

National Mining Conclave - 2024, Bengaluru

28 - 29 June
2024

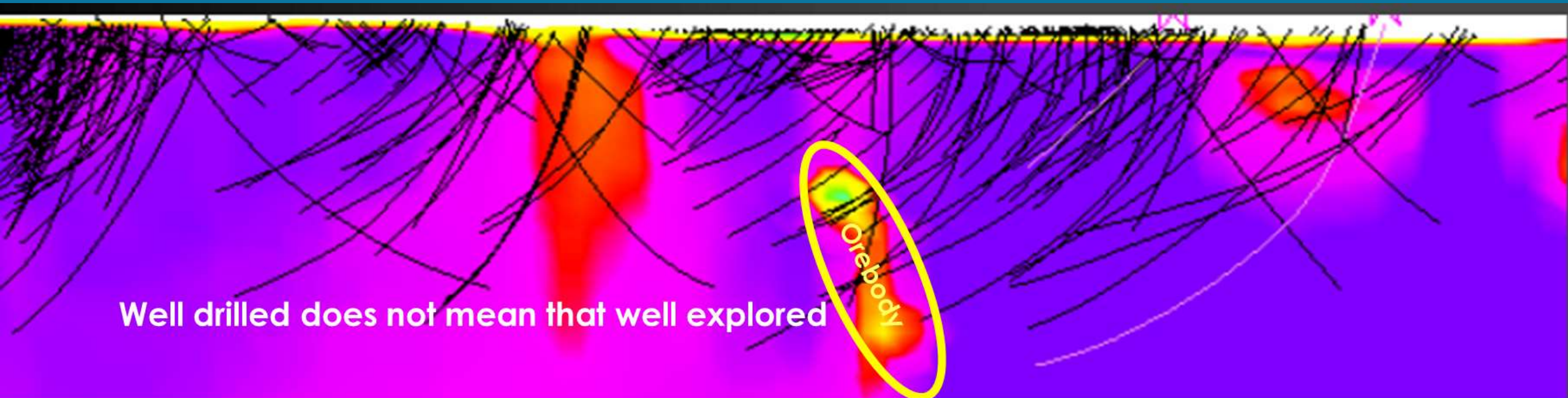


Advanced Geophysical Technology - Lowering Risk in Mineral Exploration

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Founder - GeoCube Consulting LLP (2019)



Well drilled does not mean that well explored

Key Objectives of Exploration

Greenfields:

Discover, Delineate and Develop Large Long-Life Resources in a Safe, Sustainable & Profitable Manner.

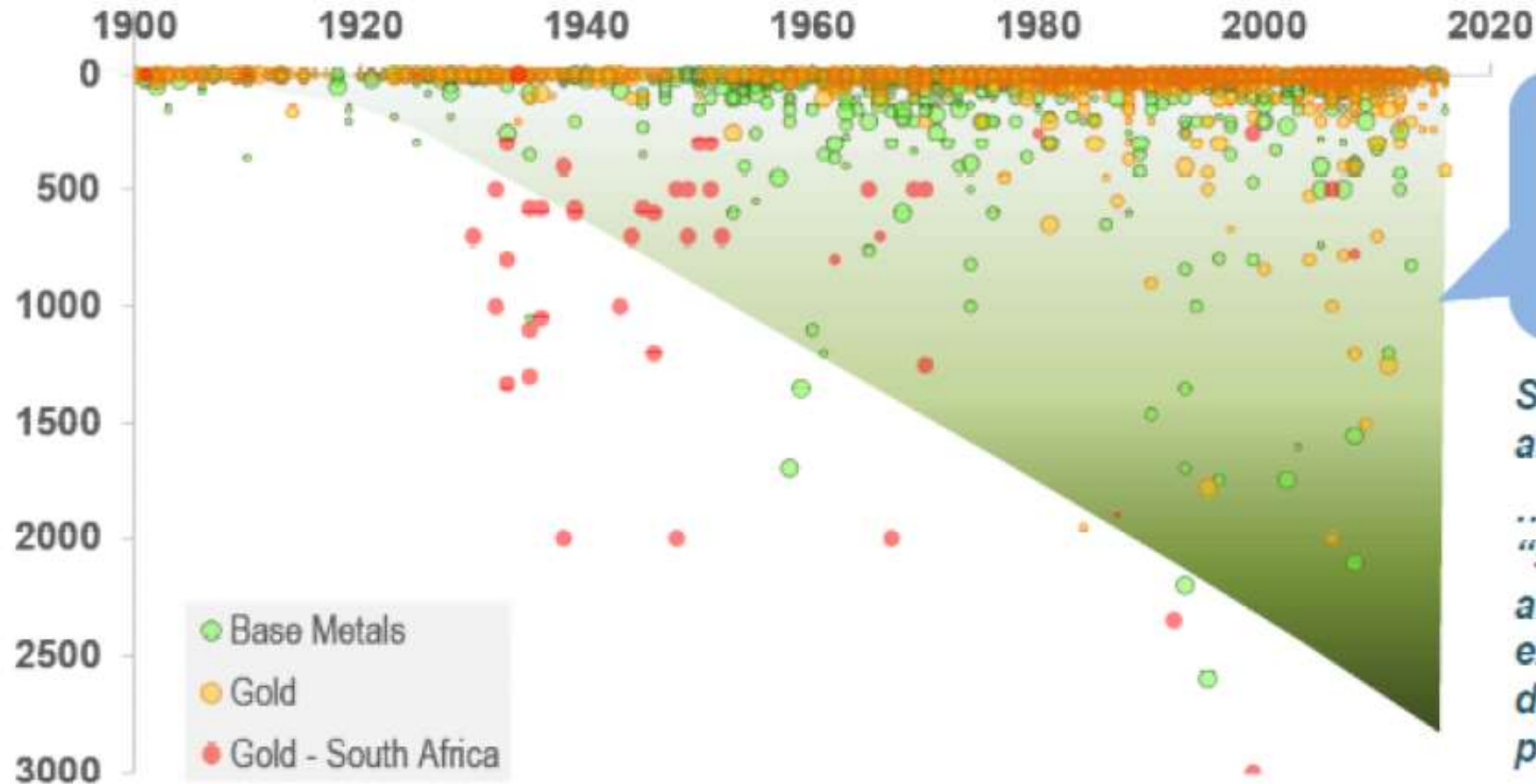
- Innovative targeting
- Technology Application
- Commercial Risk Management

Brownfields

Find hidden value in the existing Asset.

- Keep adding resources regularly
- Find out high grade pockets

Go Deep



Industry is progressively looking under deeper cover over time

*Such deposits are harder to find ... but this is a "slow-burn" story and **doesn't** explain the rapid decline in recent performance*

Depth (Metres)

Note: Size of the bubble refers to Moderate, Major and Giant discoveries
Analysis excludes Nickel laterites

Source: MinEx Consulting © March 2017

Exploration Process

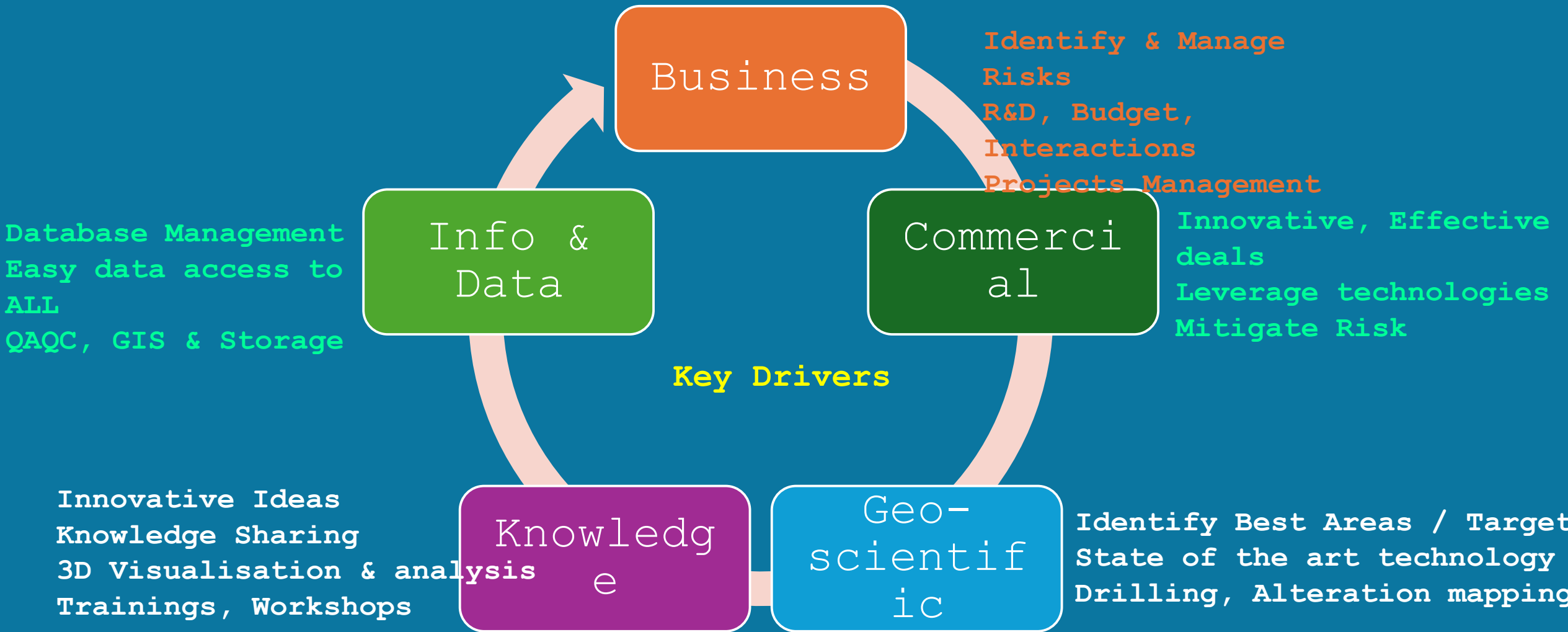
- ❖ Integrated - Innovative targeting (new ideas)
- ❖ Best Technology (quality data)
- ❖ Talented people (strong positive culture)
- ❖ Persistence (Pursuing a program, continually learning from experience and feeding that learning back into the targeting and exploration of each new project)



