spectrum and all calculated results.

## 2. EASY-TO-USE

The technically advanced features in conjunction with the flexibility of the user friendly menus make it easier and faster to obtain more measurements with better accuracy in less field time. The EXPLORE software enables the user to readily transfer the data into a spreadsheet, database or geophysical software imaging and mapping program. The importance of accurate, real-time answers while "on the outcrop" cannot be over emphasized!

## 3. RUGGED DESIGN

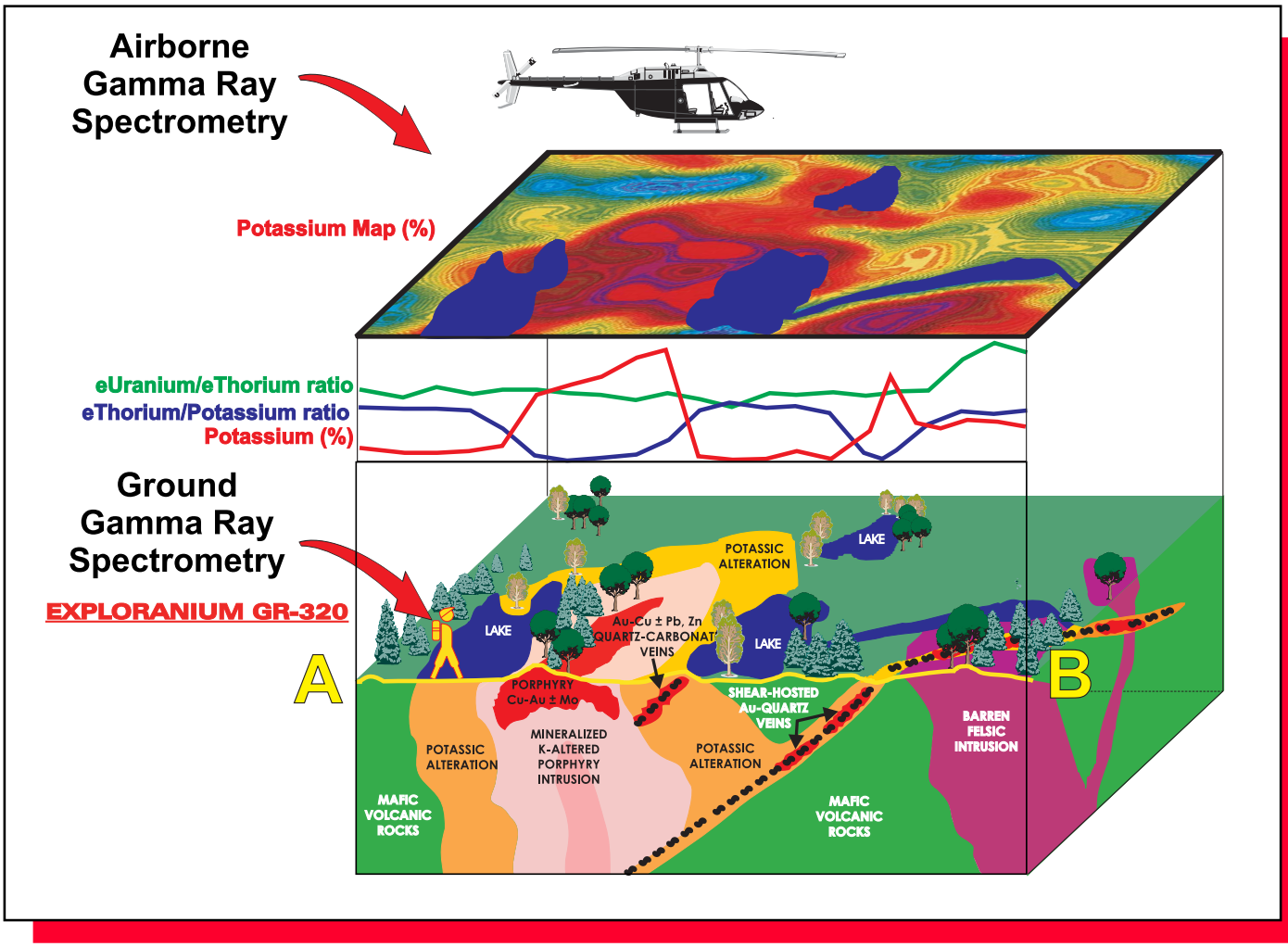
The rugged GR-320 console can be used in its own custom designed leather case or it can be transported in a backpack along with the detector.

## 4. TRAINING & SUPPORT

The system includes an operating manual as well as a practical "How To" manual describing field survey methods and interpretation.

Training seminars (1 hour to 2 days) are available in key mining countries, at conventions and to companies and groups as required.

