Cartographic Principle of the Detection of Blue Stake Hidden Installations in the Tenke Fungurume Mining Cancer in Katanga in The Democratic Republic of the Congo

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Abstract

The location, location and mapping of hidden facilities make it possible to avoid the risks of accidents and other nuisances that can cause material and human damage during the various phases of planning and construction of a project. Hence it is important to identify these to solve several problems on a given site. Damaging these buried utilities during construction work; urbanization continues to be one of the major risks for different industries. Currently, it is important to update information on hidden utilities that will serve several scientific disciplines during field work and for successful projects involving excavation, well drilling, exploration drilling, leveling And construction in the field of civil engineering. Bluestake (picketing and marking) processes identify and locate the various hidden utilities such as underground piping, ducting and cable systems, sewers and other installations that can emit a frequency that can be detected during field prospecting. Accordingly, the Blue stake processes are based on the geophysical prospecting method, see the electromagnetic approach using an apparatus consisting of a transmitter, a receiver, electrodes, the ground rod and the electromagnetic field clamp which Of the searched utility sends a detectable frequency and then locates it for mapping.

Keywords: Brucellosis; Community awareness; Goats; Guji; Risky groups; Sero-prevalence

Introduction

The Blue Stage is a process of identifying, marking, mapping and locating buried (hidden) facilities such as electrical installations, sewer pipes, fiber optics, or other similar facilities to avoid nuisance, risks of injury and damage during excavation and earthworks during the execution of geological structures (boreholes and prospecting wells, filter wells, geotechnical surveys), mining and civil engineering such as drilling in walls and concrete.

Presentation

This Blue Stake method is applied in the concession of the mining company Tenke Fungurume, which is located in the province of Lualaba ex Katanga in the Democratic Republic of the Congo about 195 Km northwest of the city province of Lubumbashi. This procedure applies not only to the mining concession but also to all operational areas of Tenke Fungurume Mining in the rest of the country (Figure 1).

Figure 1: Representation of the study area.

Problem

The Democratic Republic of the Congo has a number of public services and companies working in various fields such as hydroelectric networks, water and sewerage networks,

urbanization services and other areas of civil engineering such as road network construction, dam, earthwork, laying and then other works in geological fields such as drilling and prospecting wells, geo-mechanical survey. Some of the Congolese State's public services do not have reliable information and detailed maps of hidden underground installations in different sectors where work and various developments are evolving; where there is a risk of accidents which could damage equipment, personnel and the environment if these different installations such as electrical cables, pipes for water supply, telecommunication installations and various cavities on-site do not properly locate, map, identify and mark before performing the different types of work on a given site.

Objective

The objective is to identify research and mark the utilities to meet and then inform and prevent the risks of injuries and various types of accidents that can damage the environment, the ecosystem, or harm human life or cause property damage during excavation and penetration into buildings and land surfaces. As a result, we prepare maps to represent, diagram and locate the various buried installations and of which we do not possess any information. So we have to keep the diagrams, the maps, concern the buried or hidden utilities, and update their schemas if new information is available.

Principle And Regulation Of The Blue Stake Method (Piquetage-Marquage)

This procedure is applied when we have to penetrate a surface of more than 2.5Cm, excavate, drill, level, dig. During the various inspections of the work on the ground, we must thoroughly inspect the work area concerned by identifying, and marking the various installations located by means of suitable color paint, a drape, a picket or other marking such as lime, cement or ribbon. Thus, localized or detected installations are coded by the following colors: Red: Electric, Yellow: Gas, hydrocarbons, Orange: Communication cable, Blue: Water system, Green: Sanitary sewer systems, drains, sewers, piping Pulp, Purple: Process water from solvent extraction or electrolysis, White: Aeration system. Any field inspection prior to commencement of work such as drilling, drilling platform preparation, excavation, leveling and other civil engineering work must be done at least 48 hours or more before; in order to allow a good identification and elaboration of the detailed maps which can allow the location of the hidden installations on a given site.

Technology and Methodology for Detection of Entering Networks

Detection by destructive techniques

We mean by destructive technique, any method of sounding which rests on a mechanical and / or manual earthwork, in order to look for the structures not to hang when working nearby, while maintaining their operation [1]. There are two types of digging techniques:

- Mechanics:** generally deployed during the first tens of centimeters where we are assured of the non-existence of the risk of damage to the structure.
- Soft:** used when approaching the work on the last tens of centimeters of excavation. They are often established by hand, or by means of a vacuum truck.