Key Components

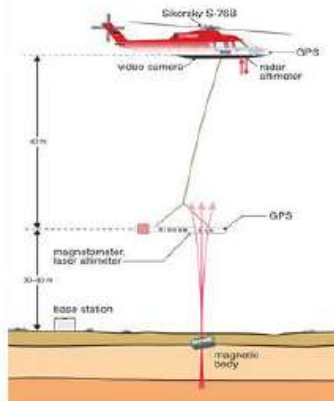
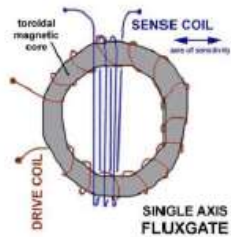
- ✓ Right Areas > best ground
- ✓ Right Ideas > best interpretation
- ✓ Right Technologies > innovation and distinctive capabilities
- ✓ Talented people > Strong positive culture team
 - ❖ *Maximise number of quality opportunities*
 - ❖ *Minimise risk*
 - ❖ *Minimise cost*
 - ❖ *Minimise time / project life-cycles*

Exploration Management

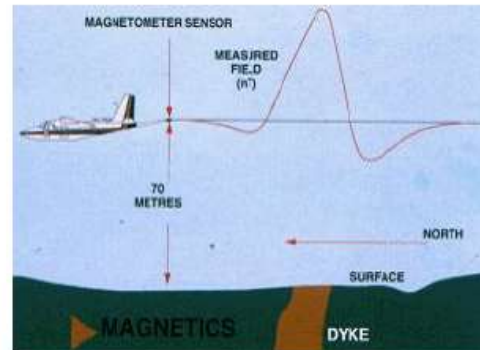
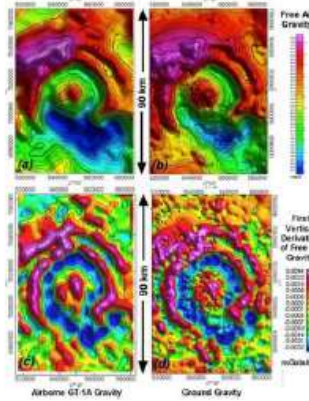


Geophysical Technology

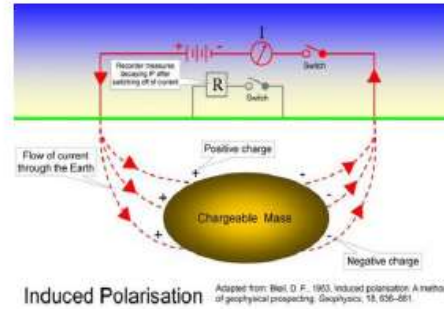
Magnetics



Gravity



IP

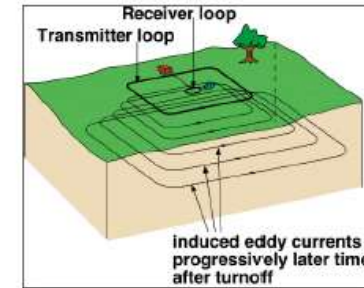
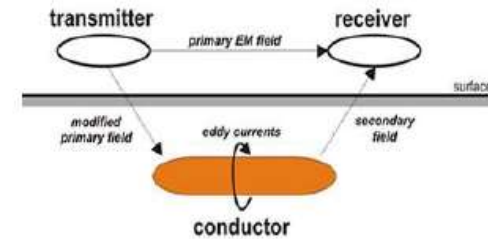


Radiometrics



EM

General principle of EM surveying



Advancements in Geophysical Prospecting

Improved Instrumentation:

- ✓ Resolution Enhancement with higher sensitivity, design etc
- ✓ Development of sensors for Increased Power for deeper penetration

Improved Data Processing Techniques

- ✓ Huge data handling, data management & processing
- ✓ 3D Modeling
- ✓ Constrained & Joint Inversions

Improved Data Acquisition Techniques

- ✓ Quicker Data Acquisition using multi-channels, multi-sensors
- ✓ Use of drones and other aerial surveys
- ✓ Use of Borehole tools

Improved Data Integration

- ✓ Data Integration of multidisciplinary data, Visualisation
- ✓ Interpretation using AI and data analytics
- ✓ High quality targets generation

Over the last decade, many new improved geophysical technologies emerged for deep earth imaging

New Technology Infusion

- **GPS integrated Magnetic and Gravity Surveys** (Ground, Air, Drone Based)
- **Induced Polarisation - Resistivity Surveys** (High Power TX, Multi-electrode)
- **Electromagnetic Survey** (SMARTem, InfiniTEM, SQUID and DHEM)
- **Deep Earth Imaging Surveys - Integrated IP - MT** (Titan - 24, DIAS-32 etc)
- **Low flying Heliborne Surveys** (FTG, Magnetic gradients and TEM)
- **3D Modeling - Inversion / co-inversions** (Grav / Mag / EM / IP / MT)
- **Multi-disciplinary Interpretation – Data Integration**

Top down or Bottom up???

Company A - Top Down

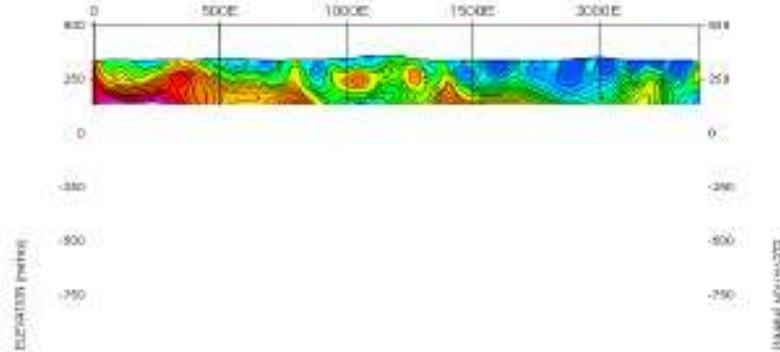
- Geology
- Geophysics (1 airborne + 1 ground survey)
- Geochemistry
- Admin
- Drilling 8 - 500m holes



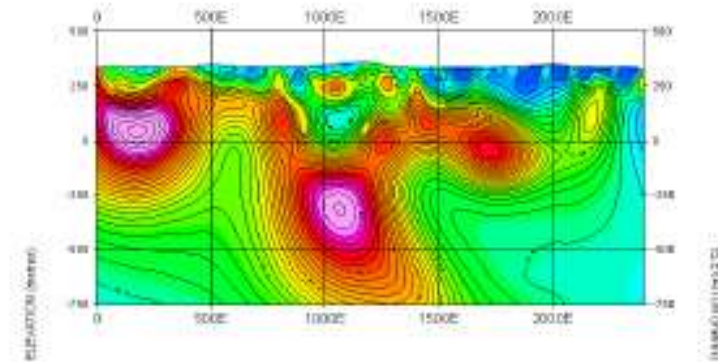
Company B - Bottom Up

- Geology
- Geophysics incl. Deep Imaging
- Geochemistry
- Admin
- Drilling 4 - 500m holes
1 - 1000m hole

LINE 800N - UNCONSTRAINED (SHARP MODEL) UBC 2D IP INVERSION



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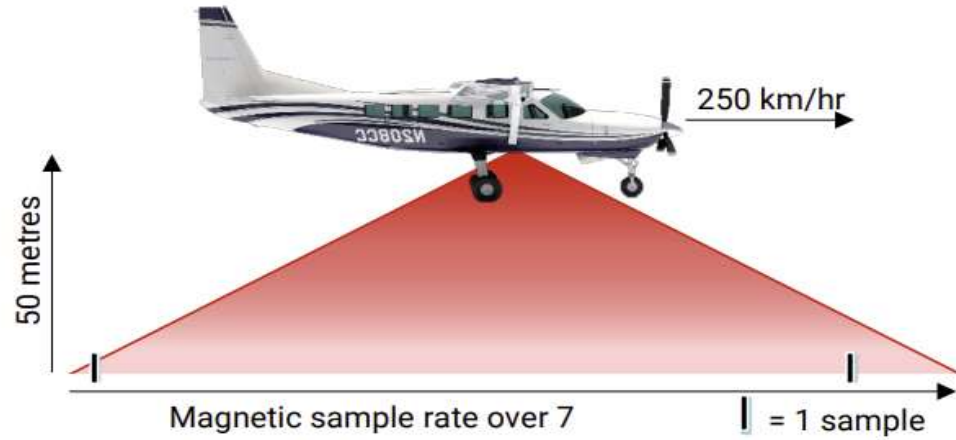


