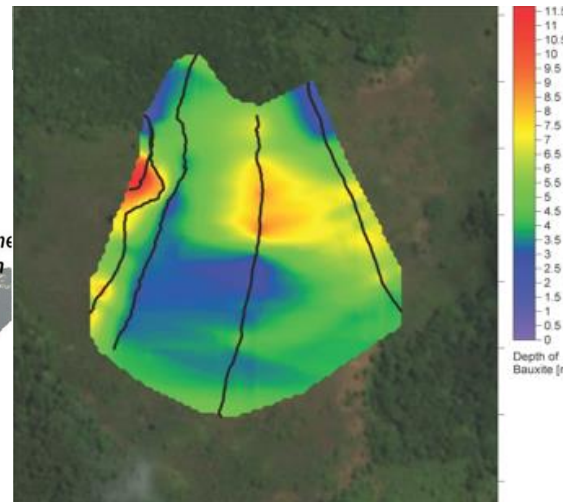
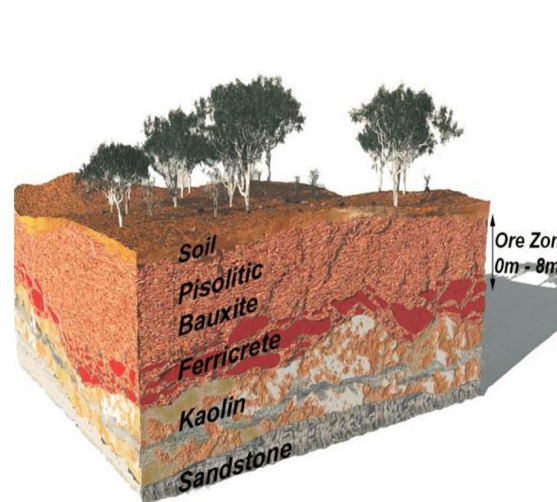
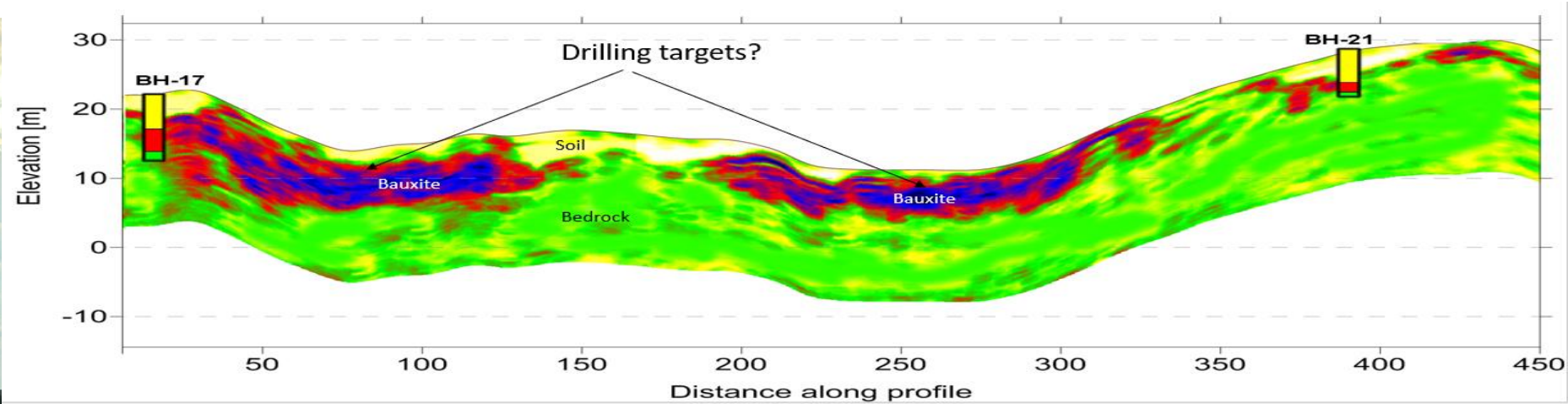


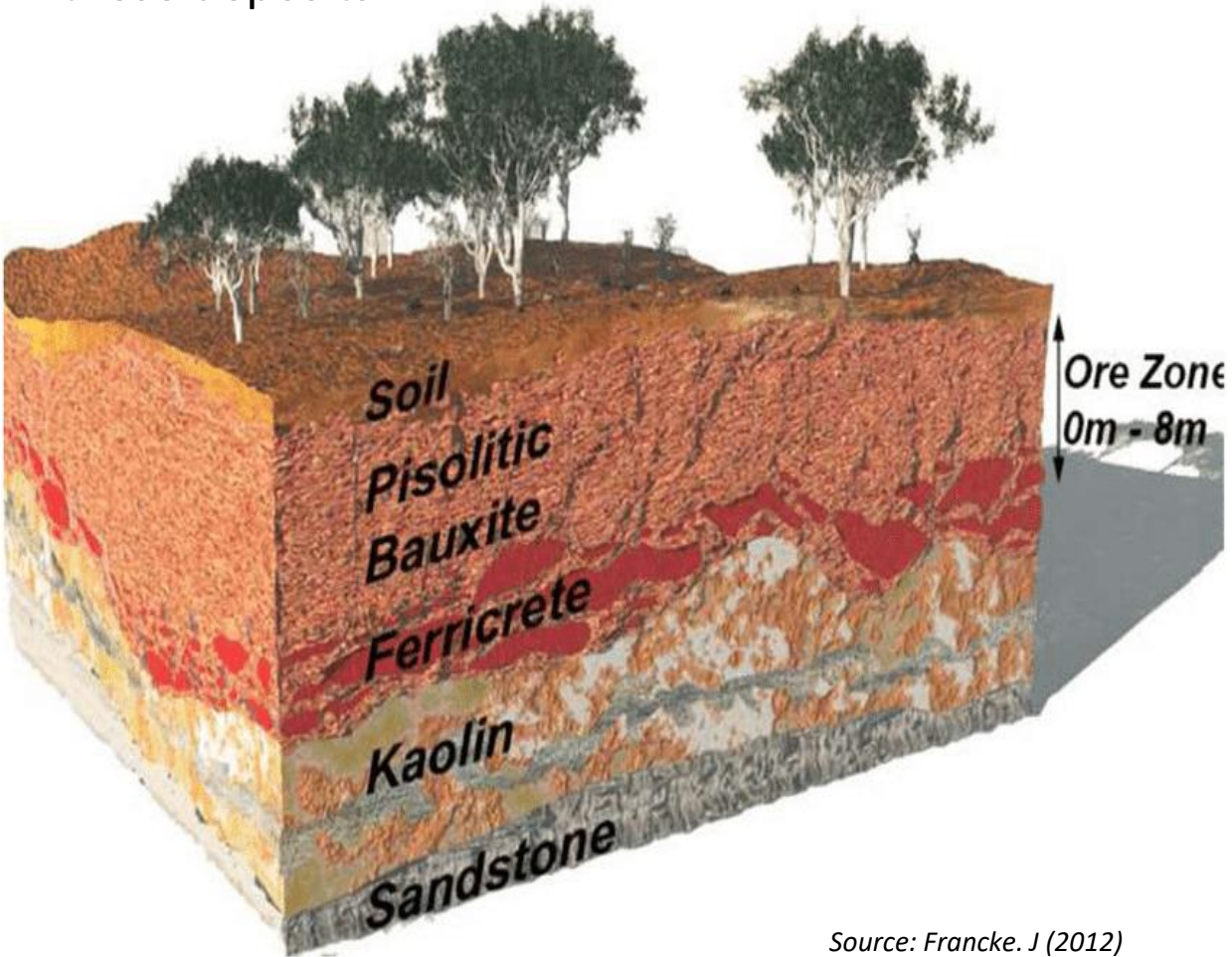
Applying Ground Penetrating Radar (UltraGPR) technologies for Bauxite exploration



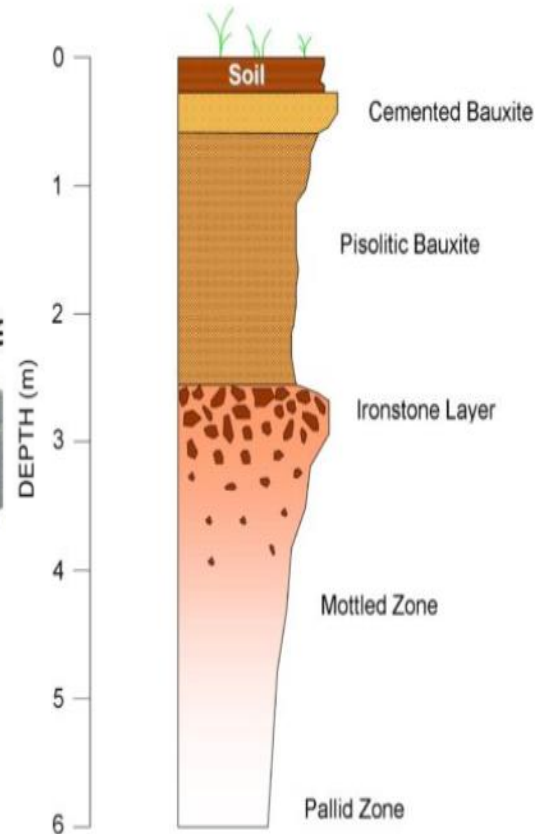
UltraGPR for Bauxite exploration

Adding value through optimizing exploration techniques

Traditional approaches to bauxite resource estimation rely on sparsely-spaced boreholes and interstitial linear interpolations, an approach which is highly speculative in nature given the extreme variability in the depths of these deposits.



Source: Francke. J (2012)



Typical Lateritic Bauxite Profile
Source: Tilley. D (2014)

The limitations of this inferential approach may be mitigated through the use of high-resolution GPR imaging. GPR has been shown to be suitable in certain deposit types to depths exceeding 35 m. Elsewhere, the nature of the overburden precludes the use of GPR, suggesting that each deposit requires careful consideration prior to trialing radar technology.