During earthworks, the excavation techniques must be adapted according to the nature of the soil and the depths indicated by the network operator. Sometimes the layout of a network does not really correspond to the reality of the terrain, for example when we see that a structure passes at the edge of a tree because we know beforehand that this is not possible. Indeed, the regulation of the roadway provides a radius of 2m from the center of the tree, where no network must pass. In this case, it is necessary to begin by digging the mechanical shovel up to a certain depth (45cm for example), then it is necessary to continue digging with soft techniques. The purpose of the use of intrusive techniques is to expose all the networks entering the work area in order to gain visibility on the position of the structure and also to know precisely its construction material, its outside diameter, its protective coating, and its geometrical characteristics. We can also see singular points such as changes in direction and slope, as well as cut-off organs and their accesses [2].

Figure 2: Excavation to install the low voltage electrical cable.

Figure 3: Excavation to install the water pipe.

According to the methodology in this Blue stake procedure (Picketing - Marking) All new underground equipment must have a demarcation wire as well as appropriate safety ribbons buried with the line of material during installation. Thus, gas

lines, communication lines, plumbing as well as optical fibers, electrical installations such as low voltage cables must be buried in the ground to a depth of 70cm and then covered with a layer of washed sand, or other fine material approved at least 30cm above the utility lays and then a suitable safety tape with an indication. The medium and high voltage electrical cables must be placed at a depth of 1.20m to 1.50m covered with red dyed concrete and an indication tape located 15cm or 20cm above concrete and then placed at ground level with the naked eye, a plate marked with a sign of visible danger (Figures 2 & 3).

Detection by non-destructive techniques

At present, there is no non-destructive method which ensures 100% detection of all types of structures, which is why it is necessary to study the different techniques and adapt them to the other types of networks and to the environmental conditions of the project area.

Principle

This non-destructive technique relies on the detection of electromagnetic waves which diffuse in a current-conducting network. The latter can be an electricity or telephone network, but also a pipeline whose construction material allows the current to be transported. This is the case for water, sewerage or gas works that are made of copper, lead or steel. In addition, some networks are not conductive in nature, but they are sometimes installed with Plynnox current conductor cables (cable or tracer wire) which allow detection. This is the case for some fiber optic networks. Three methods of electromagnetic detection are used depending on the nature of the networks to be detected, the possibility of access to the network, the presence or not of the flush and the purpose of the detection (avoidance of damage or provision of network mapping: will be detailed in the Principle and use of detection equipment which will be seen below).

Geophysical Appearance of the Blue Stake Method (Piquetage-Marquage)

The Magnetic Prospecting

Prospecting by artificial or natural electromagnetic fields (EM), generated by currents varying in time, is called electromagnetic prospecting [3-6]. Note that electromagnetic techniques are interesting, even when it is a matter of rapid recognition, a "detection" or the simple discovery of areas of anomalies, quantitative interpretation in several dimensions (2D, 3D) can become very complicated and; is far from "intuitive". On the other hand, they have a crippling defect: their depth of investigation is limited, the more limited as the frequency of the electromagnetic field is higher. Electromagnetic prospecting equipment is used for a wide variety of conductors, both natural and artificial, such as conductor's in situ rock (graphite, massive sulphide, shear zones), artificial conductors (electric lines, pipes, metal tanks and pipes, railway tracks ...).

The Concept of Electrical Conductivity

Electrical conductivity is the ability of a material or a solution to let the electric charges move freely, thus allowing the passage of an electric current. Physical Principle: Electrical conductivity is the inverse of resistivity. It corresponds to the conductance of a portion of material 1 m in length and 1 m² in cross-section. Some of the best drivers include:

- a) Metals (such as silver, copper, gold or aluminum) for which charge carriers are "free electrons".
- b) Solutions of electrolytes (having ions in solution). For these, the conductivity value depends on the nature of the ions present in the solution and their concentrations. The conductivity of a solution can be measured using a conductivity meter. Some materials such as semiconductors have a conductivity that depends on other physical conditions, such as temperature or exposure to light, etc. These properties are increasingly used to produce sensors.