Drone Magnetometers



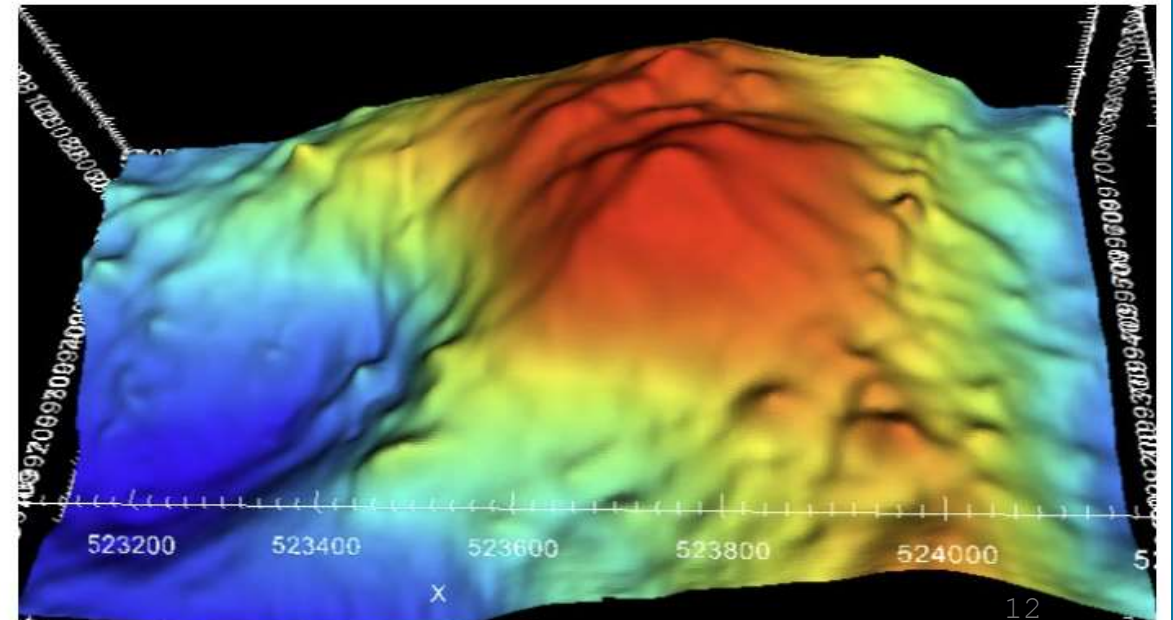
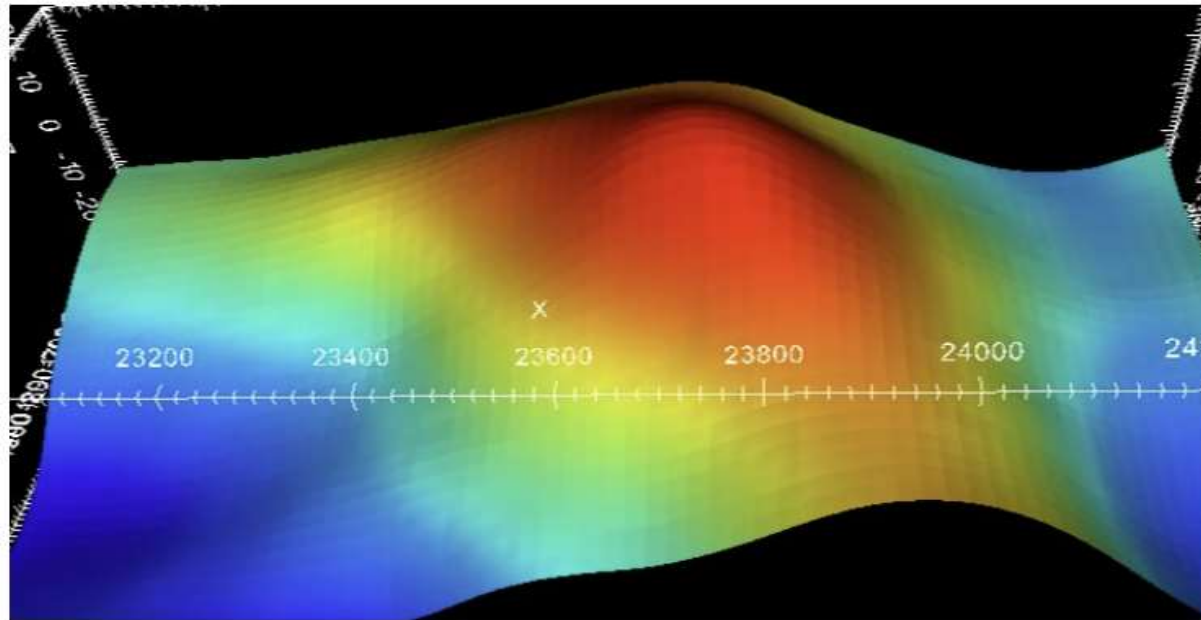
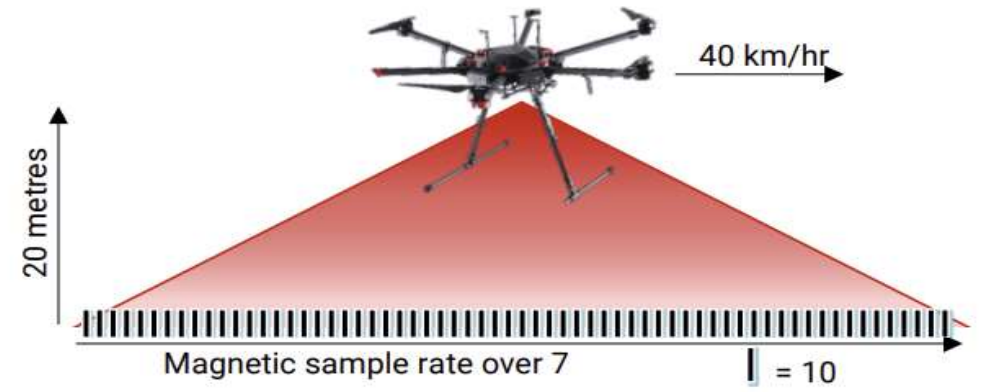
FIXED WING

50m flying height
100m line spacing
10 samples per second



UAV

25M flying height
25m spacing
1000 samples per second



Drone EM Surveys

The EM system has two operation options:

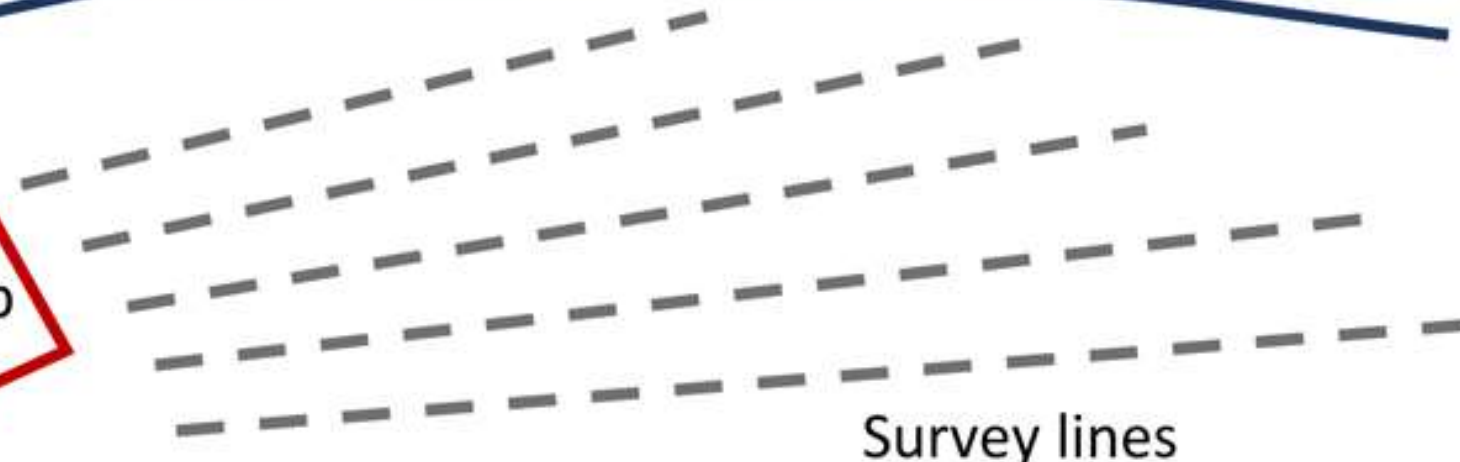
- ❖ The First Method uses a large loop on the ground as an EM source and

A) Either a small moving UAV-borne transmitter



Moving UAV-borne 3-component receiver

B) Or large fixed transmitter loop on the ground surface

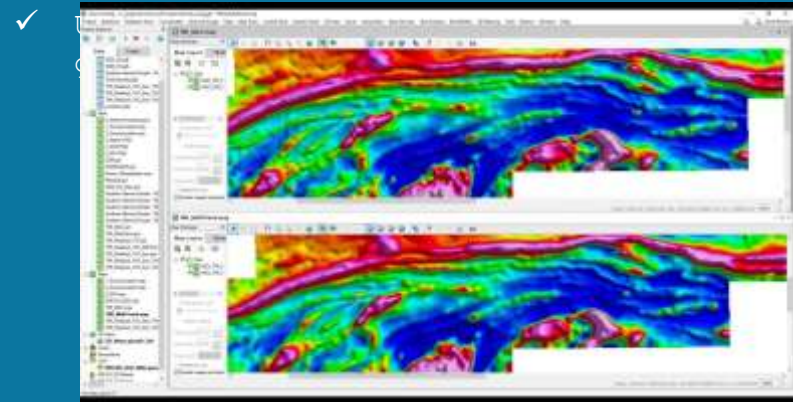
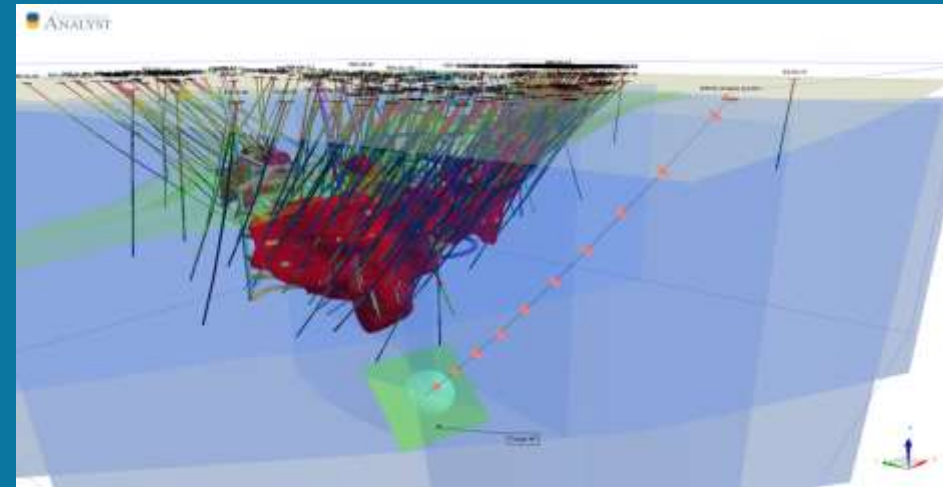


Survey lines

Software for Geophysics

Geoscience Analyst:

- ✓ A software package for geologic mapping, mineral exploration, and data analysis.
- ✓ Offers a wide range of tools for working with geologic data, including borehole data, geophysical data, and remote sensing imagery.
- ✓ Provides advanced features such as 3D modeling, geostatistics, and data integration.
- ✓ Offers integration with other software packages and data formats, including GIS software, databases, and modeling tools.

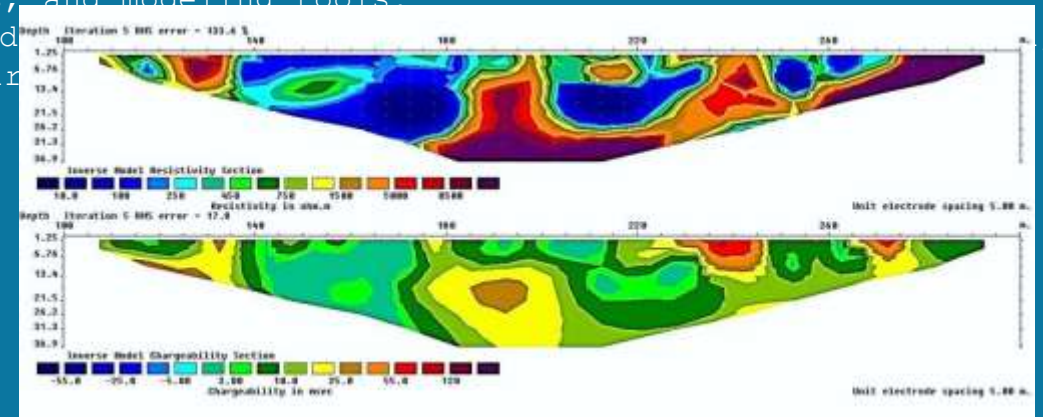


Geosoft Oasis Montaj:

- ✓ A comprehensive software package for geophysical data processing, analysis, and visualization.
- ✓ Offers a wide range of tools and algorithms for processing and interpreting data from various sources, including magnetic, electromagnetic, gravity, and seismic surveys.
- ✓ Provides advanced features such as 3D visualization, grid-based processing, and geospatial analysis.
- ✓ Offers integration with other software packages and data formats, including GIS software, databases, and modeling tools.
- ✓ Used by researchers and geophysicists in the fields of geothermal energy, environmental geophysics, and mineral exploration.