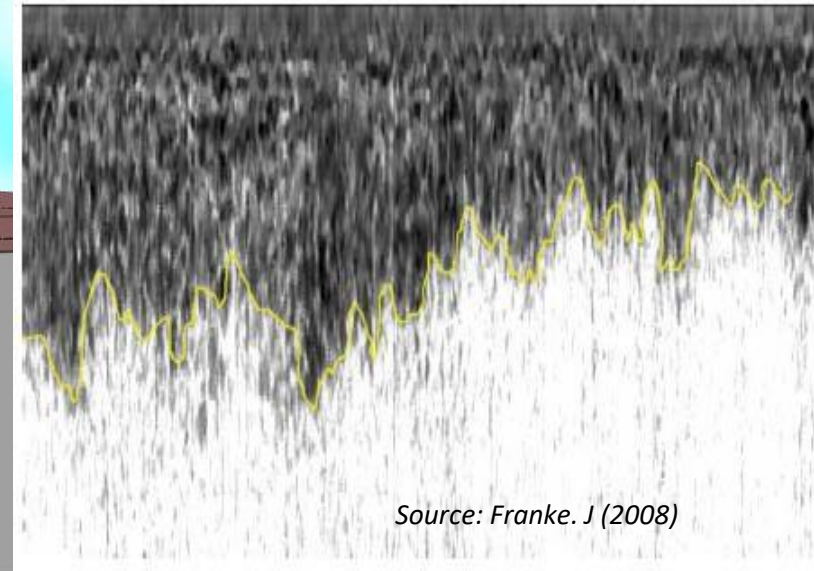
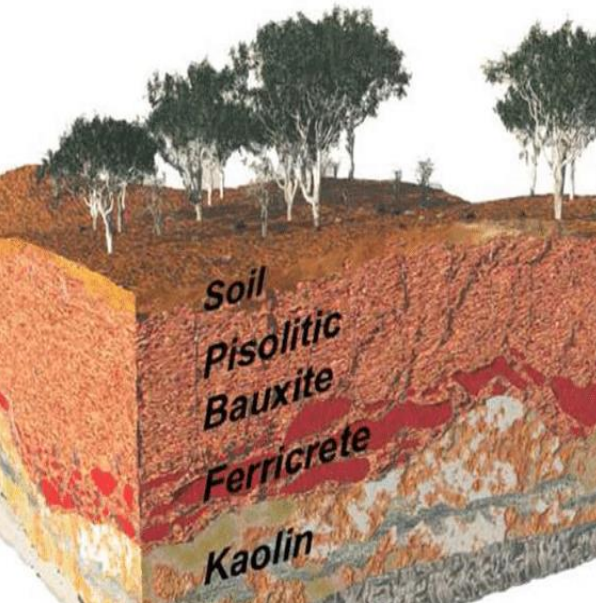
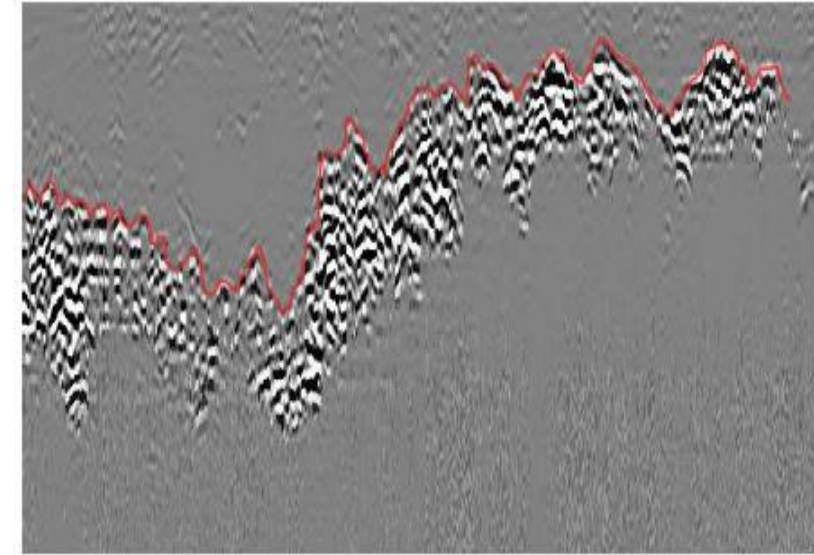
UltraGPR for Bauxite exploration



GEOPHYSICS USED FOR BAUXITE EXPLORATION?

It is common to use various geophysical research methods during this stage to study the structure and composition near-surface parts of the Earth. Usually covering a larger area quicker. These methods of applied geophysics are often used to support ongoing geological investigations, in particular 2D/3D ground penetrating radar (UltraGPR) is very good for lateritic Bauxite deposits

Important Note: the use of geophysical surveys are considered as Supportive data (Not Observations) in the JORC 2012 code guidelines. Although they can be used to increase the confidence of geological interpretation between points of observation, they should not be used for resource estimation directly



Source: Franke. J (2008)

UltraGPR for Bauxite exploration

Example application GPR results

Bauxites – Tayan (ANTAM Tbk), Indonesia

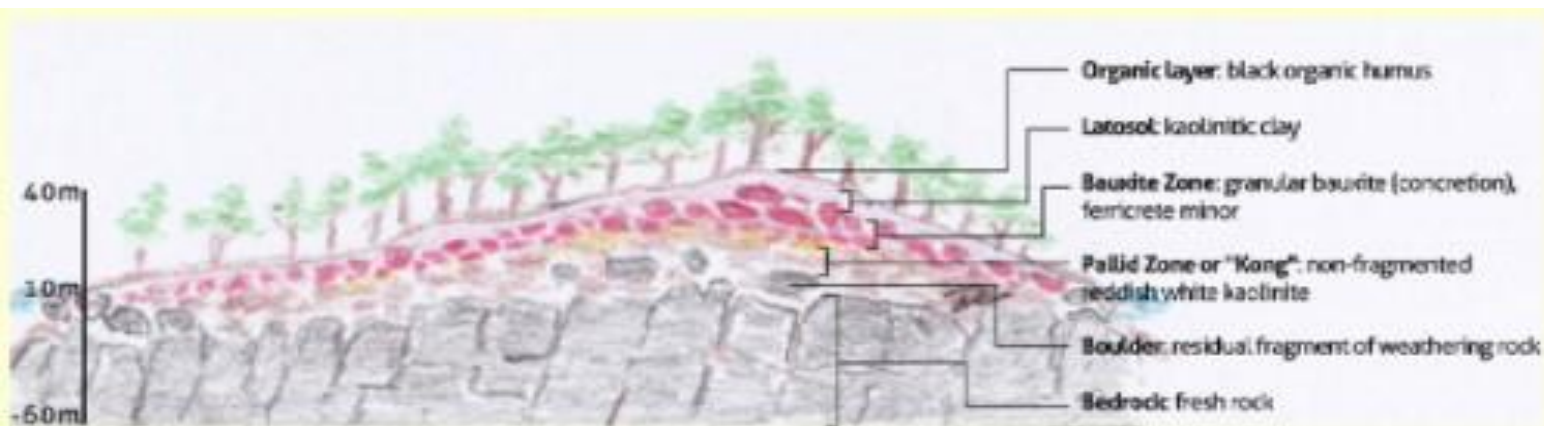
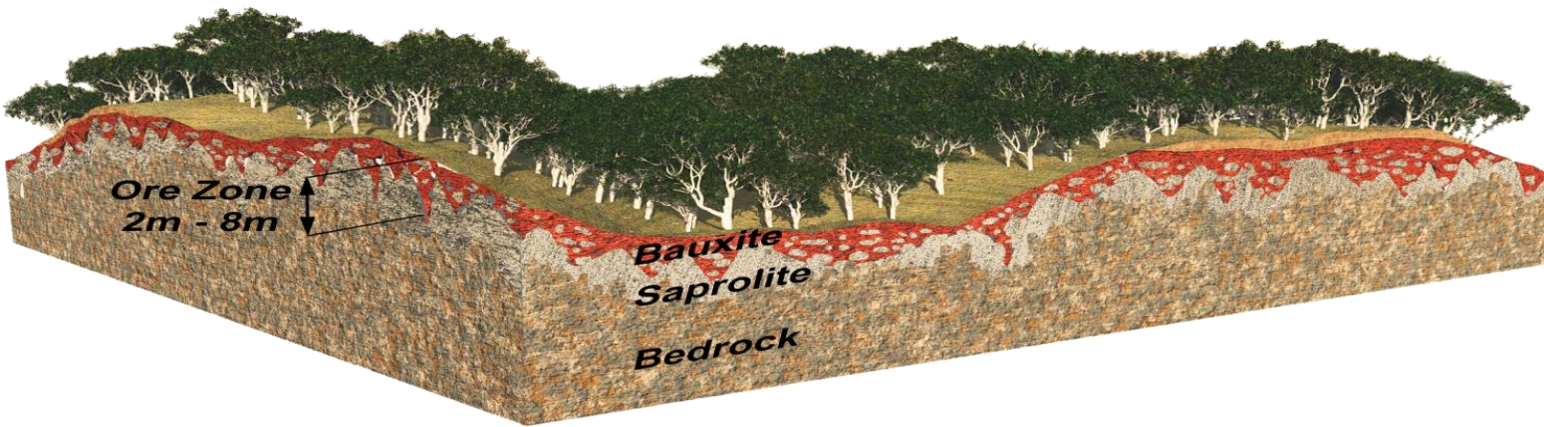


