GLOBAL GEOPHYSICAL is a geophysical consultancy firm specializing in providing geophysical solutions to appropriate mining, environmental and engineering problems. Site-appropriate geophysical techniques best suited to a specific geological/geotechnical environment are combined to provide the following cost-effective service solutions:

**ENVIRONMENTAL**
- Mapping of pollution plumes
- Preferential groundwater flow path & aquifers
- Landfill and waste dump investigations
- Structural geology, faults, fractures and dykes
- Locating buried objects

**ENGINEERING**
- Mapping of bedrock topography and rippability
- Structural geology, faults, fractures and dykes
- Mapping of subsurface cavities and old mineworkings
- Mapping of subsurface services, pipes and leaks
- Road and pavement investigations
- Shear wave velocity measurements
- Concrete integrity & rebar
- Gravimetric dolomite investigations
- Road, water & sewer pipelines, contour and borehole surveying
- Resistivity for cathodic protection

**MINING & EXPLORATION**
- Underground Mining: Roof integrity investigations
- Surface Mining: Mapping of subsurface cavities and old mineworkings
- Structural geology and mineralization
- Massive and disseminated sulphides
- Alluvial and kimberlite exploration

Geophysical Techniques
- Seismic Refraction, Spectral Analysis of Surface Waves (MASW), Ground Conductivity (EM-31 and EM-34), Ground Penetrating Radar, Magnetometry, Gravity and Microgravity, Resistivity, Resistivity Tomography, Induced Polarization, Frequency Domain Fixed Loop EM

GLOBAL GEOPHYSICAL believes that the successful execution of any geophysical project is determined in the initial planning of the geophysical survey in close conjunction with the Client. Clients are made fully aware of the limitations and deliverables of geophysical projects before commencement of fieldwork.

GLOBAL GEOPHYSICAL has extensive experience in the successful execution of mining, environmental and engineering geophysical projects ranging from imaging underground geological features to large-scale geotechnical investigations.
GLOBAL GEOPHYSICAL is a geophysical consultancy firm specializing in providing geophysical solutions to appropriate mining, environmental and engineering problems. It was established in 2001 and is currently based in Pretoria.

The company was formed by Alten du Plessis who holds a Masters degree in Physics obtained from the University of Stellenbosch in 1992. After spending one year at the Atomic Energy Corporation as a Researcher, and two years in the Department of Mineral and Energy Affairs, he joined ISS International Limited in Welkom, specializing in the application of the RockRadar Ground Penetrating Radar system. In 2001 he formed his own consultancy company which currently employ a junior geophysicist and 2 field technicians.

GLOBAL GEOPHYSICAL has extensive experience in the successful execution of mining, environmental and engineering geophysical projects ranging from imaging underground geological features, large-scale geotechnical investigations and mineral exploration. Projects have been successfully completed in countries such as South Africa, Zimbabwe, Botswana, Tanzania, Malawi. Major CLIENTS include Escom, Anglo Platinum, Anglo Coal, Sasol, Jones & Wagener Consulting Civil Engineers, Horizon Blue Resources, Sasol, Etruscan Diamonds.

EQUIPMENT & SOFTWARE

- GSSI SIR-3000 Ground Penetrating Radar system with 40, 100, 400, 500 & 900 MHz antennas
- 24 channel Geometrics SmartSeis Seismograph with roll-along capability
- IRIS Elrec Pro and VIP4000 Induced Polarization System
- AGI Supersting R8 Resistivity and IP system
- Scintrex CG-5 Gravimeter
- G5 Proton Magnetometer
- Trimble R8GNSS GPS System
- Omnistar VBS Survey System
- ENCOM Profile Analyst 8.0 Geophysical Interpretation Software
- EarthImager 2D Resistivity and IP Inversion Software
- Res2dinv Resistivity & IP Processing & Interpretation Software
- WinSeis Turbo Seismic Reflection Processing Software
- SurfSeis Surface Wave Processing Software
- SeisOpt2D Seismic Refraction Processing Software
- Radan 6 Ground Penetrating Radar Software
- GPR Slice 3D Radar Processing & Imaging Software

