

Borehole Geophysics in Kimberlites

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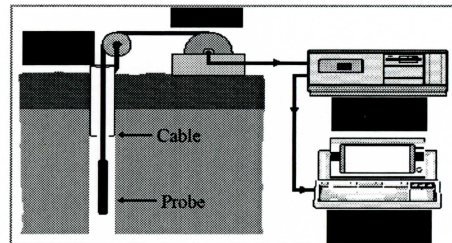
Borehole Geophysics:

- Geophysical measurements made by sensors housed inside a probe that is lowered down drill holes.
- Virtually any geophysical measurement made with surface or airborne systems can also be made in a borehole, in addition to methods suitable only to boreholes.

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- | | |
|------------------------------------|-------------------------|
| • Natural Gamma Ray | • Caliper |
| • Neutron | • Induced Polarization |
| • Density | • Temperature |
| • Magnetic Susceptibility | • Total field magnetics |
| • Inductive Conductivity | • Orientation |
| • Resistivity | • EM |
| • Full wave-form acoustic Velocity | • Acoustic Tele-viewer |
| | • Camera |

Typical Borehole System



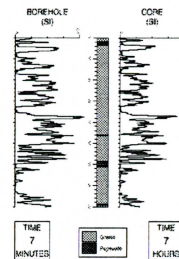
(from Killem, GSC, Exploration '97)

Why Use Borehole Geophysics?

- Quantitative and unbiased
- Efficient and cost effective
- Continuous measurements
- Immediate results
- Identifies non-visual characteristics
- Samples a larger volume

Efficient and Cost Effective

- Measurement Time:
 - Borehole: 7 minutes
 - Core: 7 hours
- Result:
 - The logs are virtually identical



Sample Volume

In a 300m NQ hole:

Core	Geophysics
Diameter - 7.5 cm	Diameter - 60 cm
Volume = 1.36 m ³	Volume = 85 m ³

Applications

- Quantitative definition of lithologies
- Accurate delineation of geological lithologies and kimberlite facies
- Invaluable where core is non-existent/missing
- Provides geotechnical information for mining engineering
- Key in developing accurate 3-D ore distribution models
- Exploit contrasts for exploration

Kimberlite Identification

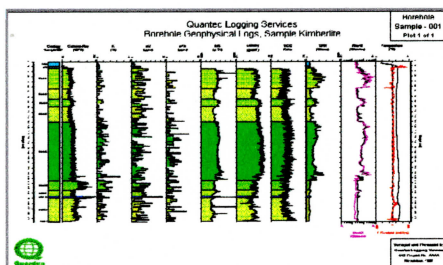
- “Five subtly different kimberlite types (not identified in chips and two types not easily identified in thin section) were uniquely identified using a diagnostic neutron-gamma cross-plot.”

– Gavin Selfe, Anglo American Corporation of South Africa, Exploration Geophysics, 1997

Physical Property Models

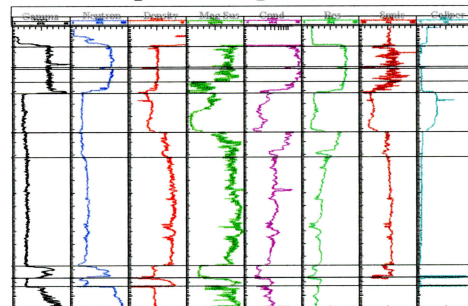
- Borehole logging is an efficient, cost effective method of making in situ physical property measurements
- Through identification of physical property contrasts, more informed decisions regarding appropriate surface geophysical techniques may be employed to locate or delineate similar subsurface structures