Figure 3: Lateral geological profile from Tayan area

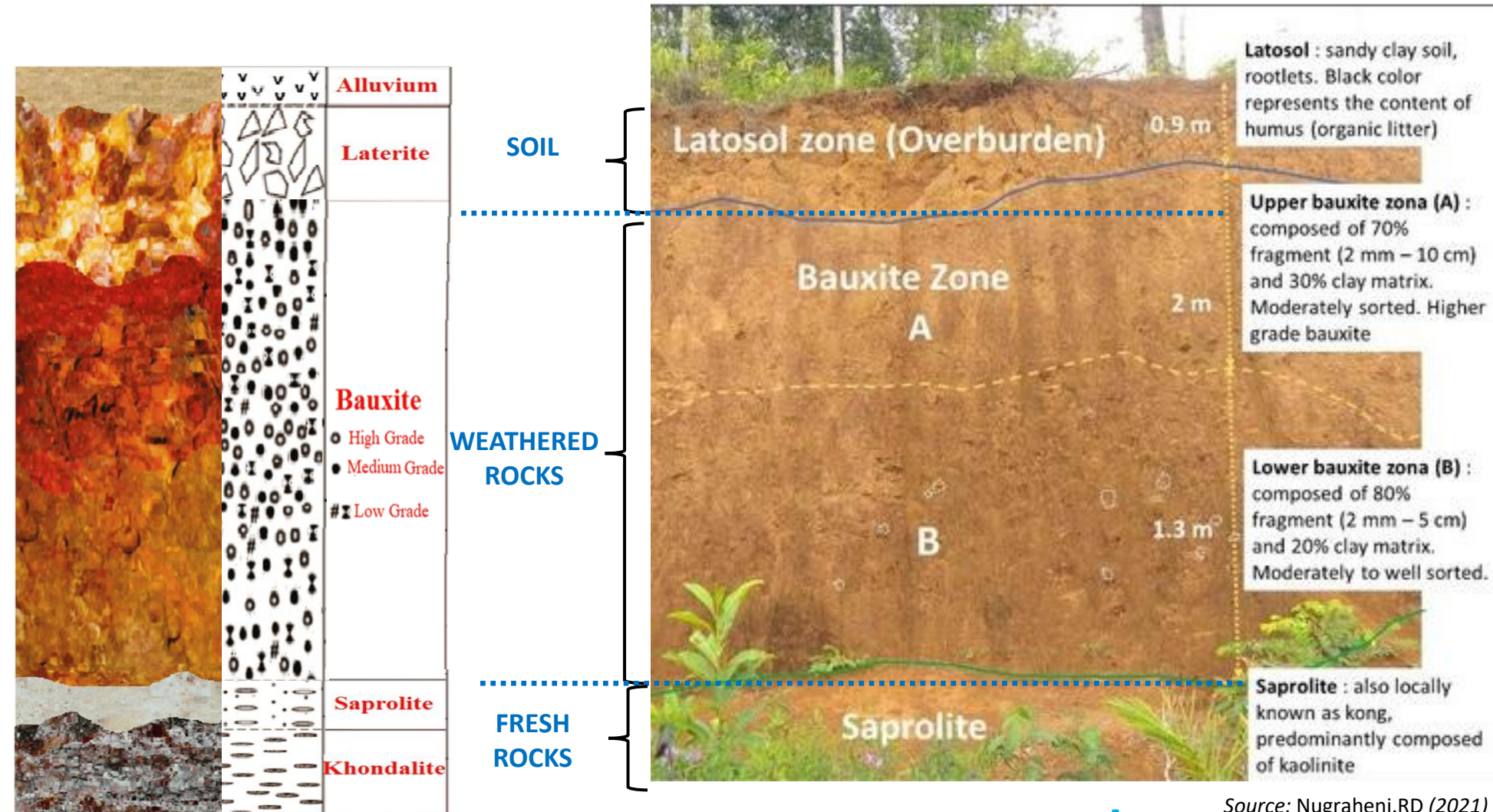


UltraGPR for Bauxite exploration

TYPICAL SOIL WEATHERING PROFILE FOR LATERITIC BAUXITE

UltraGPR zones

Weathering layers



UltraGPR can provide a great exploration tool to identify the lithological contact between Bauxite zones (Massive clays) and the saprolites (weathered rocks) to the bottom of the laterite weathering profile (bedrock)

Results usually providing global volumes of potential limonite and saprolite located within the survey area

Results combined with drilling data give greater confidence of laterite orebody dimensions and mineralization distribution for more accurate resource estimates

Source: Nugraheni.RD (2021)



UltraGPR for Bauxite exploration

The UltraGPR system

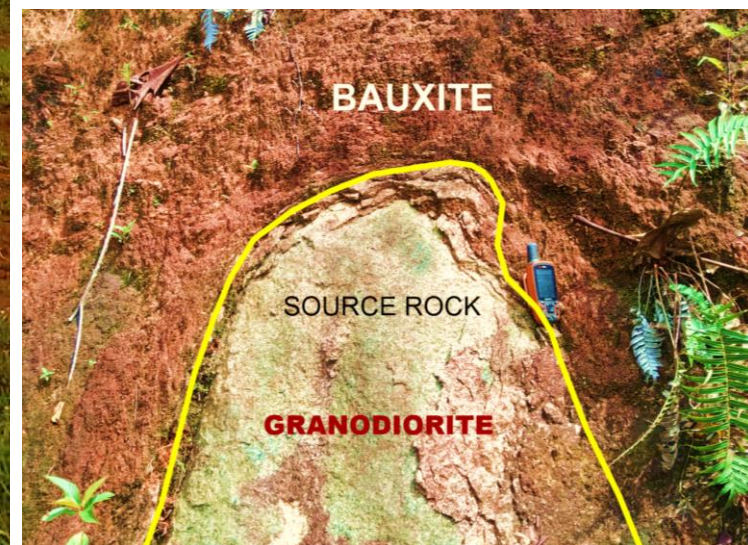


- High power transmitters and antenna (64,000 stacks) providing 3 times penetration of other commercial systems, providing depth of up to 75m
- RTK-DGPS positioning
- Extremely rugged, waterproof and portable in remote sites with limited access
- Wireless system with no fiber optics (Bluetooth II)
- Simple to use Android phone app for data-logger



UltraGPR benefits to support exploration of Bauxite Laterite

- Fast & effective, Low impact on forested areas
- Shows bauxite thickness allowing volume estimates
- Shows better definition of bedrock contact depths
- Better boundary definition of Bauxite zones
- Allows optimization of drill programs
- Saves time & money



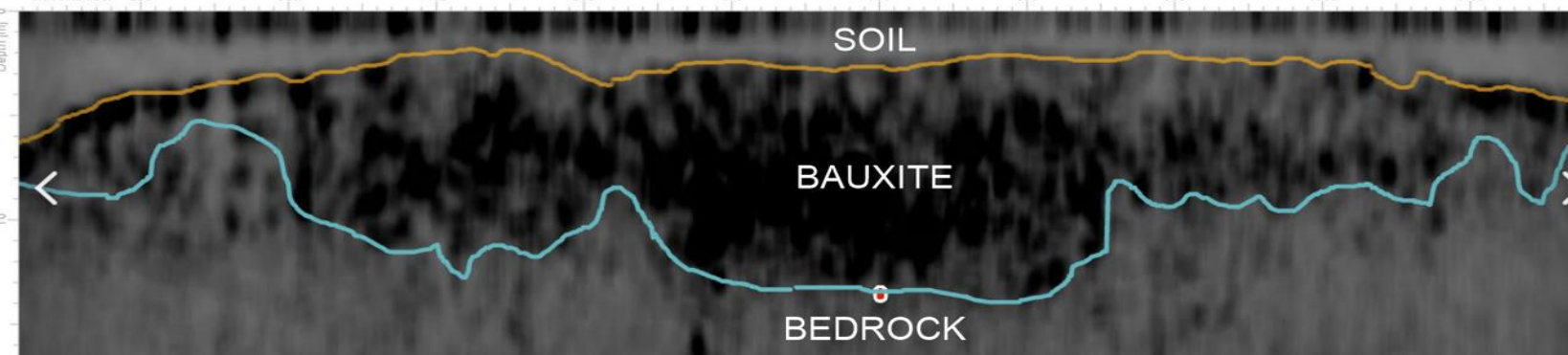
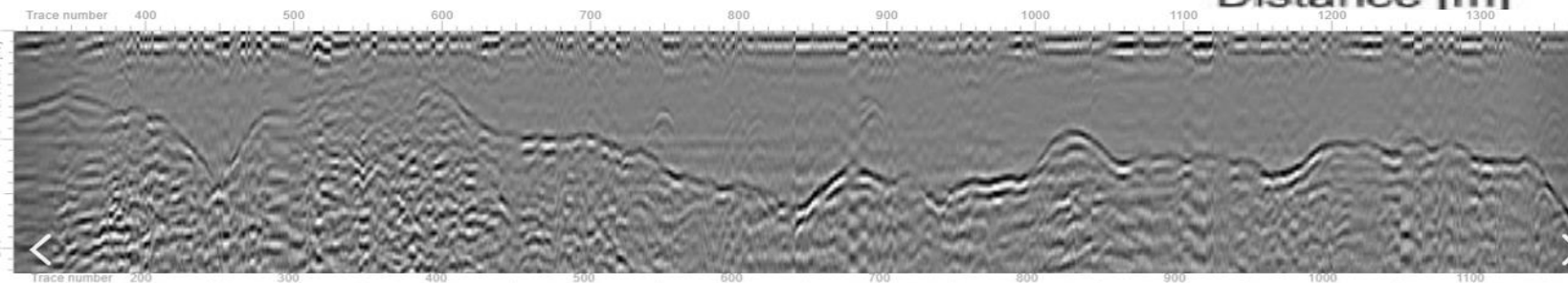
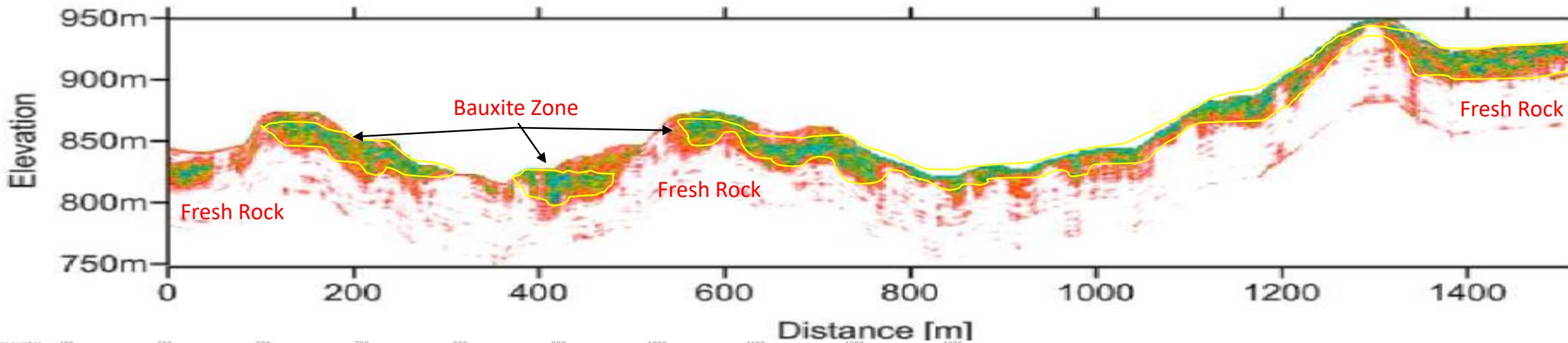