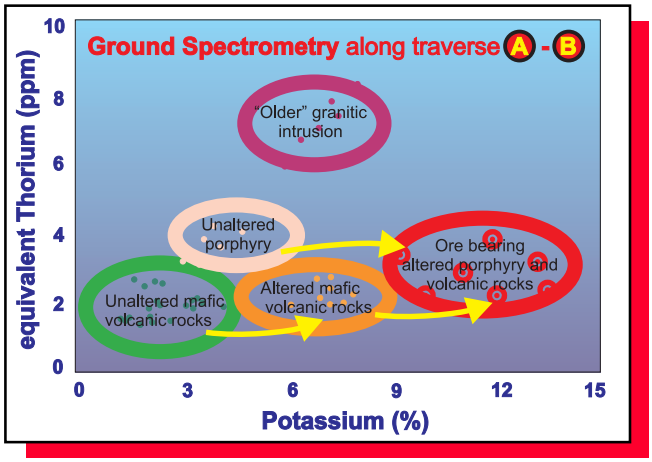
# MORE MEASUREMENTS, BETTER ACCURACY IN LESS FIELD TIME!




*Using gamma ray spectrometry, alteration associated with mineralization can be distinguished from barren rocks. In the illustration above, the unmineralized felsic intrusion has an elevated eU/eTh ratio and, although it contains elevated potassium, it lacks the characteristics eTH/K ratio low which, as the profiles indicate, fingerprint the vein and porphyry-hosted mineralization.*

***The GR-320 provides rapid and cost effective in-situ assays of K, eU and eTh and can be used as follow-up to an airborne survey, or as a stand alone ground technique.***

*Data is easily downloaded directly from the GR-320 using EXPLORE, for analysis in combination with other relevant information, such as bedrock lithology, soil geochemistry or other geophysical measurements. Graphs of eTh vs K (shown) or eU/eTh, help distinguish various barren and altered litholgies. In many cases, measurable increases in potassium alteration provide direct exploration vectors, regardless of K-mineralogy (biotite, muscovite, sericite, micocline, Kspar or other K-bearing minerals.*



## APPLICATIONS

- MINERAL EXPLORATION
- GEOLOGICAL MAPPING
- OIL & GAS EXPLORATION
- CORE LOGGING
- ENVIRONMENTAL MONITORING
- USED ON THE GROUND, IN VEHICLES & LIGHT HELICOPTERS

# GAMMA RAYS WILL COMPLEMENT YOUR OTHER METHODS

***Magnetic, electromagnetic, gravity and seismic techniques*** measure physical properties of the earth. Variations in magnetic character, conductivity or density tell us the depth, position and shape of rocks or mineral deposits, based on interpretive models. Depths to sources may be considerable - EM to hundreds of meters, Mag to tens of kilometers, gravity and seismic to hundreds of kilometers. However, relating the responses obtained to our understanding of the surface (or near-surface) geology can be difficult, especially where anomalies relate to buried sources, not exposed on the surface. We require additional geoscientific information, such as local rock properties, to constrain models used for interpretation - without these constraints, an unambiguous analysis is not possible.

***Gamma Ray Spectrometry, (GRS)*** provides a direct measurement of the surface of the earth, with no significant depth of penetration. This at-surface characteristic allows us to reliably relate the measured radioelement contrasts to mapped bedrock and surficial geology, and alteration associated with mineral deposits. All rocks, and materials derived from them are radioactive, containing detectable amounts of a variety of radioactive elements. A gamma ray spectrometer is designed to detect the gamma rays associated with these radioactive elements, and to accurately sort the detected gamma rays by their respective energies. It is this sorting ability which distinguishes the spectrometer from instruments which measure only total radioactivity.

***In practice, the combination of these deeper probing methods (mag and EM in particular) with the surface chemistry provided by GRS, gives us the most impact.***

# WHY DO WE NEED TO KNOW ABOUT K, U, TH?

Potassium, uranium and thorium are the three most abundant, naturally occurring radioactive elements. K is a major constituent of most rocks and is the predominant alteration element in most mineral deposits. Uranium and thorium are present in trace amounts, as mobile and immobile elements, respectively. As the concentration of these different radioelements varies between different rock types, we can use the information provided by a gamma ray spectrometer to map the rocks. Where the "normal" radioelement signature of the rocks is disrupted by a mineralizing system, corresponding radioelement anomalies provide direct exploration guidance.

Airborne methods provide valuable, systematic coverage of large areas. Ground spectrometry greatly improves the resolution of individual radioelement sources. By relating radioelement variations measured by a properly calibrated ground spectrometer to relevent lithogeochemical variations, based on a control group of samples, you can substantially reduce your analytical costs.

Ground surveys do not require a corresponding airborne survey. They are easily conducted by one person as a reconnaissance survey or using grid lines. The resulting geochemical information provides an important additional layer of information significantly improving bedrock and surficial mapping and ore-vectoring.