Res2Dinv and Res3Dinv

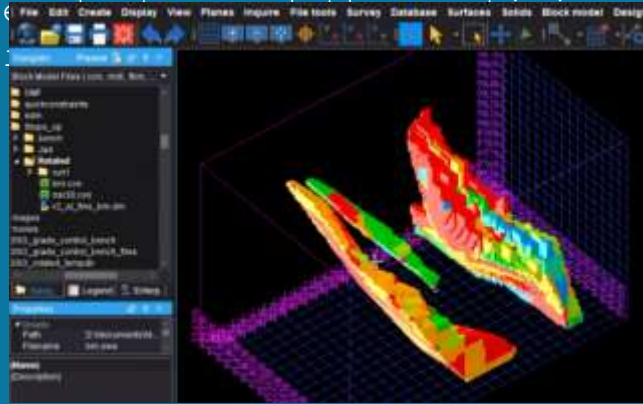
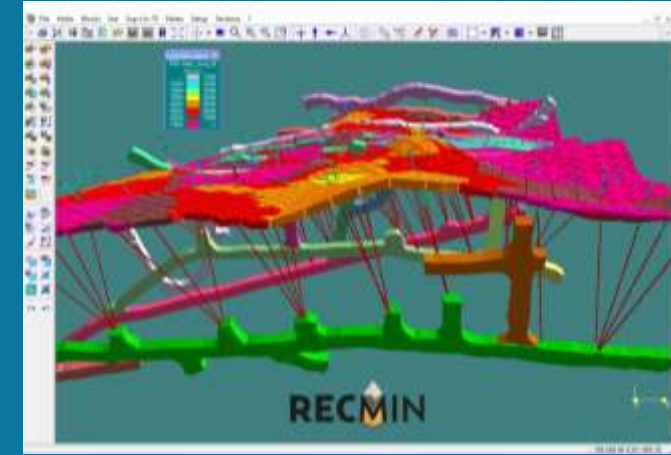
- ✓ A software package for resistivity and IP imaging offers a wide range of tools for data processing, inversion, and interpretation of geophysical data.
- ✓ Provides advanced features such as 2D and 3D modeling, tomography, and time-lapse monitoring.
- ✓ Offers integration with other software packages and data formats, including GIS software, databases, and modeling tools.
- ✓ Used by geophysicists, hydrogeologists, and mining professionals for a variety of applications, including mineral exploration, groundwater studies, and environmental monitoring.



Software for 3D Models

RecMin

- ✓ RecMin is a mining software that serves the professional of geology and mining engineering very well for the work of mining topography, geological modeling, estimation of mineral resources, mine design, ore control, etc.
- ✓ RecMin offers practical and intuitive tools to support the management and 3D design of the information of a mineral deposit when evaluating the exploitation of a mineral deposit, which helps to simplify various routines and tasks to the professional the time they spend, to have more time

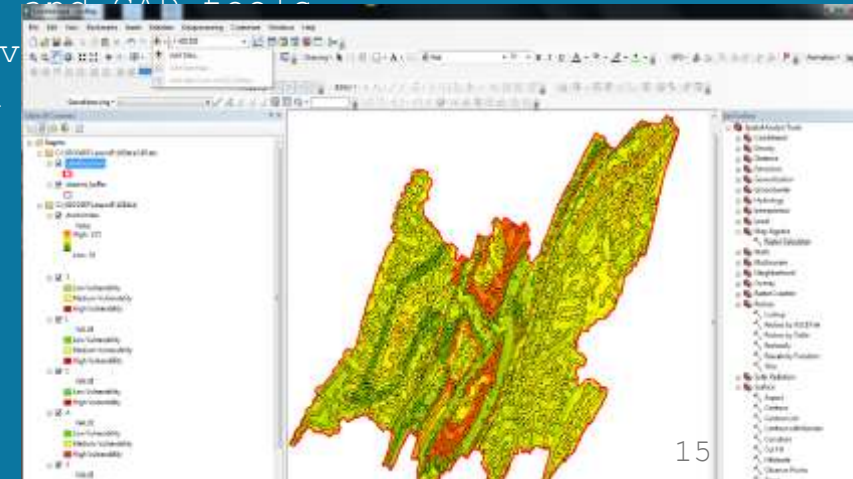


Surpac:

- ✓ A leading software package for geological modeling and mine planning
- ✓ 3D models of ore bodies, designing mine layouts, and optimizing mining operations
- ✓ Provides advanced features such as block modeling, geostatistics, and pit optimization
- ✓ Offers integration with other software packages and data formats, including GIS software, databases, and CAD tools
- ✓ Used by mining professionals in a variety of projects including open pit and underground projects

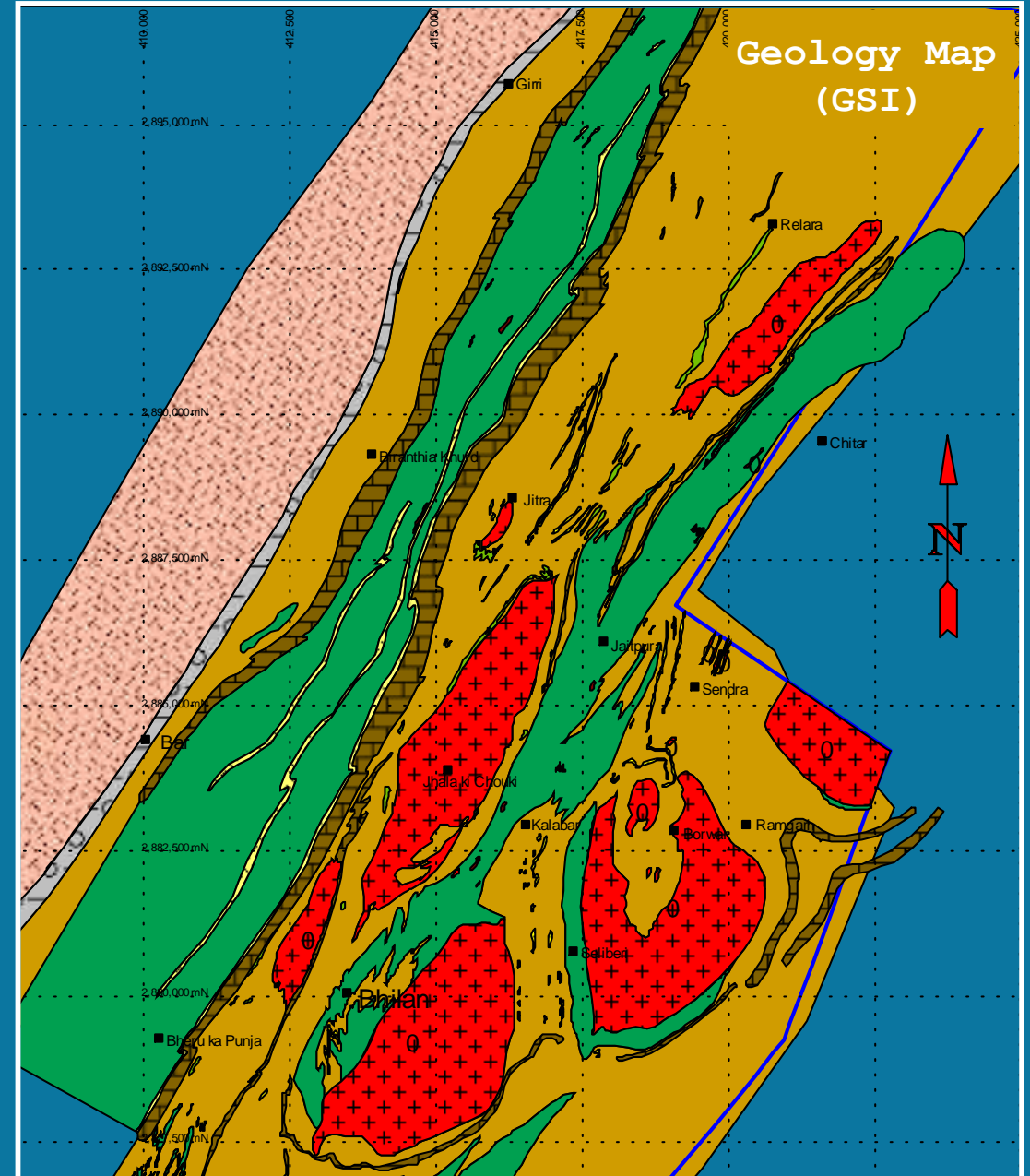
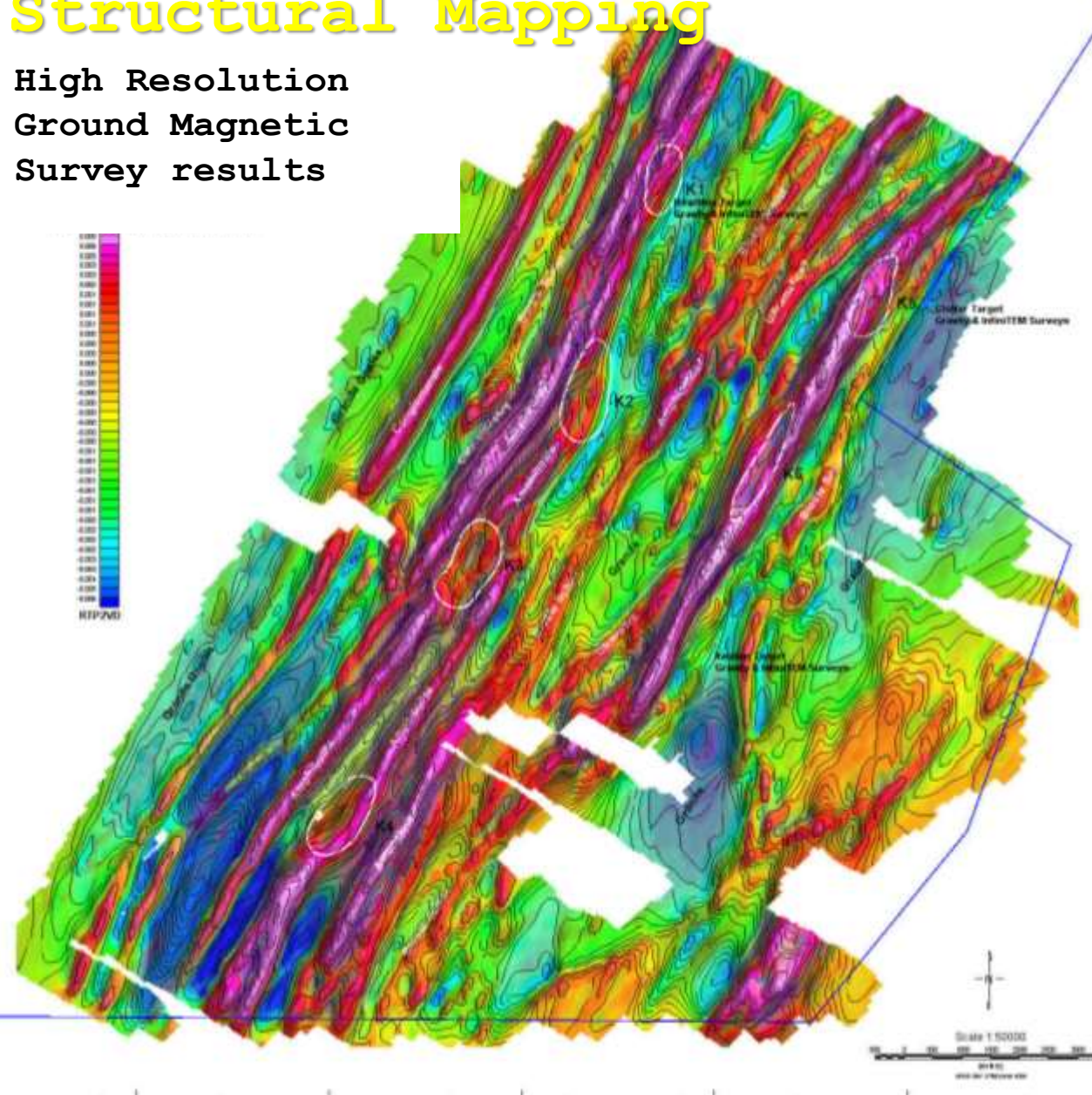
Arc Map and QGIS:

- ✓ Tools for creating, managing, analyzing, and displaying geographic data.
- ✓ Provides advanced features such as 3D visualization, spatial analysis, and data visualization
- ✓ Offers integration with other software packages and data formats, including databases, spreadsheets, and other GIS software
- ✓ planning natural resource management and environmental studies



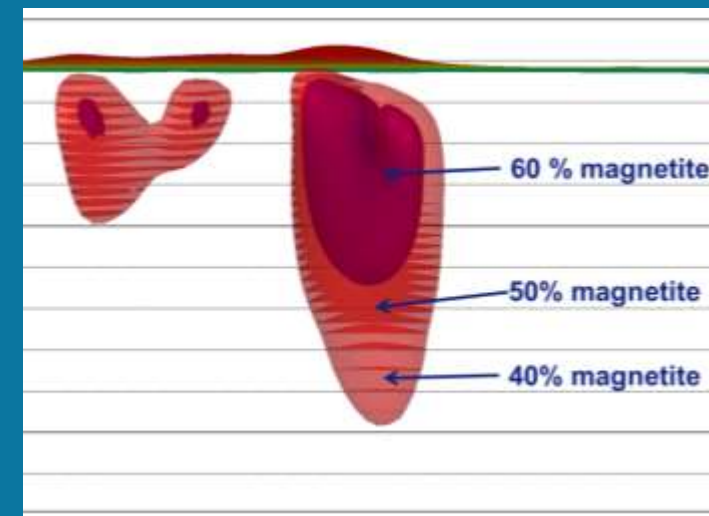
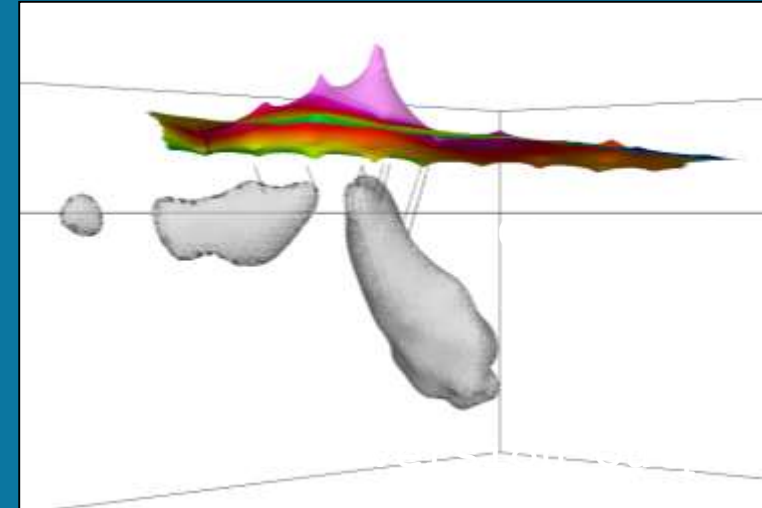
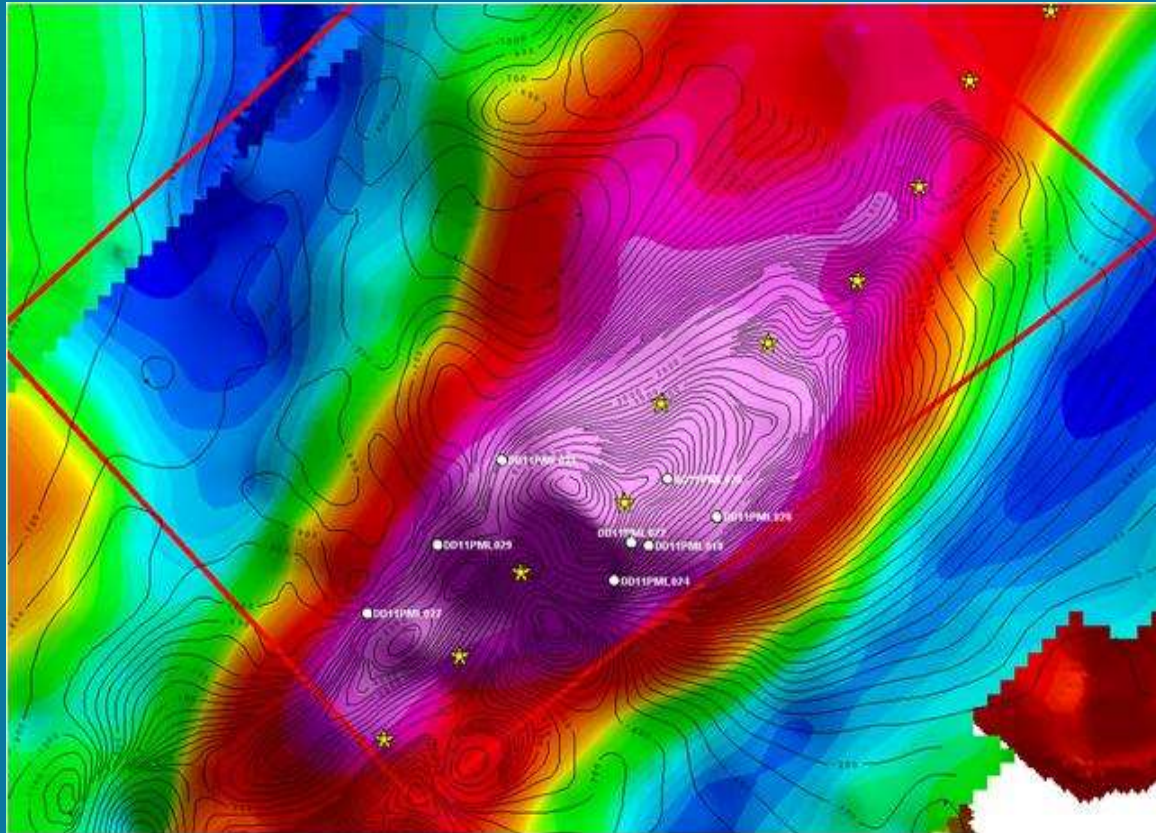
High Resolution Ground Mag Survey – Litho-Structural Mapping

High Resolution
Ground Magnetic
Survey results



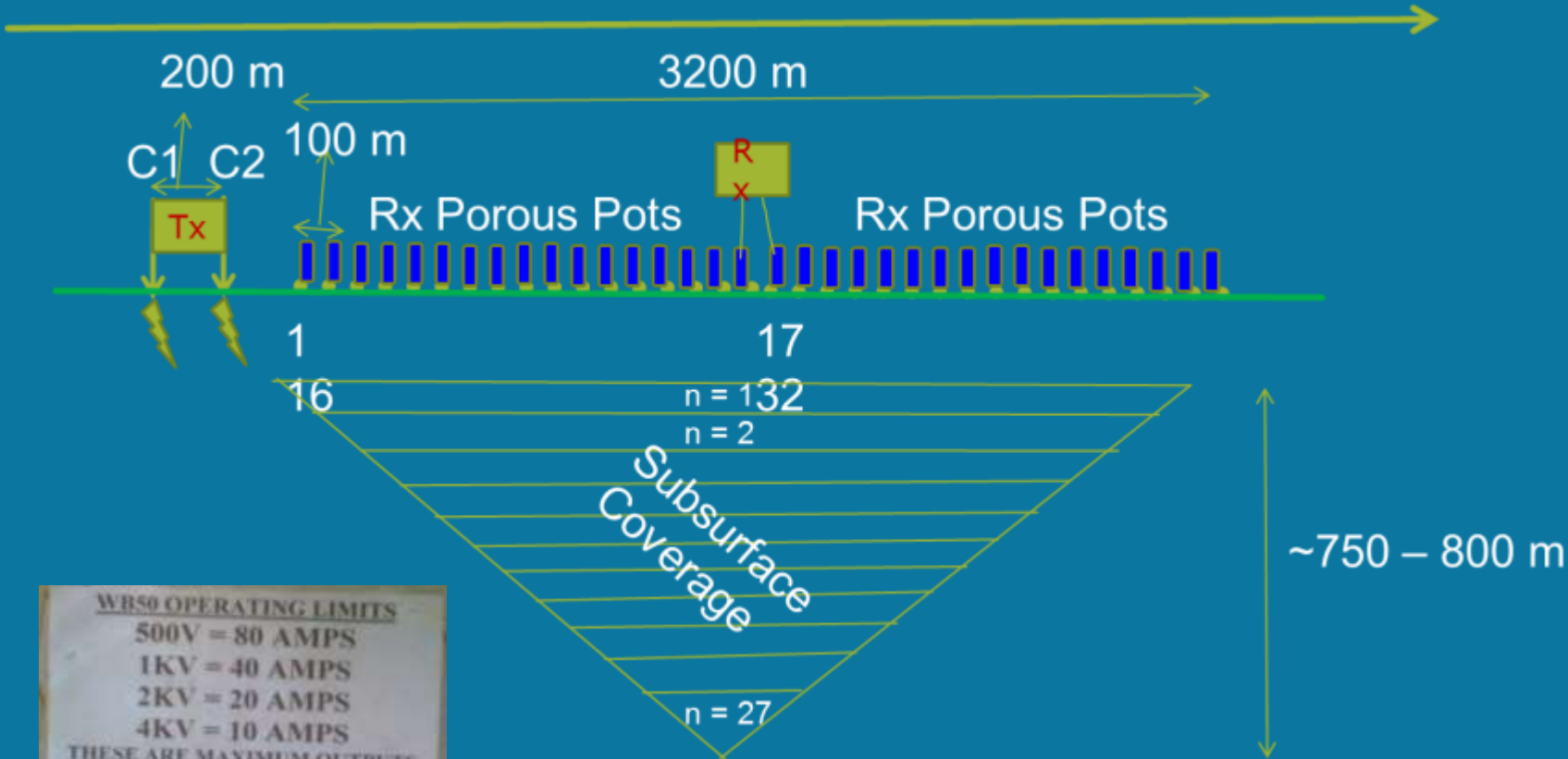
Magnetic - Gravity Modeling (3D Inversion)