UltraGPR for Bauxite exploration

UltraGPR Deliverables



groundradar



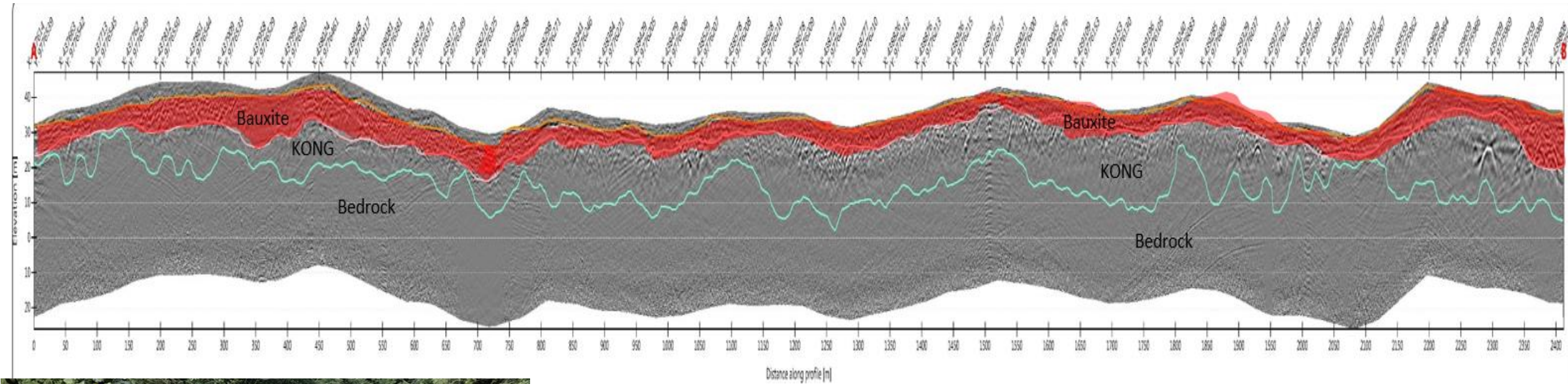
www.ptgeosearch.com

UltraGPR for Bauxite exploration

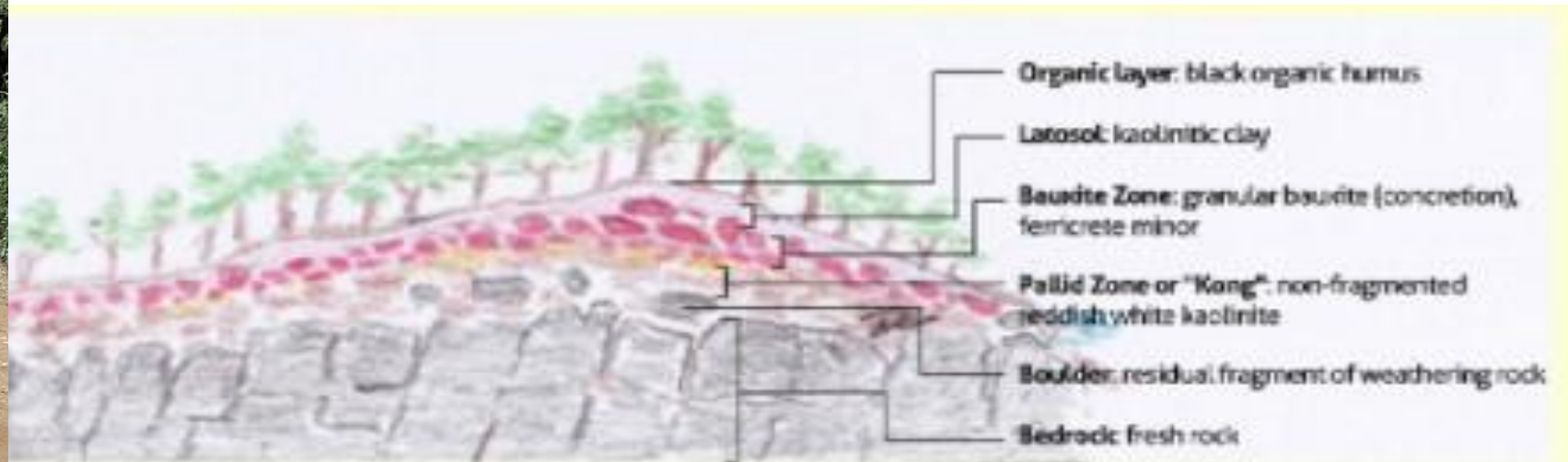
UltraGPR Deliverables



groundradar



www.ptgeosearch.com

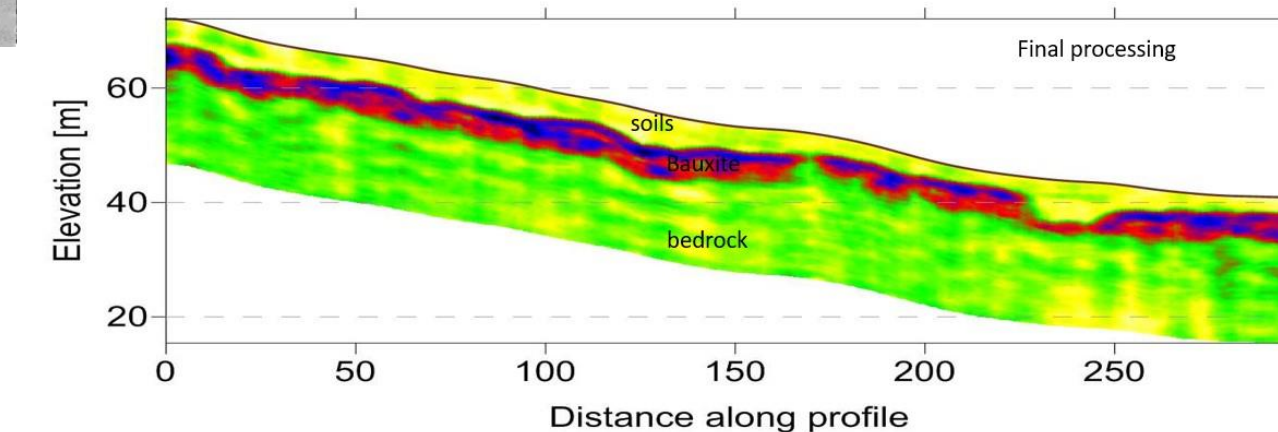
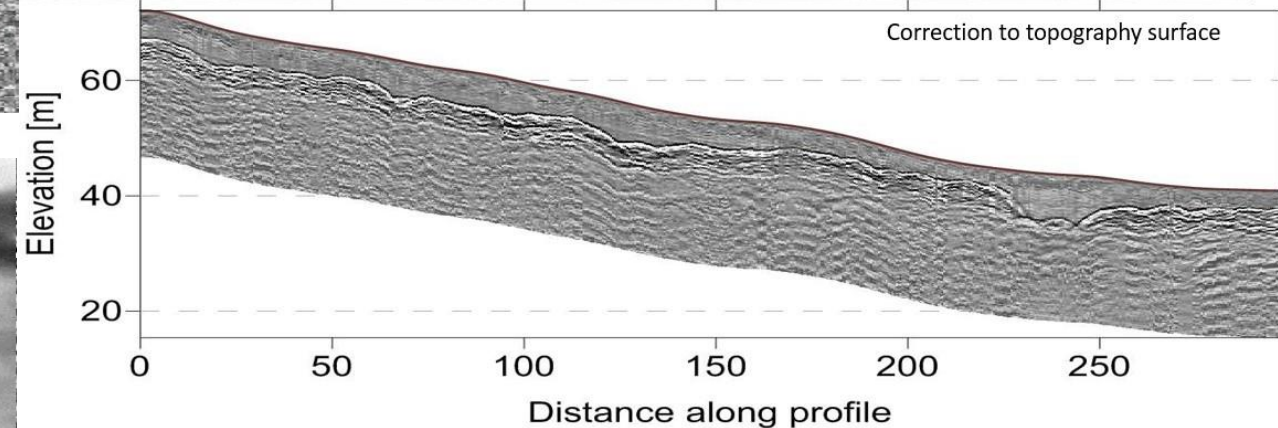
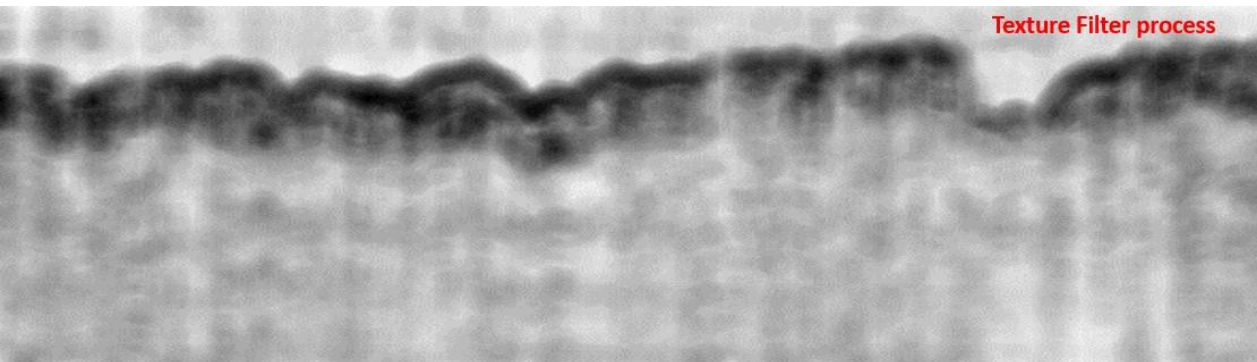
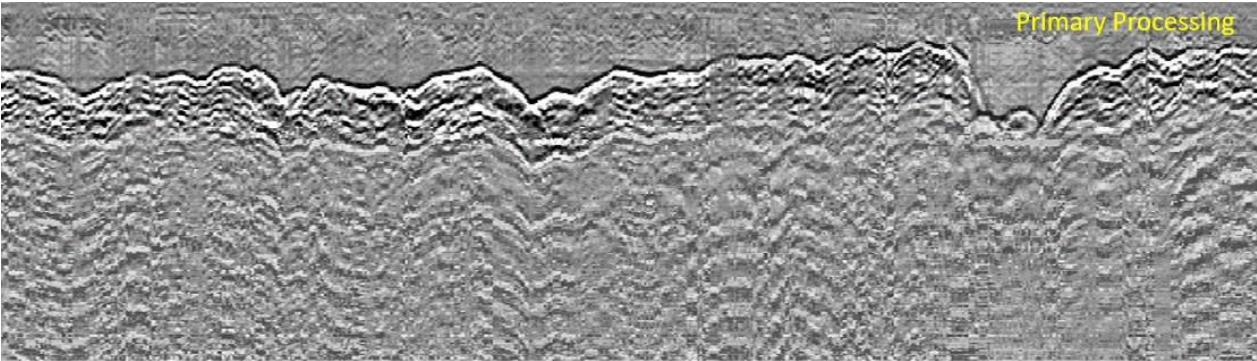