The Concept of Electromagnetic Induction

In variable regime, electric field and magnetic field are closely related, and even literally in dissociable. It is from this that comes the name of electromagnetism. A variable magnetic field generates an electric field: in this consists the electromagnetic induction of Faraday. In a conductor, an electric field creates a current, which creates a magnetic field; it is the law of Ampere. The EM prospecting method involves simultaneously three distinct physical processes, namely:

- a) The first consists in the production of a primary magnetic field which varies with time;
- b) The second is the birth of induced currents (eddy currents) in all the conductors on which this primary field acts;
- c) The latter is the detection of these conductors by the measurement of the secondary magnetic fields created by the eddy currents.

The amplitude of currents induced in a conductive body depends on several factors, roughly equivalent, which are: the electrical properties of the conductor; the dimensions and shape of the conductor; the frequency of the primary field; the location of the driver in relation to geophysical instruments

With regard to the Blue stake method, the detectors used apply the principles and methods of geophysical prospecting based on the localization of electromagnetic field induced on different utilities sought on the ground. The different frequencies transmitted by the utilities are picked up (detected) by means of a transmitter and a receiver. Using a GPS, the data are collected and then processed to obtain a map representing different anomalies of the conductors buried in the ground and of which we have no information in a given sector.

Materials Used in the Blue Stak Method (Pike-Marking)

VLOCPR02

Figure 4: Overview of the display screen of the transmitter.

Figure 5: View of the transmitter of the VlocPro2, laying on the ground during the prospecting work on ground.

Is an electromagnetic current detector composed of a transmitter and a receiver. The latter acts as a current generator whose power and frequency are modulable. A control screen indicates the various variables which are listed in the table below (Figures 4 & 5).

Presentation and description of receiver

Figure 6: Screen layout and receiver display.

The receiver is as shown below. The tube is made of carbon fiber which makes it resistant and lightweight. In the diagram you can see the different information provided by the main screen: The compass indicates the direction of the search utilities (i.e galvanized cables or pipes); the color changes to blue when the direction is parallel to it (Figures 6 & 7). The arrows help to point to this one while the gauge gives a maximum (or a minimum depending on the mode used) to plumb the utility finds. Also, the detected frequency and a depth gauge (within 10 cm) are shown. Simply press the “i” key to get the depth to the nearest centimeter (in the display, we are not talking here

about accuracy) and the intensity of the signal in Ampere. After having connected the transmitter to the network according to the different cases that will be seen below, the measurement in the field is done as follows:

Figure 7: View of the VlocPro2 receiver, on the ground during field surveys.

- Briefly locate the utilities by scanning from right to left, keeping the detector perpendicular to the ground,
- Orient the receiver with the compass (blue light when in the axis),
- Check the direction of the utilities by turning the receiver at 90 degrees, the signal must be minimum since it is oriented perpendicularly,
- Once the position and direction are established, the base of the detector must be placed on the ground and
- “i” to display (“+” to record) current and depth. The detector has an internal memory for recording.

Figure 8: Diagram illustrating the calculated and measured depth.

Figure 9: Diagram illustrating the zones affecting the quality of the depth measurement.

Note that the depth measured is the distance from the base of the receiver (at ground level) to the axis of the pipeline either

of the cable or pipe. Thus for networks whose diameter is not negligible, it will be necessary to subtract the length of the radius to have the exact depth of the top generatrix of the network. Attention, in certain cases, the diameter supplied is the nominal diameter, which differs from the outside diameter for some pipes (steel, for example). Always use the outside diameter to calculate the exact depth (Figure 8). Particular attention should be paid when locating in areas with elbows or perpendicular fittings as depth measurements may be imprecise due to distortion of electromagnetic fields. This constraint is very important and obliges us to always be vigilant and to take a critical look at the results obtained (Figure 9).

sebakmt5000: vibratory acoustic impulse detector

Unlike electromagnetic detection, acoustic detection is another non-destructive technique used to detect non-metallic networks. It is currently one of the most relevant methods for identifying plastic structures and connections. This detection technique relies on the injection of pulses by the generator before they are picked up by a receiver at ground level. There are two methods of signal injection:-Injection of pulses on the pipe: fixed on the plumb of the structure by a flange, the generator sends vibrations that are received by an accelerometer. This method is frequently used for water pipes. It has the advantage of not causing the cut of service to the customer. Injection of pulsations on the fluid contained in the pipe: complicated for the implementation, this method often provokes the presence of a representative of the concessionaire of the network, as well as the cut of the service, ensured by the work to the customers, because direct fluid access is required. We can sometimes avoid the interruption of the service by a connection on the "pressure" socket in the box.