TYPICAL PROJECTS COMPLETED: 2005 TO 2008

- Mapping of Massive and Disseminated Sulphide Mineralization, Insizwa Complex, Kokstad, Eastern Cape using Induced Polarization (IP) and Resistivity Tomography
- Multichannel Analysis of Surface Waves (MASW) Investigation at proposed nuclear power station site, Eastern Cape
- Multichannel Analysis of Surface Waves (MASW) Investigation to map rock fracturing and shear velocity at Kimberley
- Escom conductivity and resistivity measurement for Cathodic Protection at proposed Mmamabula, Dedisa, Victoria-West and Bravo power stations using EM-34 and Resistivity
- Seismic Refraction Investigation at proposed Braamhoek & Lima Pump Storage Schemes for mapping bedrock topography and structural geology
- Mapping of structural geology and depth of weathering at proposed Lwala Smelter, Burgersfort, Mmpumalanga,
- Micro-gravity survey for Meletse Golf Estate to map dolomite sinkholes and bedrock topography
- Resistivity Tomography Investigation at Algorax, Port Elizabeth, to characterize in-situ sollicrete
The use of geophysical methods in groundwater contamination investigations requires an integrated geophysical approach to provide useful solutions. **GLOBAL GEOPHYSICAL** uses traditional and state-of-the-art geophysical methods such as EM-31/EM-34, Magnetics, Multichannel Analysis of Surface Waves (MASW) and Seismic Refraction to map pollution plumes and preferential groundwater flow paths between pollution source and recipients.

**GLOBAL GEOPHYSICAL** also performs geophysical investigations for landfill and waste dump characterization. Geophysics is the ideal non-destructive solution for investigating the subsurface and can provide cost-effective answers if used appropriately and in suitable environments.
In addition to seismic refraction and ground penetrating radar to map bedrock topography, **quantitative geophysical solutions** are used in geotechnical and engineering investigations.

For example, **GLOBAL GEOPHYSICAL** uses Multichannel Analysis of Surface Waves (MASW) as a solution to map shear wave velocities, which are used to calculate the shear modulus profile of a site.

In-field data quality control is implemented to ensure that data of sufficient quality and volume is collected to ensure quality results.

- Mapping of subsurface cavities and old mineworkings
- Mapping of subsurface services, pipes and leaks
- Mapping of bedrock topography
- Shear wave velocity measurements for geotechnical investigations
- Hi-Resolution structural investigations
- Road and pavement investigations
- Characterization of site geology

Geophysical data is integrated with area plans, allowing visual interpretation and analysis. **GLOBAL GEOPHYSICAL** strives to deliver quantitative and useful answers to engineering and geotechnical problems, in providing solutions tailored to the specific needs of the CLIENT.
Example of GPR scan to map the presence of shallow service

The example to the left shows the hyperbola image created when scanning over a subsurface service such as an electrical cable or a pipe. GPR offers an advantage in that it can detect both metal and PVC/concrete pipes.

Global Geophysical utilizes advanced 3D software processing & interpretation to create 3D model and depth slices to assist in interpretation of services.

This approach requires that data be acquired on a grid (typically 0.5 to 1.0 metres spacing between scans) to allow for a high-density coverage of any target of interest.

The advantage of this processing technique is that features can be mapped and visualized which may not be visible during a conventional survey where interpretation only relies on the inspection of 2D data.

In the example shown in the figure on the left, one can observe a weak reflector corresponding to a subsurface service. This service was not at all visible using a conventional 2D approach and would have been missed if a conventional survey was performed.
Multichannel Analysis of Surface Waves (MASW) is a relatively new seismic approach to map shear wave velocity as a function of depth without the use of boreholes as required with borehole shear wave velocity measurements. The technique utilizes the dispersive nature of Surface Waves (also known as Rayleigh waves or Ground Roll), to determine shear wave velocity as a function of depth and distance. A shear wave velocity cross-section can be generated with shear wave velocities mapped for all layers of interest.