# GR-320 enviSPEC FEATURES

- 256/512 channel operation: software selectable.
- One or two detector input: size range of 21 to 512 cu. ins.
- Automatic spectrum stabilization: internal or natural isotope.
- 8 regions-of-interest set from the keyboard.
- High linearity ADC with zero dead time.
- Choice of coincidence or anti-coincidence operation.
- Exposure rate mode + isotope analysis for environmental data.
- Assay mode for geophysical data - %K, ppm eU, eTh.
- Large internal data memory with input capability for GPS position.
- RS-232 serial digital output facilitates spectrum, ROI and GPS data.
- Rechargeable (standard) or alkaline battery operation.
- Full remote control capability.
- User applications programs supplied.
- Background, K, U and Th calibration using traceable test pads.

# GR-320 enviSPEC SPECIFICATIONS

## Geophysical/Environmental Gamma Ray Spectrometer

***256/512 Channel Operation:*** For most geophysical applications, the 256 channel operation is fully adequate. However, the extra precision provided by the 512 channel capability, expecially in the lower regions of the spectrum, offers significant improvements in data resolution for the environmental sector. This 256/512 channel option is software selectable from the GR-320 keyboard.

***Two Detector Capability:*** In most portable applications a single 21 cubic inch sodium-iodide detector is adequate. However, in surface vehicle, helicopter and aircraft applications, larger crystals are required. The GR-320 can support detector packs of up to 512 cu.in.

***Automatic Spectrum Stabilization:*** The operator may select to stabilize the system using an internal Cesium source, or choose a naturally occurring isotope at the site of operation. In the local isotope mode, the system automatically accumulates until the isotope data is useable for gain control.

***Calibration:*** Exploranium calibrates each spectrometer on test pads traceable to GSC standards to assure the accuracy of each instrument.

***Assay Mode:*** Using internal calibration constants, the GR-320 measures concentrations in %K, or ppm of U and Th.

***Regions-of-Interest:*** Up to 8 ROIs may be set from the system keyboard.

***Exposure Rate:*** For environmental applications, the GR-320 does automatic natural isotope spectrum stripping, and then carries out a full peak analysis to identify any isotopes in the stripped spectrum. The individual isotope exposure rate is then computed by using internal calibration data.

***High Linearity ADC:*** The GR-320 uses a unique technique to achieve fast, zero dead time analog-to-digital conversion with excellent differential linearity. This capability is important in large detector/high count rate applications.

***Sample Time:*** From 1 to 9999 seconds.

***Coincidence:*** Either coincidence or anti-coincidence operation is possible when two detectors are used with the GR-320.

***GPS Data:*** The GR-320 has the capability to accept the location data from a portable GPS receiver. This position data is then stored in memory with the spectrometer data.

***Real Time Clock:*** A real time clock is built into the system.

***Data Storage:*** The GR-320 enables the operator to select combinations of ROI, spectra and GPS data to be stored in an internal memory (capacity 384 kbytes) or output via an RS-232 port. 690 full spectra or 3574 sets of ROI data can be stored.

***Display:*** An LCD graphics display is used to display computed data as well as full spectra data.

***Digital Output:*** Bidirectional serial (RS-232) output port with operation up to 19200 Baud is provided. Data is fully buffered so that 1/sec data transfer of full spectrum data does not interfere with data acquisition.

***Power:*** The GR-320 is powered by a rechargeable battery pack with built-in charger, or by 9-15V DC external power. The following power options are also available: a battery pack for operation with 6 "D" type alkaline batteries, and a power attachment permitting operation from 14-40V DC.

***CONSOLE MECHANICAL***

***Dimensions:*** 10" diameter x 9.5" width x 4" height (25.4 cm x 24.1 cm x 10.1 cm)

***Weight:*** 9lbs (4.08 kg)

***DETECTOR SPECIFICATIONS***

***GPS-21:*** Hand carry detector: 21 cu. ins. (0.35 litres), 4.5" diameter x 15.5 long (114 x 394 mm), 8lbs (3.5 kg)

***GPS-112:*** Portable detector: 112 cu. ins. (1.8 litres), 6" x 6" x 18" (152 x 152 x 457 mm), 28 lbs (12.7 kg)

***GPS-256:*** Vehicle borne: 256 cu. ins. (4.2 litres), 8.5" x 7" x 31" (216 x 178 x 787 mm), 53 lbs (24 kg)

***GPS-512:*** Vehicle/airborne: 512 cu. ins. (8.4 litres), 13" x 7" x 31" mm), 98 lbs (44 kg)

FUGRO INSTRUMENTS
21 Mellor Street
West Ryde NSW 2114
AUSTRALIA
Ph: +61 2 8878 9000
Fax: +61 2 8878 9012
Email: sales@fugroinstruments.com
Web: www.fugroinstruments.com