Figure 10: Prospecting by the acoustic method.

Detection of buried networks at 20 cm and generally suitable for non-conductive pipes, this method of detection contains several disadvantages: -No indication of depth of detection: it is therefore not adapted to the mapping of buried networks; Ineffectiveness of detection in the presence of a vegetable ground or under a concrete pavement (field not properly compacted); signal noise in the presence of dense traffic in the vicinity, a sheath or other obstacles above or nearby; difficulty in locating short connections; risk of damaging certain pipes by the injected pulsations. Owing to these disadvantages, this method

is increasingly abandoned and replaced by electromagnetic detection and georadar techniques. The following is an example of an acoustic detector [1] (Figures 10 & 11).

Figure 11: Overview of the Hydrolux 5000 H2 Device localization of water leaks by acoustic method and its wave generator or pulse: PWG / 2-FAST (B).

Experimentation and work on land

In this study we use the VIVAX METROTECH vLocPro2 series detector equipped with a transmitter (transmitter), receiver, electromagnetic field clamp (clamp), earth rod, cables and a GPS. Note that the receiver has a compass as a guide, indication and orientation. The transmitter produces an electromagnetic field which is recorded and then picked up by the receiver in the form of the different investigative frequencies during prospecting operations, either in wide mesh and tight on site. These frequencies can be changed depending on the driver located on the ground. The VLocPro2 series detector is a unit that provides radar (radar) functions at several search frequencies. There are two modes of signal detection of the desired installations:

Passive mode or power

only the receiver is used and allows a simple and fast location of most underground networks. This mode is efficient in wide mesh during the general recognition of the various drivers on ground having a large area. Here the network itself emits a wave whose frequency is known, it is the case of some electrical networks; the detector receives this frequency and allows the identification of the utilities induced by this frequency (photo 8). Note that the passive mode is subdivided into:

- 50Hz mode: which picks up signals at 50Hz come from the under voltage electric cables
- And on the metallic networks induced by these cables.
- Radio mode: which receives detectable radio signals come from high power transmitters. Radio signals will be used to locate most conductive networks of more than 50 linear meters and of telecommunication cables in burrows and other ground wires for the protection of lightning sensitive equipment.
- Cathode Protection Signal Mode (CSP): Allows the receiver to locate the 100Hz frequency generated by a Cathodic protection current generator (Figure 12).

Figure 12: Large-mesh prospecting.

Active mode or active detection

This mode is used when the magnetic field is too weak. A current of a given frequency is circulated in the conduit or the wire rope which is transformed into an antenna, so that from the surface the direction is followed by an indicator compass located on the receiver of the detector. We use simultaneously the receiver and its transmitter which allows to generate a frequency on the sought-after utilities in order to locate and identify these with much more precision and then obtain the information on the depth of the utilities that we seek. Note that this mode is used in reduced mesh in addition the sought conductors must be visible to allow to connect the different accessories of the detector in ground. Thus, this technique is deployed with the use of a current transmitter whose frequency of the signal transmitted must be the same as that of the receiver. This mode has several availabilities for field detection, namely:

Indirect or inductive transmission mode

Figure 13: Prospecting in Indirect / Induction mode: Base camp.

This mode is used when the contact with the conductive network to be detected is not possible to establish a direct connection. To establish the transmission, we position the transmitter on the surface of the ground in line with the structure so that it can induce a positioning frequency. Moreover, the establishment of the issuer is carried vertically network tracing or geo referencing, referring to the plans from the response to visible utilities field. Nevertheless, this method has technical limitations such as the risk of confusion during the transmission of the signal which is broadcast on the conducting networks close to the detected structure. This can greatly influence the accuracy of plan metric measurements and depth accuracy.

Thus, this mode is sometimes used to carry out the layout of underground conductive networks because of its speed of execution of the non-necessity of connecting the transmitter to the network. Nevertheless, it is formally discouraged to use it for geo referencing services, as it is the least accurate mode of transmission (Figure 13).

Connection in direct mode

Figure 14: Prospecting in Active-direct mode.