MASW offers the following advantages compared with Seismic Refraction and is often successful where Seismic Refraction has failed:

- MASW utilizes high-energy surface waves and can be used in seismically noisy areas where Seismic Refraction body waves not have sufficient signal to noise ratio for accurate first arrival picking.
- MASW does not suffer from velocity inversions and can be used in areas where a shallow high velocity layer underlain by softer material makes Seismic Refraction unusable. For example, in areas of shallow calcrete underlain by softer sand before the deeper bedrock layers, MASW will be able to map all the layers of interest.
- MASW can be used on tar/concrete surfaces without any problems where high velocity waves traveling through the upper surface may interfere in normal Seismic Refraction studies.
- MASW offers improved lateral resolution compared with Seismic Refraction and may be used to map narrow faults and fracture zones.

Global Geophysical uses SurfSeis software developed by the Kansas Geological Survey which utilizes advanced processing tools such as overtone analysis for proper selection of the fundamental Rayleigh mode. The use of a multi-channel approach allows for a more quantitative analysis of surface waves.

TYPICAL APPLICATIONS

- Mapping of Shear Wave Velocity
- Bedrock Topography
- Liquefaction Potential Studies
- Mapping of Shear Modulus and other Elastic Moduli
- Improved Site Characterization combining Shear with Compressional WaveVelocities
Global Geophysical employs a wide range of geophysical techniques for the location and delineation of Kimberlites and Alluvial Diamond Deposits.

**ALLUVIAL DIAMOND EXPLORATION**

**Resistivity**, (Mapping of clay, gravel and bedrock interfaces).

**Ground Penetrating Radar**, (GPR), (Mapping depth to bedrock in moderate conductive environments up to a maximum depth of ± 30m).

**Induced Polarisation**, (Mapping of clay, gravel and bedrock stratigraphy)

**High resolution Ground Magnetic Surveying to locate and model Kimberlite Pipe.**

**Kimberlite Center**

**Modeling capabilities of magnetic datasets and derivations of key variables, such as, depth to top of kimberlite, width of kimberlite and the general shape of the pipe.**

**KIMBERLITE EXPLORATION**

**Micro Gravity Surveying**, (Mapping depth of cover and combined modeling of Magnetic and Gravity datasets).

**Magnetotellurics (MT)**, (Mapping the orientation of the kimberlite pipe and the delineation of it at great depths).

**Seismic Refraction**, (Mapping the depth of weathering with high accuracy).

**Electromagnetics**, (EM), (Mapping of conductive overburden and clays caused by weathering).

**Resistivity**, (Mapping of resistive as well as conductive zones associated with kimberlites).

**Induced Polarisation**, (IP), (Measurement of the dispersive effects caused by minerals such as clays or sulphides)

**Global Geophysical**

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Native gold has highly unusual physical properties, e.g., it has the highest specific gravity of any natural material and is an excellent conductor of electricity, it is present at best in amounts of a few parts per million by volume and therefore cannot be directly detected in-situ by any known geophysical methods.

Thus, those geophysical methods which offer the possibility of being used in the exploration for gold deposits fall back on less direct approaches, for example, the structural relationship of gold deposits (using magnetics and gravity) and the detection of associated or pathfinder minerals which may be present in much larger amount than the gold itself.

**Other Geophysical Techniques Applicable to Gold Exploration:**
- **Gravity**
- **Seismic Refraction** - (Mapping buried river channels for placer gold deposits).
- **Resistivity** - (Mapping of conductive sulfides and mapping of resistive near surface zones of silification associated with gold mineralisation).
- **Induced Polarisation** - (Mapping of metallic sulfides and quartz veins).
- **Electromagnetics (EM)** - Used where massive sulfides, conductive faults or fracture zones, or more resistive silicified rocks may be associated with gold mineralisation.

Linear Magnetic anomalies are usually caused by dykes, in this case these dykes may be associated with gold mineralisation, the pole reversal, (red and blue), indicates an age difference.

**Magnetotellurics (MT)** is a state-of-the-art geophysical technique used to image the subsurface at great depths. The figure (left) depicts the change in resistivity with depth. The blue end of the color scale represents conductive zones and the red/purple end of the color sale represents resistive zones.