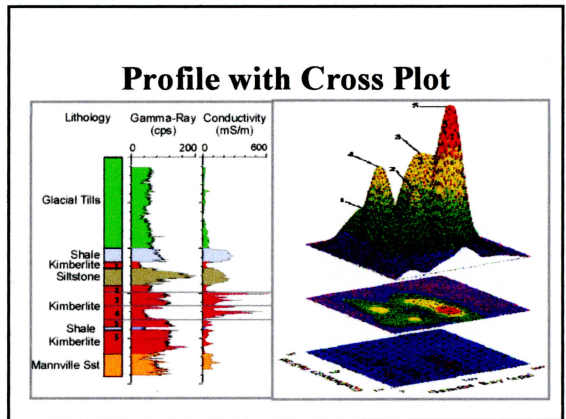
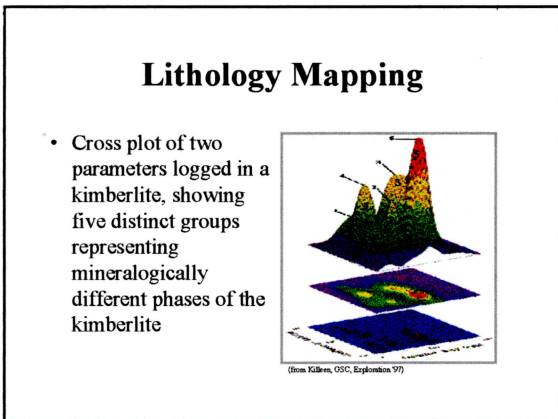
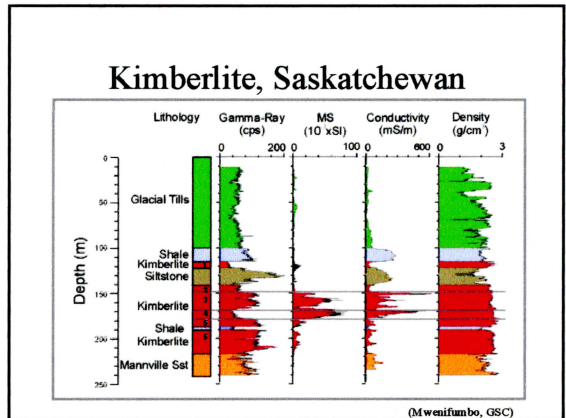
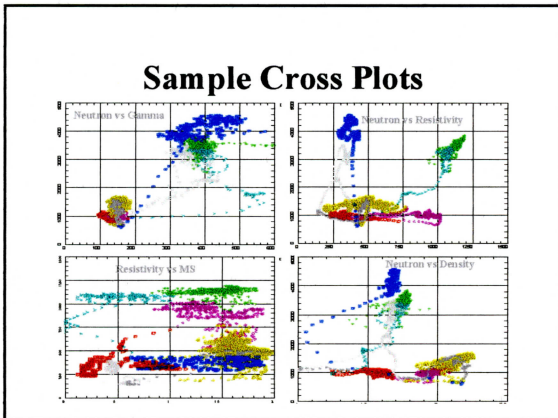
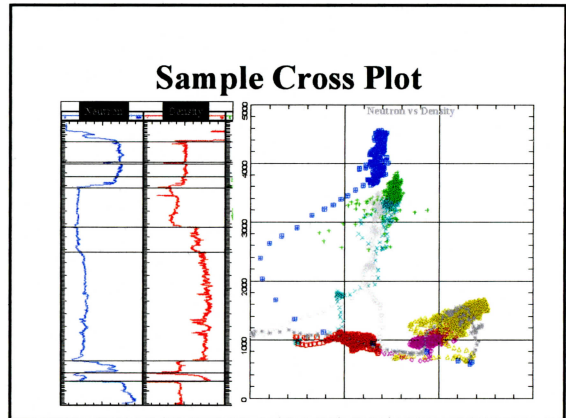
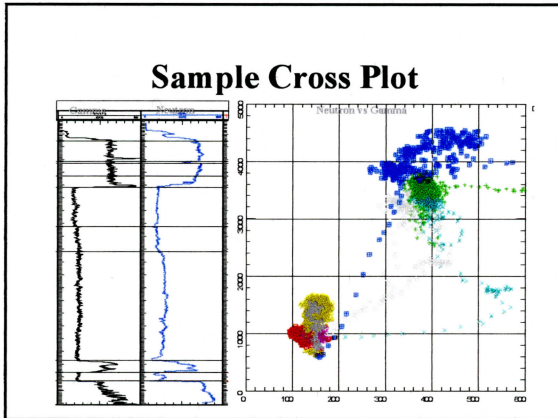
Lithology Delineation



Physical property logs can accurately delineate lithologic units

Sample Composite Plot





Two Stage Procedure

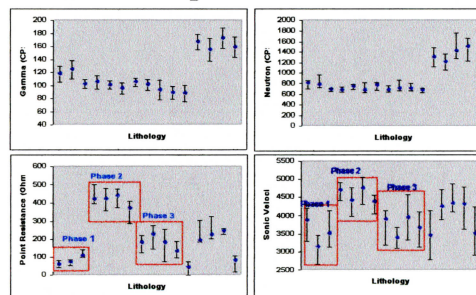
One:

- Statistical characterization: means or medians, standard deviations or spreads
distributions of each petrophysical logging parameter for each lithology is based on a representative control data set.

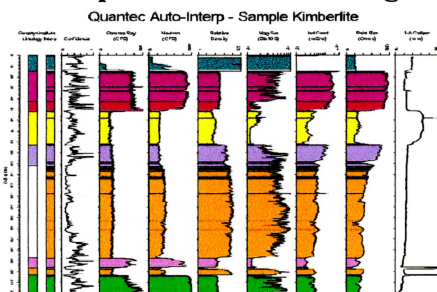
Two:

- Discrimination, in which data points are assigned to the "nearest" control class in multi-parameter space.

Sample Statistics



Sample of Predictive Logs



Automatic Interpretation

- Automatic interpretation software performs rapid analysis of multi-parameter logs and expedites presentation of interpreted results in a meaningful form
- The algorithm exploits the contrasts in petrophysical signatures between different lithologies

Summary: Physical Property Logging

- Quantitative definition of lithologies
- Accurate delineation of geological lithologies and kimberlite facies
- Invaluable where core is non-existent/missing
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FOR MORE INFO:

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