Lateral geological profile from Tayan area

UltraGPR for Bauxite exploration

Example UltraGPR in bauxite

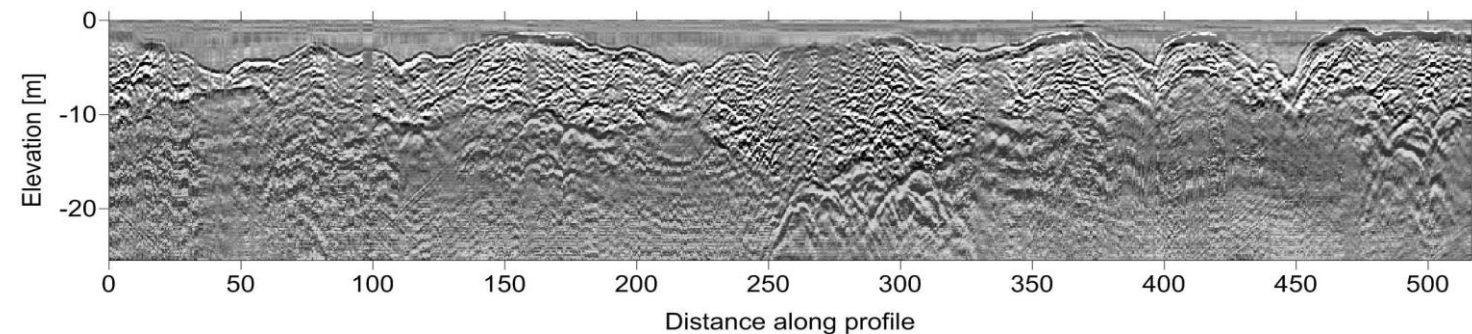
Processing and Primary interpretation methodology



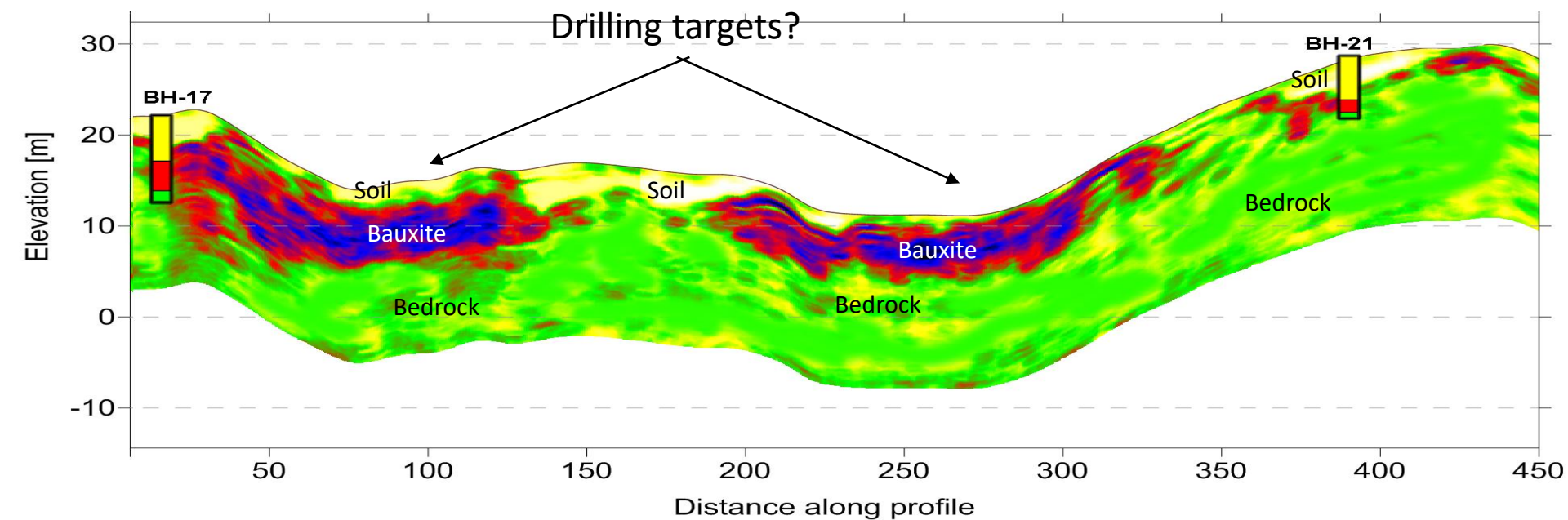
Initial processing is completed using depths along a flat elevation plane, these depth are then draped along a topography Surface to conform with the project site situation

UltraGPR for Bauxite exploration

Example UltraGPR in bauxite



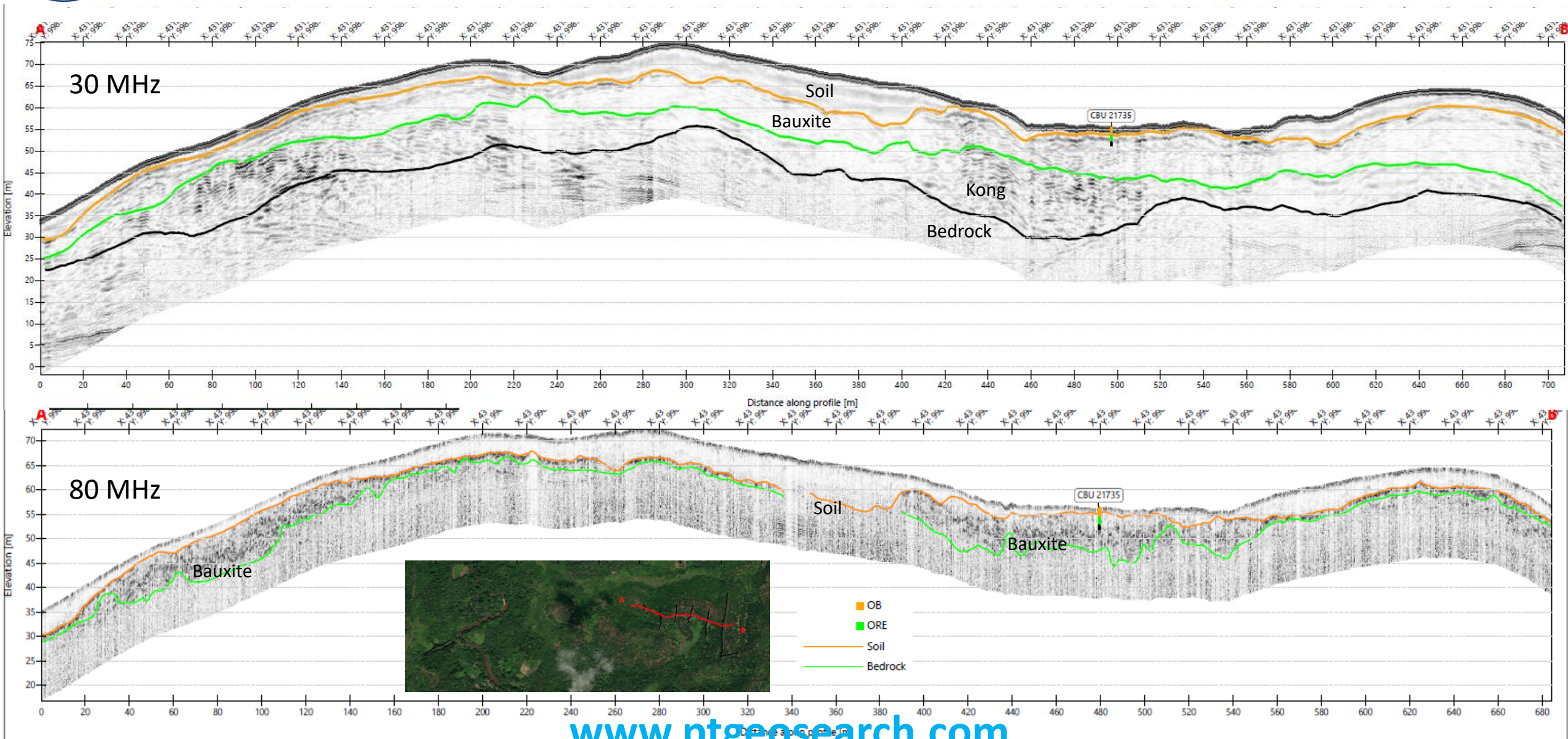
Processed UltraGPR survey comparison with drilling data for better exploration target infill drilling