Magnetite Tonnage - Grade Potential



32 Channel IP Resistivity Survey

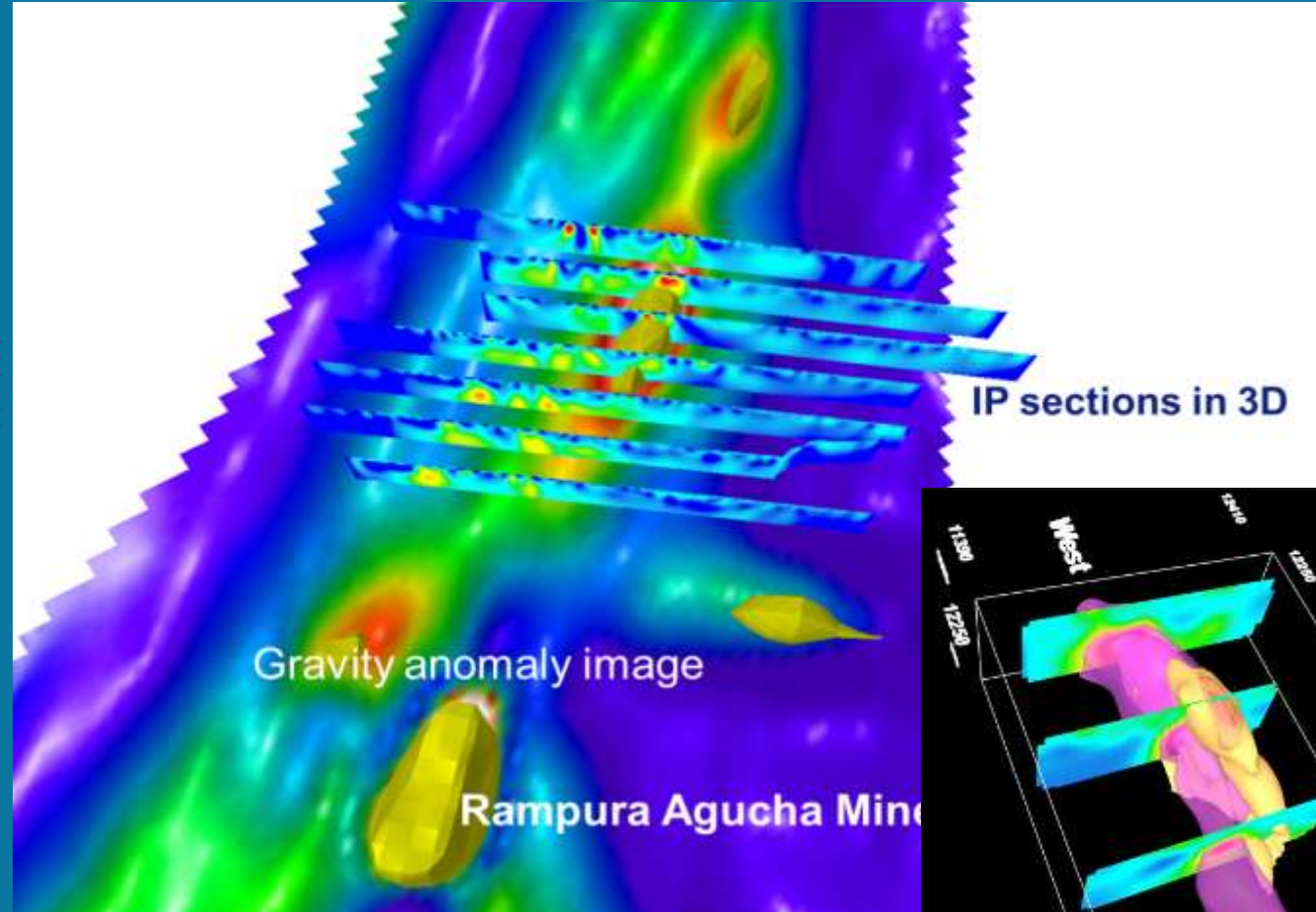
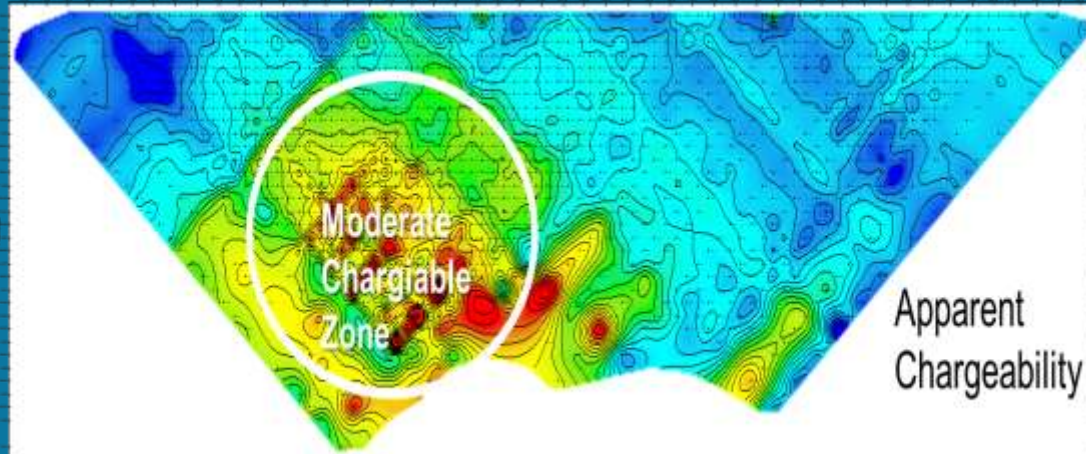
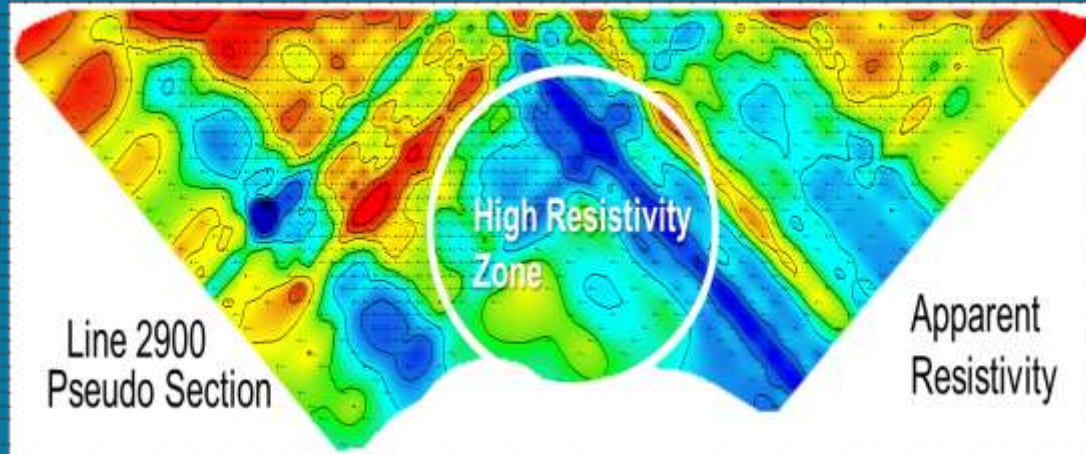
Full-waveform data Transmitter / receiver
 Flexible IP probes with varying transmitter and receiver separations.



WRS0 OPERATING LIMITS
 500V = 80 AMPS
 1KV = 40 AMPS
 2KV = 20 AMPS
 4KV = 10 AMPS
THESE ARE MAXIMUM OUTPUTS
 NORMAL OPERATION LEVELS
 WILL BE LOWER.