This mode is used when we have the possibility of access to a conductive part and not protected by an isolation of the network, we connect the transmitter with clamps to the electrodes connected to it by connecting cords and cables. The first cable is connected to the desired conductor and then the second to a ground point with a rod driven into the ground. Thus, the transmitter supplies electrical energy to the desired line or network. The transmitter and receiver must be set to the same frequencies during field searches, and using the compass we can follow the precise orientation of the desired utility. Here the frequencies we had used a frequency between, 8 kHz, and 512Hz. Note that the security measures are very strict, do not connect equipment without the permission of those who manage the research network or on a cable more than 35V. Its combination with high power and low frequency contributes significantly to the realization of greater electromagnetic detection distances. In addition, the transmitter is protected from parasitic currents around it. This makes it possible to obtain the best results, even in the presence of a large underground dense area in buried networks (Figure 14).

The Magnetic Field Clamp (Clamp mode)

The magnetic field clamp allows the signal from the transmitter to be injected into the utility in use. This signal is picked up by the receiver, following the compass the orientation of the utility sought will be easier to trace. Note that the clamp must be well enclosed around the utility. Note that the search utility is visible and accessible to place the clamp with a specific frequency between 8kHz and 200Hz. Moreover, the current emitter allows selection only of a frequency adapted to the clamp. It does not generate any connection to the earth and is particularly useful for detecting power networks. This mode considerably reduces the risk of confusion between conductive networks that are too close. Thus, it allows a more precise detection than that which is guaranteed by the mode of transmission by induction (Figure 15).

Figure 15: Prospecting in Live Mode: The Magnetic Field Clamp.

Results of Field Research

In this section, we will present some fieldwork in inductive and passive mode when localization of a pipe of water pipe and electrical cables buried underground. Note that there are several cases but we will illustrate some more general examples.

Case of a Galvanized Pipe

Working in active mode: These data (a and b) were taken using the electromagnetic field clamp (Clamp mode)

Figure 16: Histogram of resistivity recorded by the receiver with respect to distance traveled.

a) The transmitter is set at a frequency of 32.8 kHz, by injecting the 100 mA current into the ground (Figure 16).

Figure 17: Histogram of resistivity recorded by the receiver with respect to distance traveled.

b) The transmitter is set at a frequency of 65.5 kHz, by injecting the 100 mA current into the ground (Figure 17).

c) The transmitter and its receiver are set to the same frequency (Figure 18).

Figure 18: Curve representing the distance traveled (m) with respect to the recorded intensity (mA).

- d) The transmitter is set at a frequency of 32.8 kHz
- e) The transmitter is set at a frequency of 65.5 kHz
- f) Working in active armature mode: without direct connection

Table 1: The transmitter is set at a frequency of 32.8 kHz.

Example	Mode	Frquency (kHz)	Resistivity (Ωm)
a	Active / direct connection	32.8	100
b	Active / direct connection	65.5	10
c	Active / induced: Indirect : without connection	32.8kHz	

During field work, the receiver and its transmitter are set at the same frequency; For example, in 32kHz mode, in this mode the transmitter is not connected to the utility sought by any connection. The emitter generates an induced electromagnetic field which translates into the waves that enroll the desired utility; the receiver picks up these waves, which appear on the screen as electrical energy in milliampere. Thanks to the compass we can follow the direction of a pipeline or different utilities sought (Table 1).

Case of an Electric Cable

Figure 19: Histogram representing the distance traveled (m) with respect to the sensed intensity (mA).

In this case, we had set up the receiver and the transmitter at a frequency of 32 kHz during field reconnaissance, that is, in active armature mode. For safety reasons the equipment used must not be connected to live electrical cables. To establish the transmission, we position the transmitter on the surface

of the ground in line with the structure so that it can induce a positioning frequency (Figure 19).

Cartography of Utilities Obtained

Figure 20: Théodolite digital Trimble Photo.

Figure 21: GpsTrimble.

Figure 22: Map obtained on Autocard of the various utilities detected in the search site.

The coordinates of the different utilities sought were obtained thanks to a GPS, in consequence the treatments of these last were made using software GIS and Autocard. Note in this framework we will illustrate the map obtained by the autocard sector software of our field research. These utilities are located at a depth that is not constant. In general, the depth of investigation varies between 0.30Cm and 1.50m depending on whether it is an electrical installation (cable) or a piping installation (Figures 20 & 21). The coordinates taken were put in an Excel file during their processing on autocard but converted into CSV file during processing and digitization on GIS. Note that the map shown below was realized by the drawing software Autocard (Figure 22).