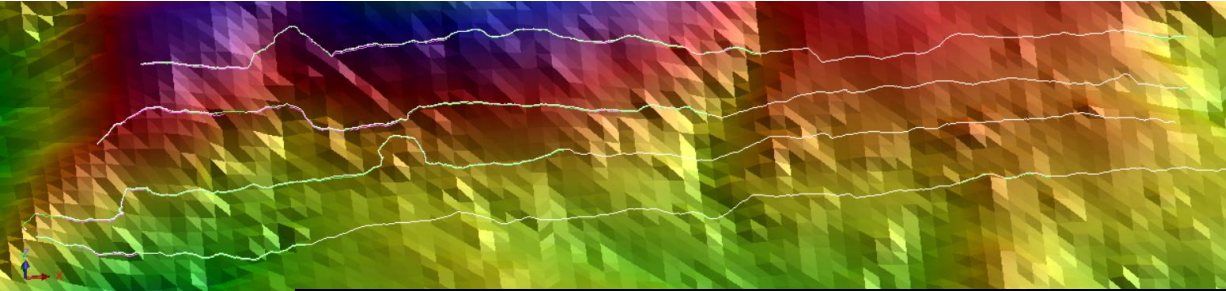
UltraGPR for Bauxite exploration

Comparison of Interpretation Result 30 MHz vs 80 MHz



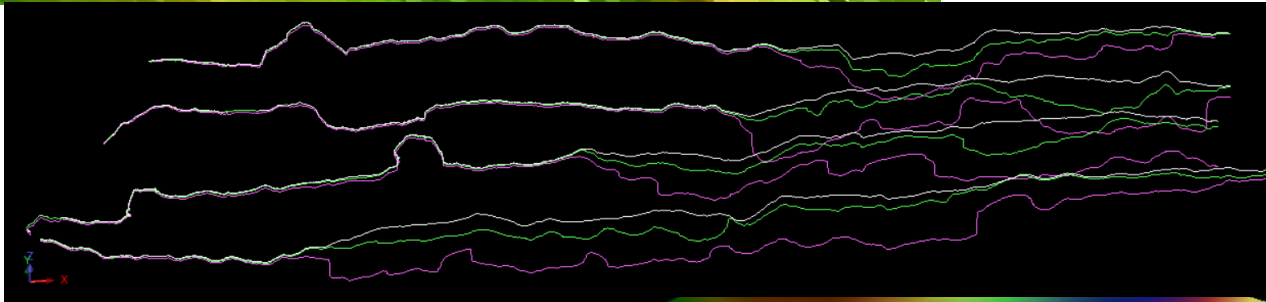
UltraGPR for Bauxite exploration

Topography Draping to Lidar



Secondary Processing – 3D modelling SURPAC

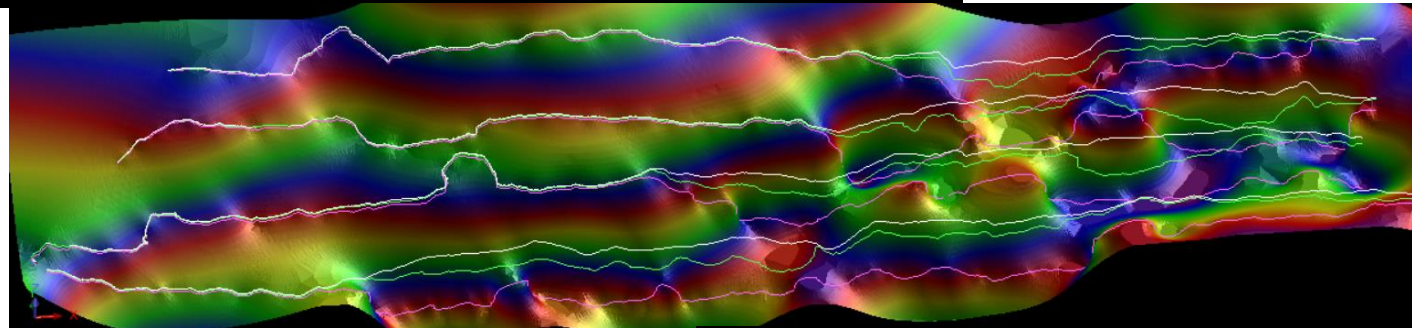
3D wireframes



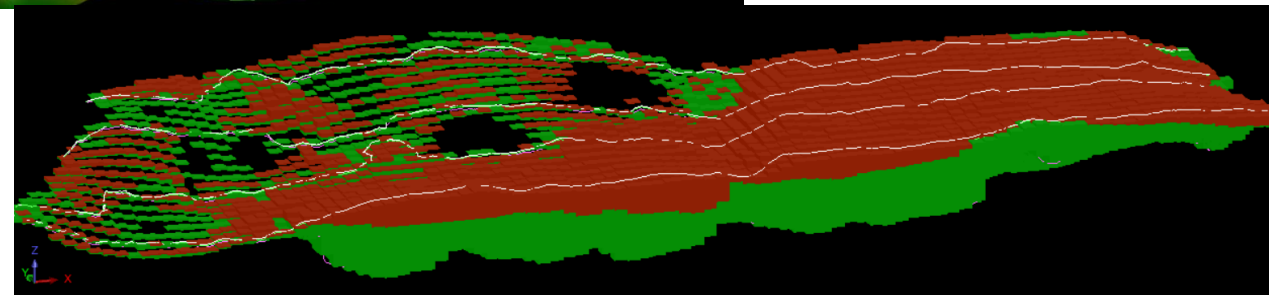
Laterite volume 3D models		
Lith Type	Volume	Tonnes
SOIL-OB	200,000	360,000
SAP-ORE	450,000	720,000
Grand Total	650,000	1,080,000

RD Limonite -1.8sg / Saprolite 1.6sg

Surface contouring/Gridding



Block Model / Volumes



Additional step include adding the drilling assay results to improve the correlation of the GPR results and increase confidence in the models

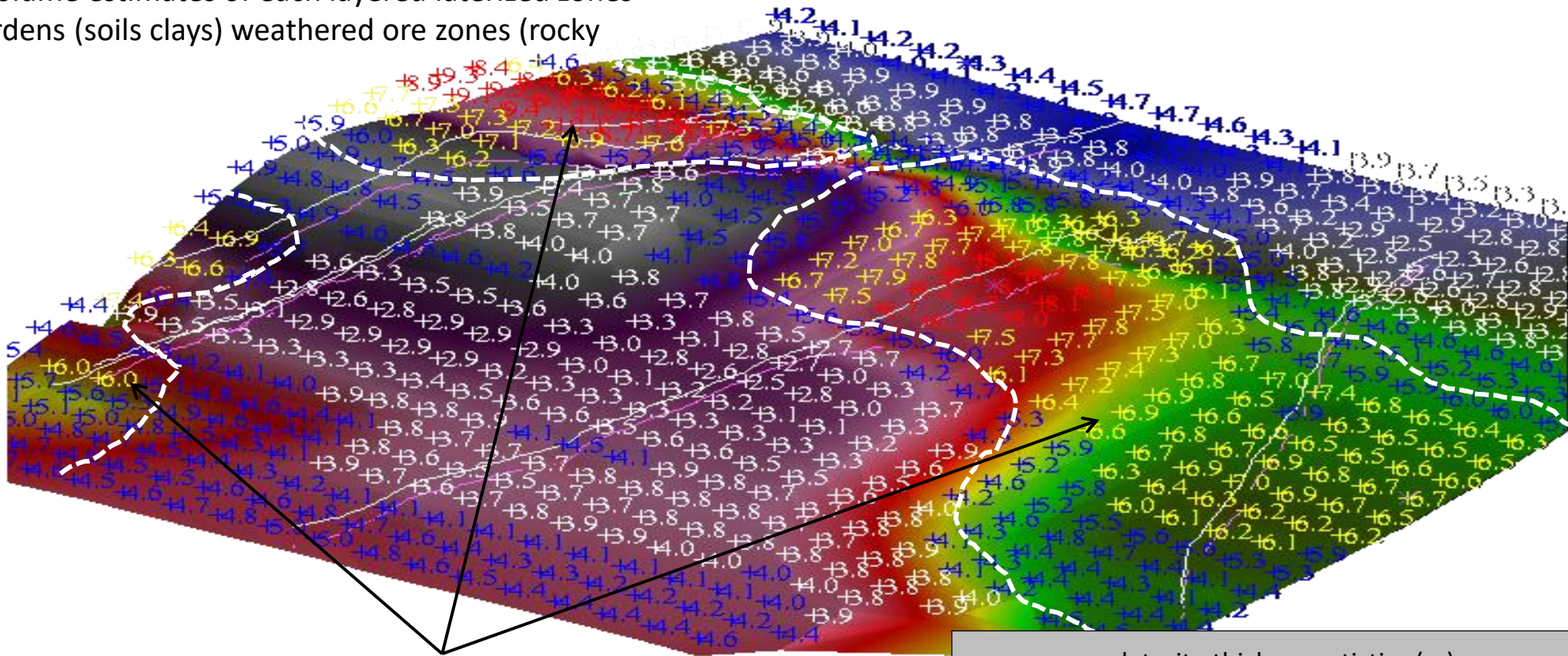


UltraGPR for Bauxite exploration



depth to bedrock model (Base of Bauxite)

Good for Volume estimates of each layered laterized zones for overburdens (soils clays) weathered ore zones (rocky saprolites)