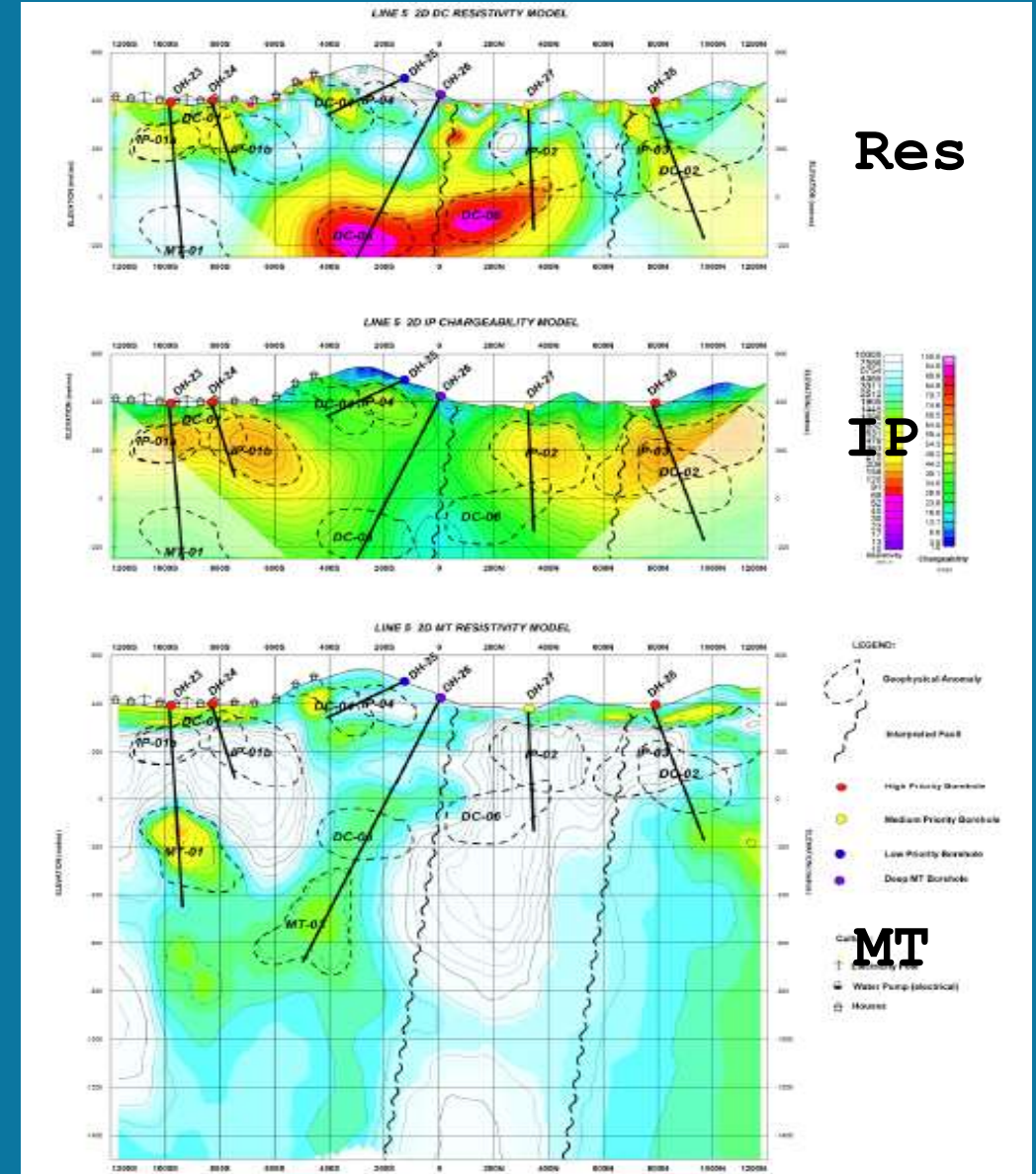
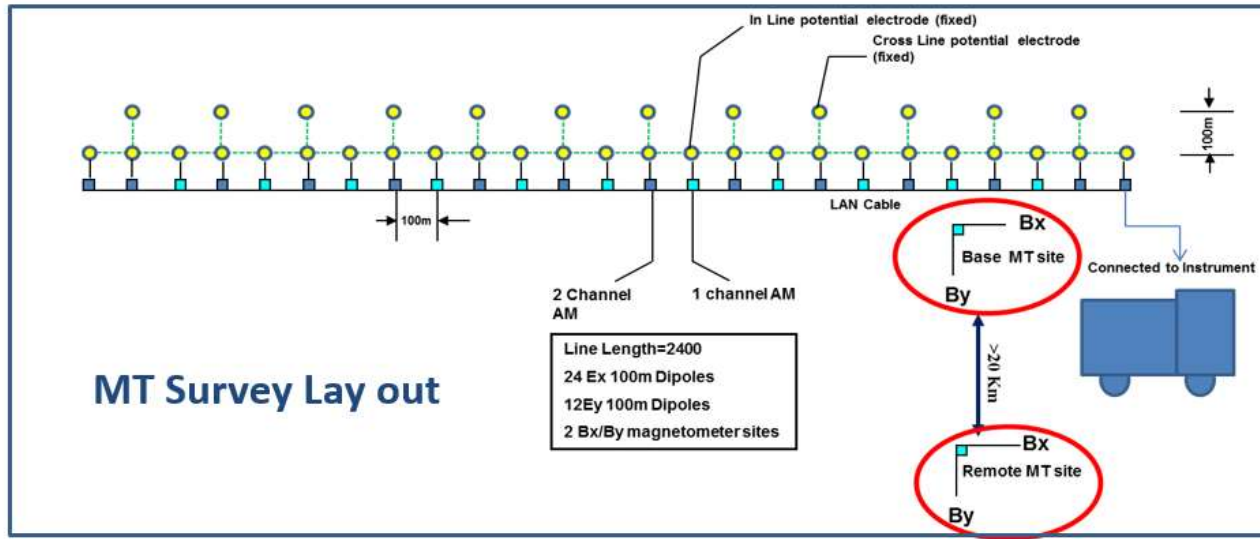
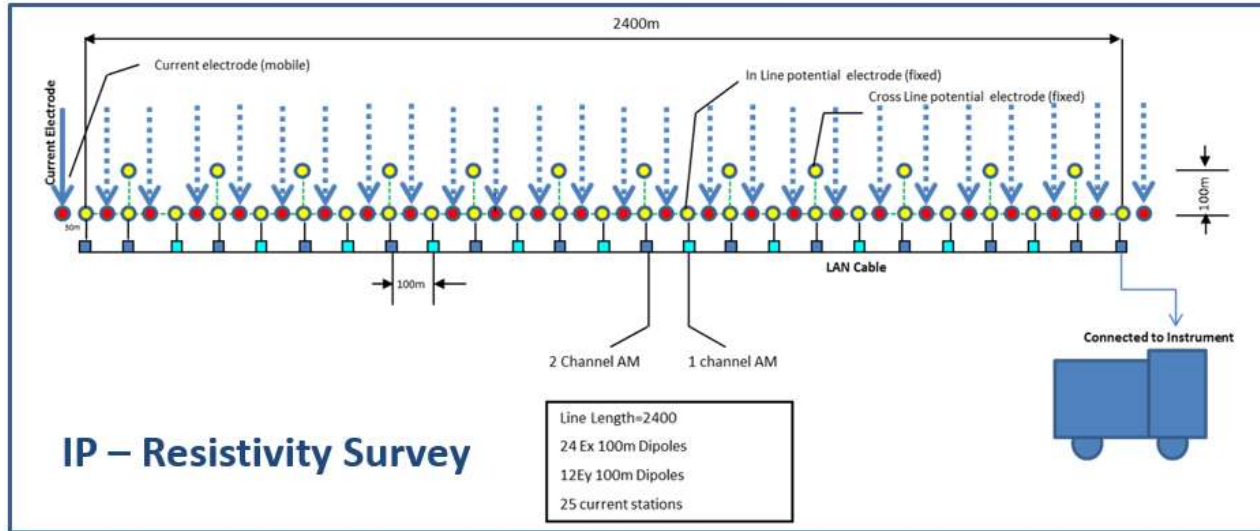


IP Results



Titan – 24 DCIP & MT (Deep Earth)

Survey Layout

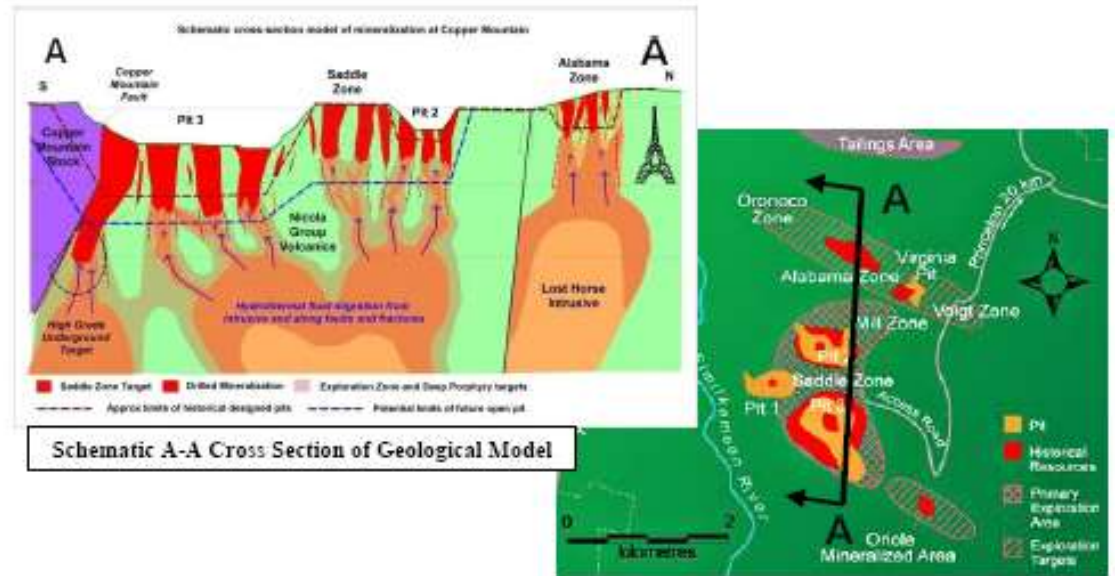
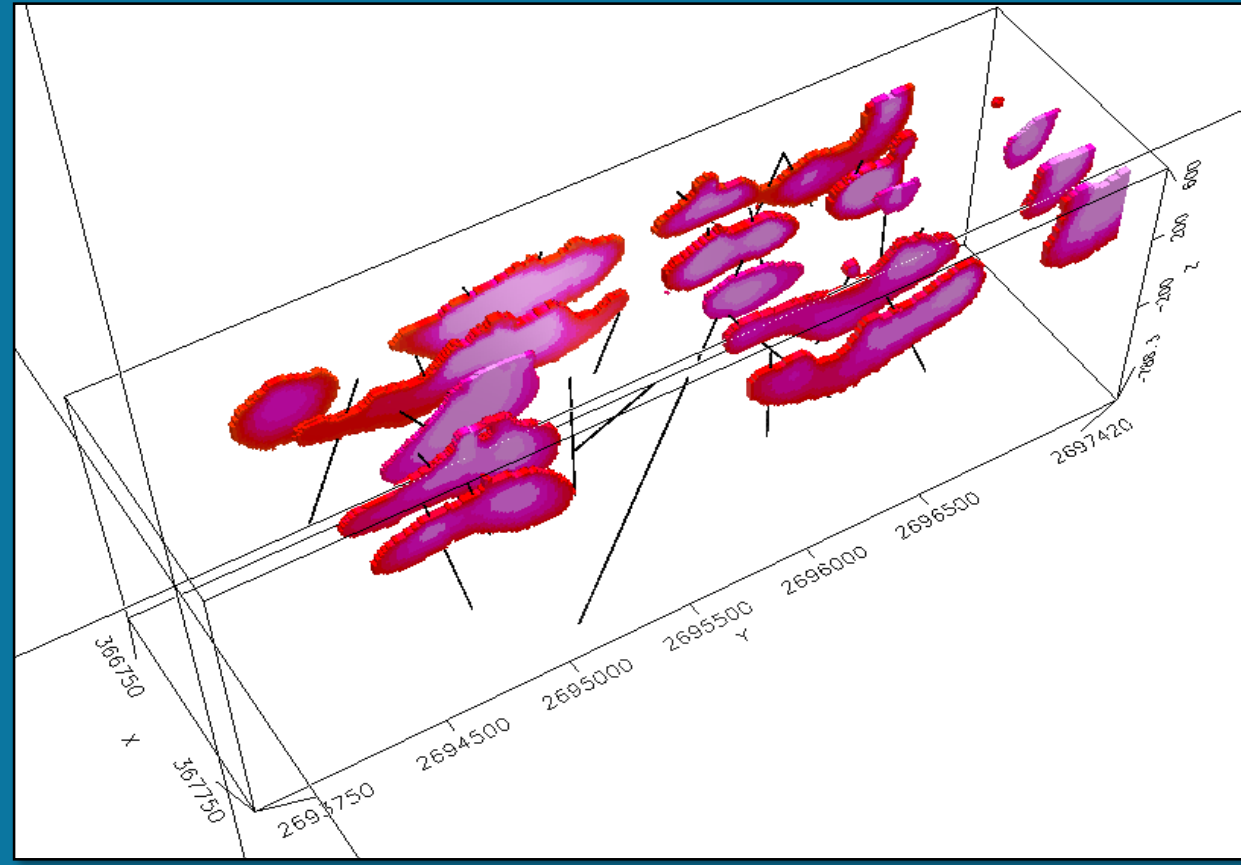
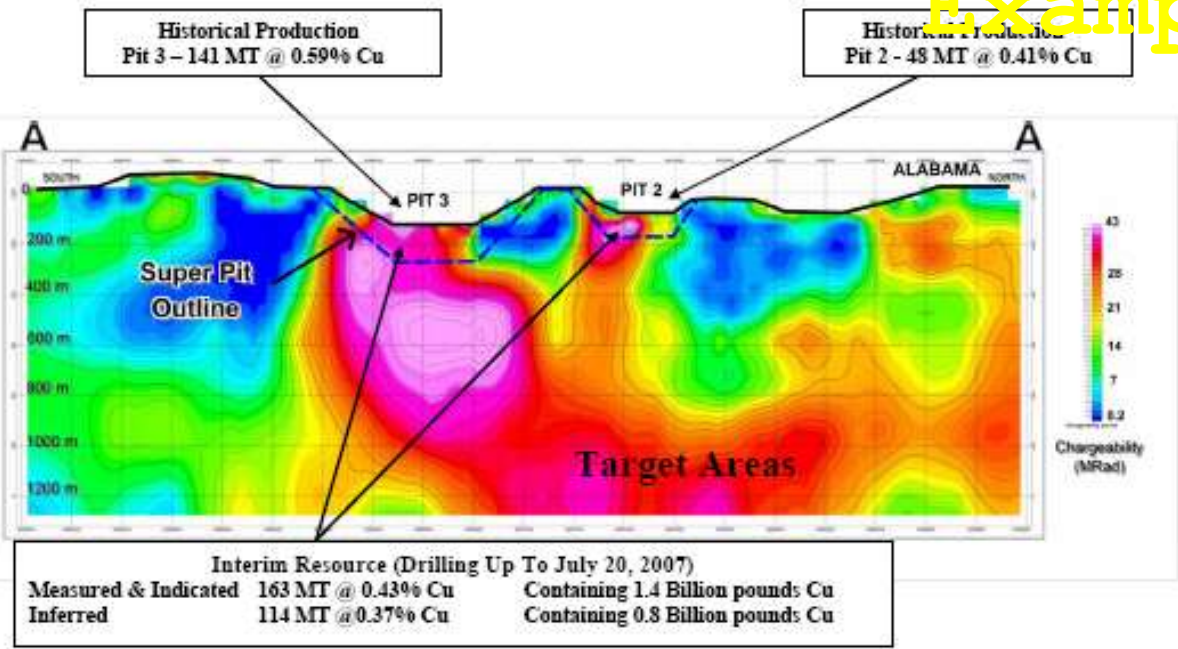