Recommendation

Figure 23: Excavation works for road drainage on Biayi.

After the time spent on our research and prospecting on the ground and view the need and importance of this method Blue stake (picketing-marking) hidden utilities of which we have no information in the screen; we recommend to the administrative and administrative authorities of the Congolese State to be able to provide the Republic with laws and norms that can enable the different services of the state such as cadastre, urban planning and civil engineering services and all those working in the fields roads and other construction sites and to individuals see other power companies is inspired and put into practice the standards of this method of Blue stake (picketing-marking) in order to avoid and prevent accidents in their yards or damaging existing utilities that can cause material loss or workers' lives on the ground or deprive several people or residents of a neighborhood without electrical energy or water after damaging the utilities (photo14). Lack of detailed plans and maps of various utilities can cause very serious damage during excavations, f and drilling on the ground from which the prevention of these various dangers is necessary. Thus the Congolese State or other bodies, or even individuals, could use this Blue stake approach for development projects and urban planning in different societies in order to perform the various tasks safely according to the principles and standards in the framework for environmental protection and sustainable development. Our wish in this area of research and projection in the future; is to extend this method to obtain maps and detailed plans of several sectors which can be consulted by different public services of the state or by private individuals with the major aim of not damaging the utilities meetings and then to update them in cases of excavation discovery and penetration at various sites and sites in accordance with the appropriate safety principles and standards (Figure 23).

Conclusion

The Blue Stage method, which is a process of identifying, marking, and mapping buried (hidden) facilities, enabled us to work with reduced wire mesh to precisely locate electrical cables and pipe sector of our research in the city of Fungurume in the province located in the vicinity of the national road N ° 39 to the NW of the city of Lubumbashi. During fieldwork, electromagnetic prospecting in active mode where the direct connection of the electromagnetic field clamp connected to the transmitter and around the equipment sought and / or the electrodes connected on the one hand to the ground on the ground, using a ground

rod and the other on the utility sought gives much more detail regarding the location, direction and depth of galvanized pipe located in our research explained above. Our finding is that the current injected into the ground from the emitter expressed in milliamperes; records a resistivity which decreases as a function of the distance traveled on ground; in other words, the closer you are to the transmitter source (the transmitter), the stronger the signal, the farther away from the source the resistivity decreases, therefore the location and identification of the desired utility becomes more and more difficult.

The histograms and curves shown above interpret the way in which the required utilities (galvanized electrical cables and pipes) perform during the geophysical prospecting work on an electromagnetic field approach with respect to active mode in direct connection using either the electromagnetic field clamp, or the electrodes pushed into the ground and connected to the equipment (the Vloc Pro2 detector). Let us note that in this case we work in a reduced mesh for more precision on ground. The same applies when working in active armature mode where the transmitter is not connected to any utility (cable, hose) searched on ground. The passive mode is used for general recognition in wide mesh, allowing us to locate different signals that are considered anomaly during field prospecting.

It should be noted that acoustic detection by Hydrolux5000H2 and its acoustic generator PWG / 2-Fast require good attention

and hearing when working on terrain; the very sensitive input equipment even registers the surrounding parasites, which can lead to a misinterpretation of the results and therefore be misled. The representation on the map of the utilities by different colors can be explained according to the code which governs this method as seen above in order to distinguish the networks from the electric cables, those of the pipes or the like. It should be noted that the detection of these hidden utilities was carried out on clayey, sandy and talcous soil, as well as on the siliceous and dolomitic shales characterizing the series of mines located in our research area.

References

1. Soufiane laqbayli (2013) Study of market development opportunity in the network topography market 24: 38-39.
2. Technical guide for works in the vicinity of networks (2012) p. 71.
3. www.observatoirenationalddict.fr/sites/default/files/fichiersPDF/textes%20reglementaires/guidetechnique06-2012.pdf
4. Keary PM, Brooks (1991) An Introduction to Geophysical Exploration. Black well scientific publications, pp. 1-281.
5. Reynolds JM (1997) An Introduction to Applied and Environmental Geophysics. Wiley Chichester UK, pp. 1-710.
6. Telford WM, LP Geldart, RE Sheri (1990) Applied Geophysics. Cambridge University Press, 2nd edn.

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