Thicker Bauxite laterization zones

3D laterite global volumes for Limonite & Saprolite layers

laterite thicknes satistics (m)		
min	max	mean
2.3	11.3	4.7

Generation of drilling targets to optimize drill programs to save time and money

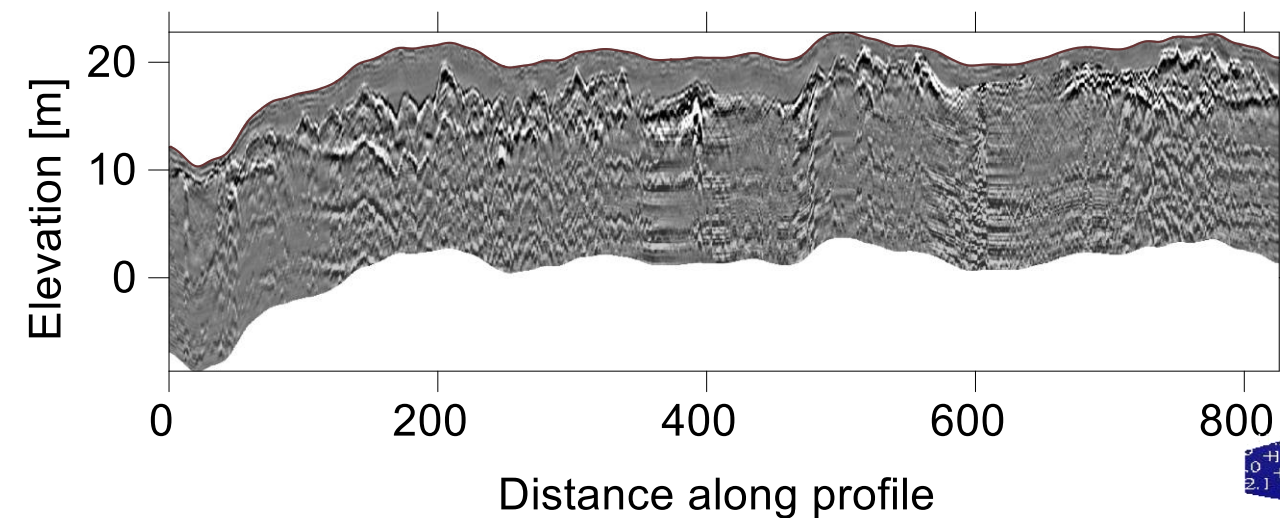


UltraGPR for Bauxite exploration

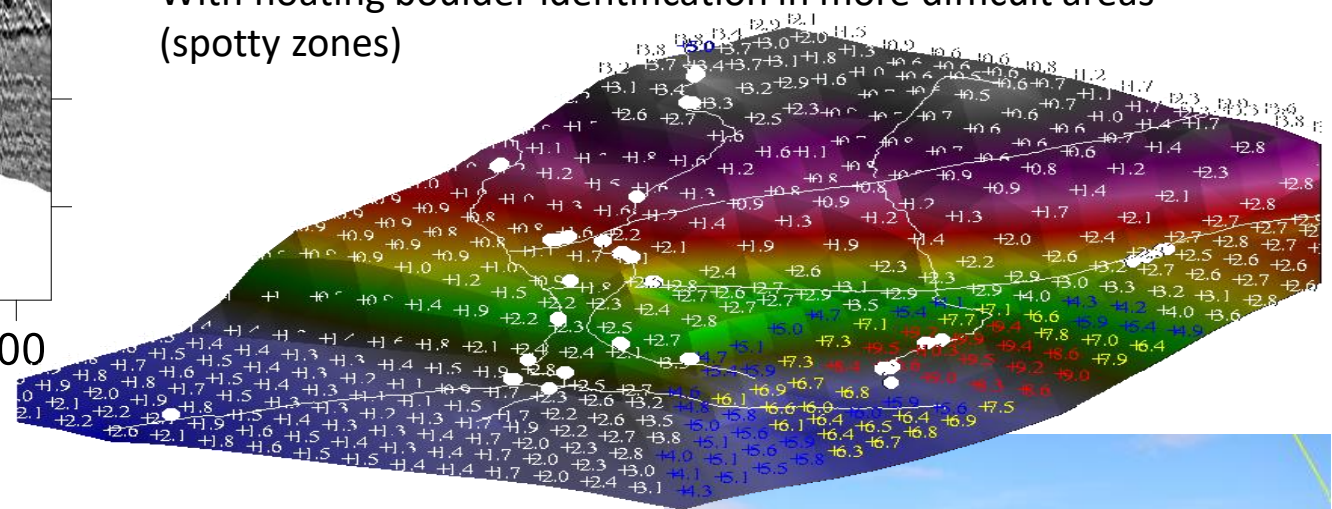


groundradar

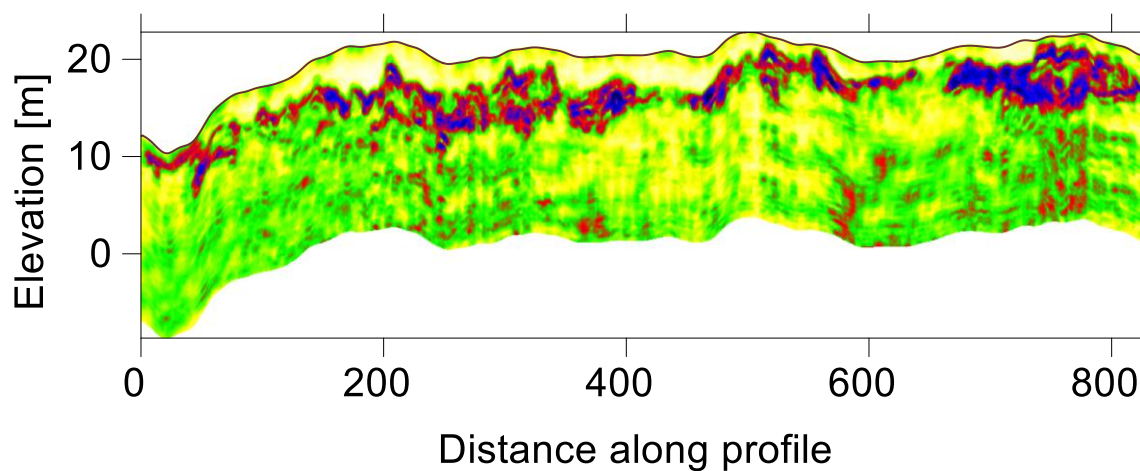
Example UltraGPR results



With floating boulder identification in more difficult areas (spotty zones)



UltraGPR in Kalimantan bauxite





UltraGPR for Bauxite exploration





UltraGPR for Bauxite exploration



www.ptgeosearch.com

UltraGPR for Bauxite exploration

Core drilling & Sampling

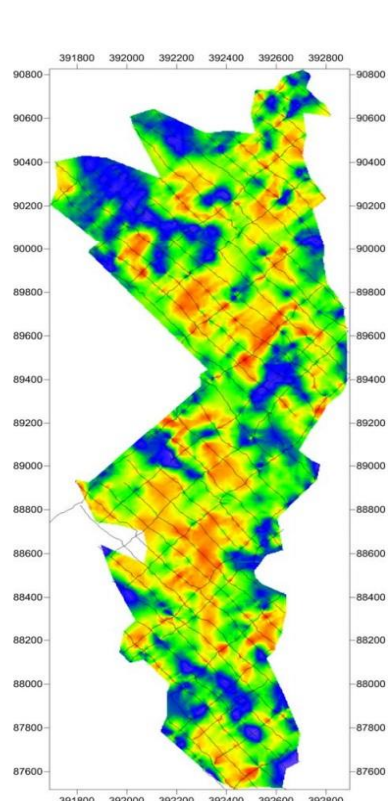


Once weathered laterite zones have been identified from initial mapping and UltraGPR surveys infill drilling can be aligned to the geological structures with drilling completed in the optimal locations to target the best laterite zones

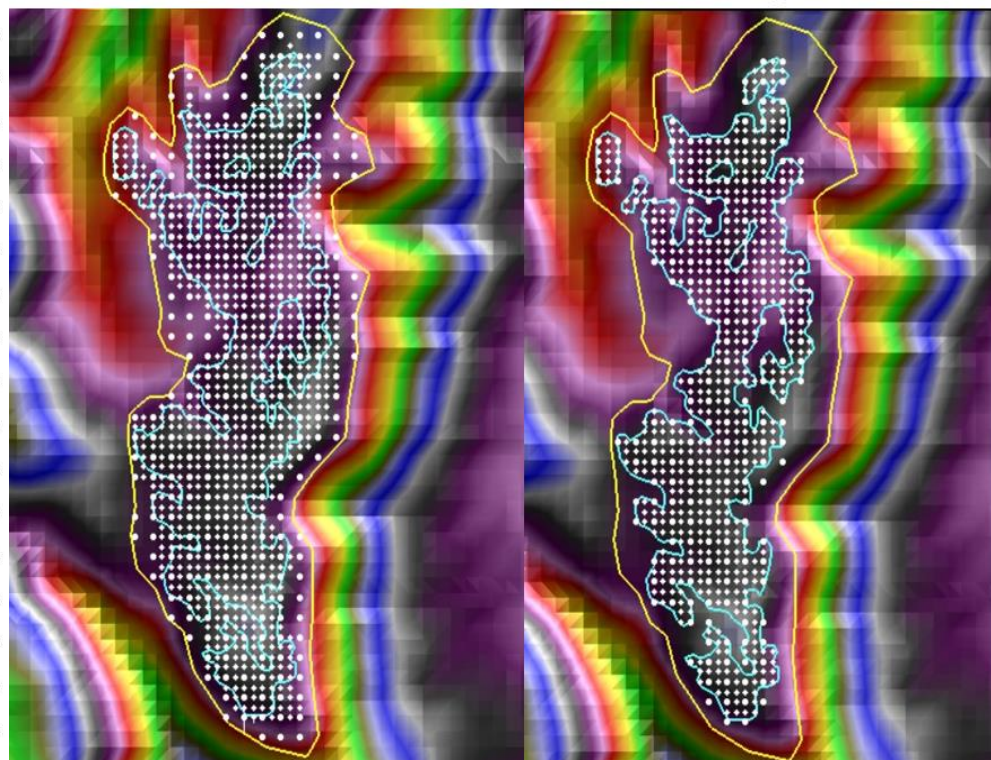
Potentially reducing expensive drilling and sampling costs by up to 40%

Additional benefits by completing the drilling phases quicker. The resulting significant completion time benefits to reach Mineral Resource Milestones faster

www.ptgeosearch.com



Traditional Blanket grid 100-50m



Combined method grid 100-50m



UltraGPR for Bauxite exploration



UltraGPR is mostly used for exploration, usually on a 100m grid, matching the drilling coordinates, but application to grade control can also be applied in some areas to 50m or 25m grids, when required

Typical working 2 -3 team in parallel

Team 1 – GPR Acquisition

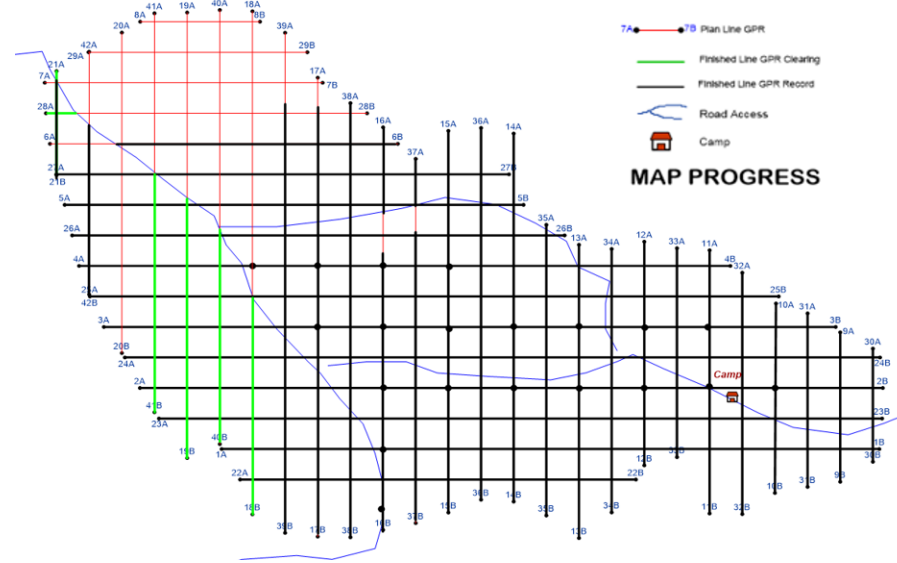
- 1 GPR Operator
- 3-4 field assistants

Team 2 – Line clearing

- 1 Line manager (GPS)
- 3-4 field assistants

Team 3 (optional) – Line clearing

- 1 Line manager (GPS)
- 3-4 field assistants





UltraGPR for Bauxite exploration



Other FAQ's

- In good conditions with lines already prepared UltraGPR acquisition team can achieve 1.5 - 3km/day on average
- Monthly targets are between 40-50km and can cover large areas up to 500-1,000ha/ month
- Line clearing and preparation is key to quick results
- Primary processing by Groundradar can be obtain within 24-48hrs usually, typically it is sent in batches weekly or monthly depending on the site communications
- Groundradar can also provide a viewer software for the client to edit the interpretation with new drilling and ongoing works
- Full, partial and rental packages are available to suit the clients needs and budgets