COPPER MOUNTAIN MINING CORPORATION

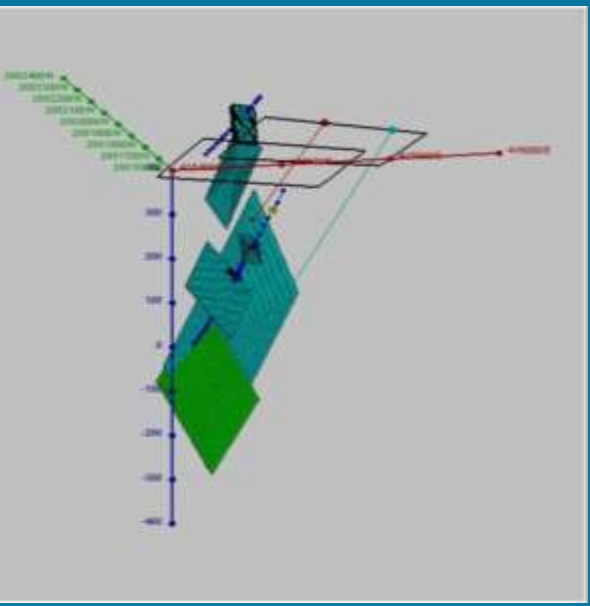
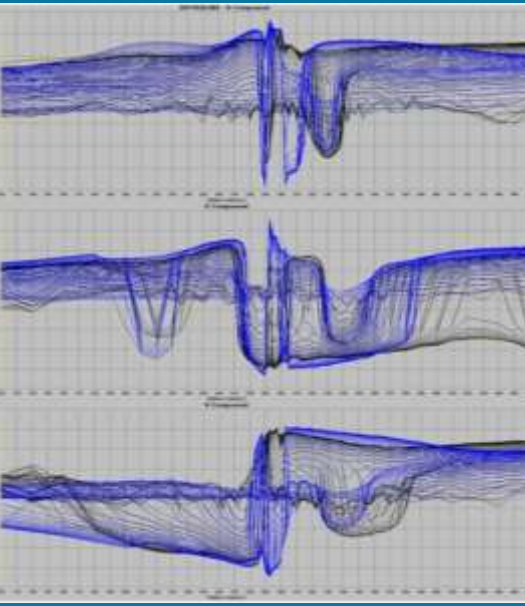
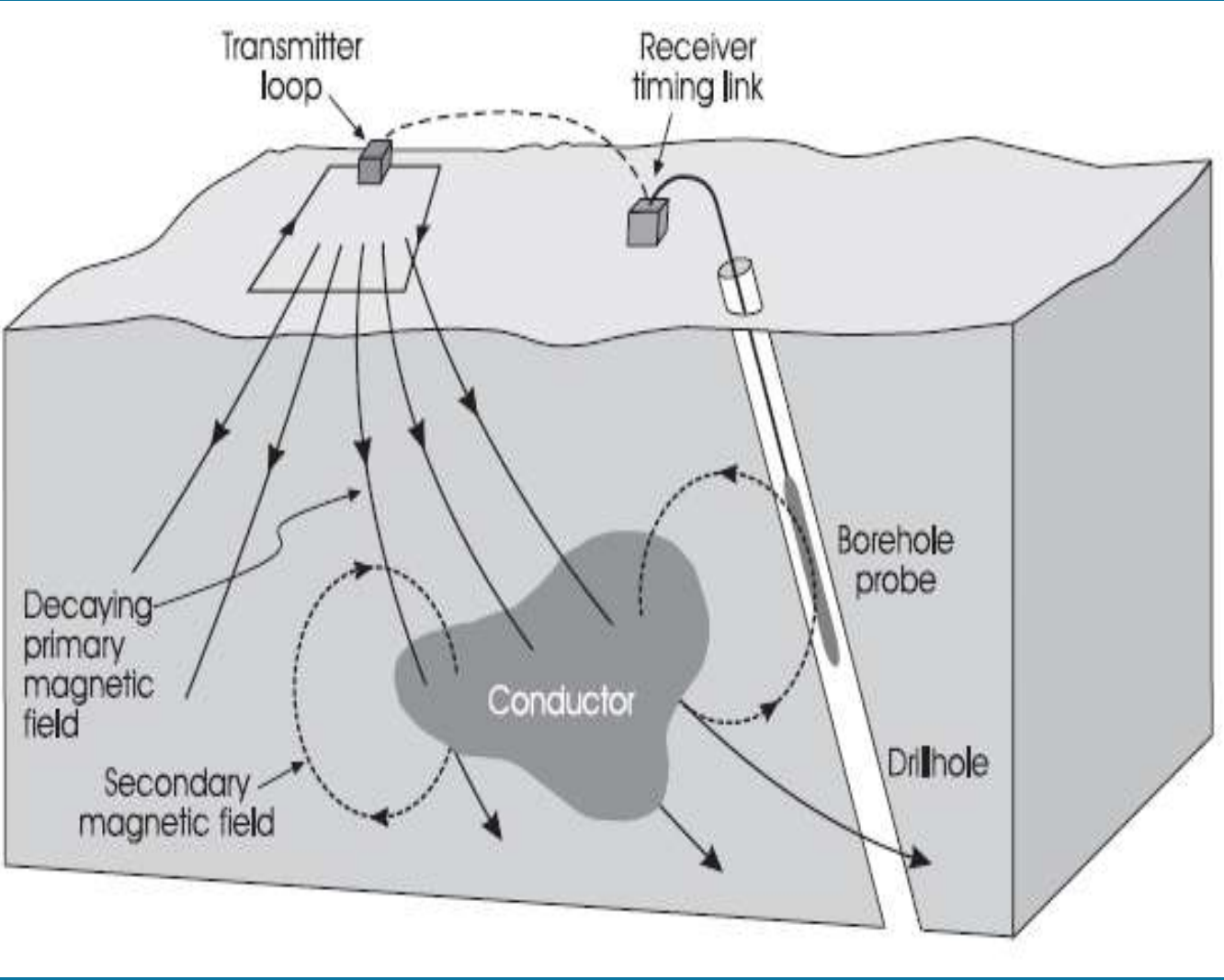
NEWS RELEASE DATED DECEMBER 4, 2007 –

TITAN 24 DEEP EARTH IMAGING RESULTS SUGGEST LARGE TARGETS

Examples of Titan 24 Survey



Downhole EM Survey (Search around Borehole)



Many off-hole conductors can be discovered in this survey

Conclusions

- 1) The modern geophysical technologies with increased resolution and effective depth of probing will provide great support for new discoveries.
- 2) Selection of right technology at right place not only aid better predictability and but also reduces costs.
- 3) Multi-disciplinary prospecting, data integration and data interpretation with concepts is very important for future discoveries.
- 4) Advance Technology support in Exploration will Minimize the Risk and provide confidence for finding new discoveries



Thank you

Exploring your way to success!!!

“In the fields of observation, chance favours only the prepared mind” - Pasteur - Source Woodall (1994)