www.ptgeosearch.com

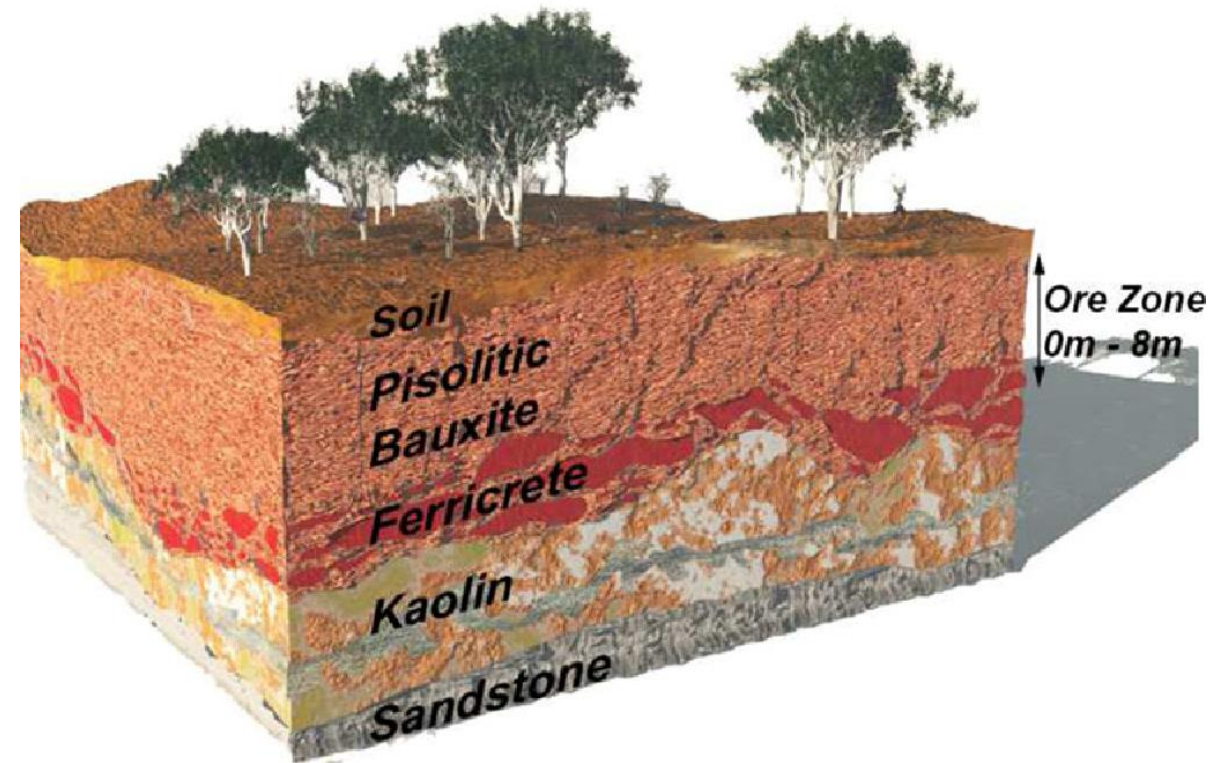


UltraGPR for Bauxite exploration



Major Clients and Projects

- Weipa, Australia (RioTinto)
- Boddington, Australia (South32)
- Tayan, West Kalimantan (ANTAM Tbk)
- MRN, Brazil (RioTinto, Vale, BHP, Norsk)
- Paragominas, Brazil (Norsk Hydro)
- Juruti, Brazil (Alcoa)
- Alpart, Jamaica (Alcan)
- Ketapang, West Kalimantan (Bumi Lipuan Teknik)





UltraGPR for Bauxite exploration

Examples of Other Geophysical Methods used in Laterites



Geophysical Survey Method	Average Price Ranges, without local labor costs	Daily survey capabilities	Additional labor requirements	Data Processing time	Notes
RESISTIVITY (Equipment Weight 50-80 kg)	Rp 10-20 Million /km	500-1000 m/ day	8 -10 local labor helpers to assist	1 -2 months	Medium cost option with Good resolution to identify rocky saprolite and bedrock contact,
SEISMIC REFRACTION (Equipment Weight 30-60 kg)	Rp. 30 Million /km	300-400 m/day,	8 - 10 local labor helpers to assist	1 - 2 months	High cost option with Good resolution to identify rocky saprolite and bedrock contact, but method is inefficient for large remote areas
UltraGPR - Ground Penetrating Radar (Equipment Weight 5 -7 kg)	Rp. 8–12 Million /km	1500 – 3000m / day, with line clearing	2 – 3 local labor helpers to assist	3 - 5 days	Provides Best low cost option for excellent resolution Depth to rocky saprolite and bedrock, Quick and robust system for minerals exploration



UltraGPR for Bauxite exploration

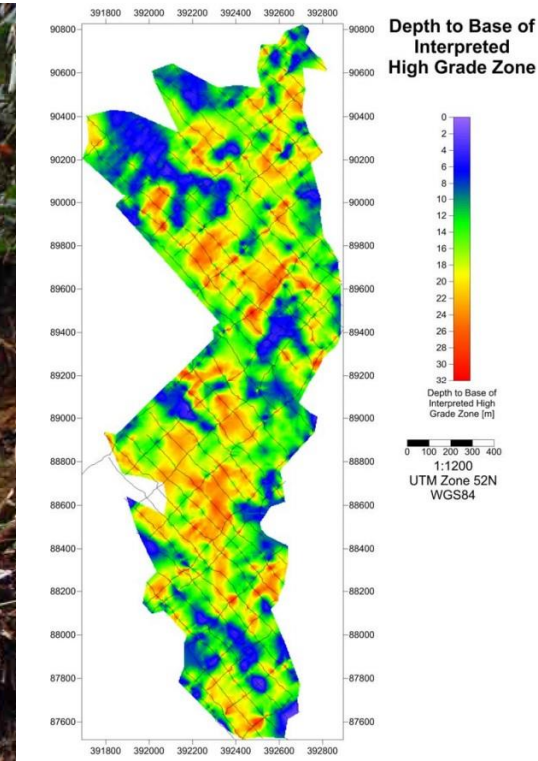


UltraGPR by GroundRadar Survey equipment specifications

More detailed technology information can be found at;

www.groundradar.com

UltraGPR offers increased penetration, accuracy, ease of use, speed of surveying and reliability. Real-time sampling technology has enabled the imaging of deeper reflections than has been possible with commercially-available systems to date. Depths of up to 75 m have been achieved in lateritic weathering profiles with UltraGPR, whilst maintaining excellent profile resolution. By eliminating all wires and fiber optic cables, as well as cumbersome control units and batteries, the UltraGPR has been reduced to a single 9 m long tube. The traditional laptop computer used on commercial GPR systems has been superseded by the use of a mobile phone or PocketPC to control acquisition parameters and store data. Communication between components employs Bluetooth technology. The unit is completely waterproof and can be deployed over the most challenging of terrains.



www.ptgeosearch.com



PT. GEO SEARCH

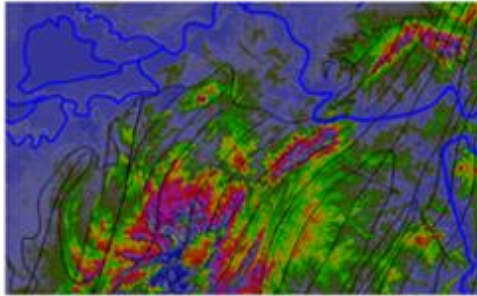
Fresh Ideas—Systematic Investigations—Optimum Results

PT Geo Search is an independent association of Australasian professional consultants providing technical services to the Asian exploration & mining industry.

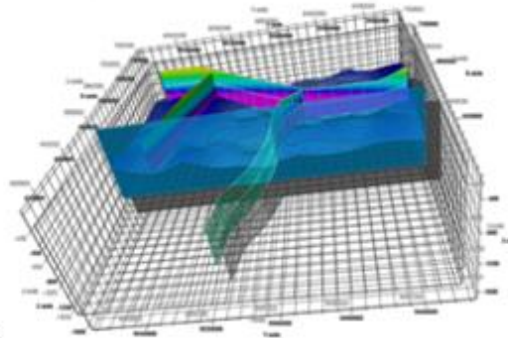
Capability Statement

Specialist services Geo Search provide:

- same day license plotting and preliminary project assessment for investors **FREE OF CHARGE**
- Exploration target generation and Resource evaluation
- Specialist in GIS methodology
- Application of in-house geophysical survey techniques including Seismic, Proton Magnetometer, resistivity/IP, down hole logging & Ground Penetrating Radar (GPR)
- Exploration planning and Management
- Database management
- Technical & Project Due Diligence
- Project development and management
- Resource modelling and Estimation
- General Geology & Mine planning advice for investors



GIS techniques to identify regional targets previously overlooked deposits



Geo Search in house geophysics capability can help identify less obvious exploration targets & provide extra confidence in existing resources development

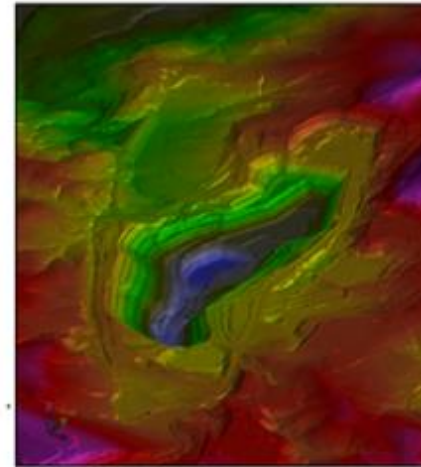
Great mining projects always owe their success to good geology and good planning.

In addition to our well recognized expertise in the Indonesian Thermal Coal & Nickel laterite sectors, we also have significant local experience in other commodities including:

- Copper / Gold & other precious minerals
- Lead / Zinc & other base minerals
- Tungsten
- Molybdenum
- Iron ore & Mineral sands
- Industrial and Agri-minerals



Geo Search can help you at all stages of your project development from greenfield exploration to mining feasibility studies



Geo Search uses cutting edge software and techniques for geological resource modelling to increase efficiency and optimize mine returns

We perform our work according to international best practice. Including reporting to the following codes, such as JORC (2012) and KCMJ (2011):

At Geo Search we use our unique blend of tried & tested systematic exploration techniques as well as cutting edge software, GIS & Geophysical technology to ensure our clients technical needs are at the forefront of the industry standards making new significant discoveries and building world class projects successfully.

Contact Us at PT. Geo Search

Phone : +628123869379

For all inquires: tobias.maya@danmar.asia

Fresh Ideas—Systematic Investigations—Optimum Results

www.ptgeosearch.com



UltraGPR for Bauxite exploration



Thank You.

Contact Us at PT. Geo Search

Phone : +62-812-386-9379

For all inquiries : tobias.maya@danmar.asia

Fresh Ideas – Systematic Investigations – Optimum Results

www.ptgeosearch.com