MAGNETIC FIELD MEASUREMENT TECHNIQUES AND INTERPRETATION OF THE ANOMALY

Prepared by

Idem Technology R & D Team

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CONTENT

1.EARTH'S MAGNETIC FIELD

The magnetic field of the Earth, the electricity generated in the outer core in the liquid state currents are produced by. Solid interior with base of liquid outer core in the Boundary region between the surface of the core, the liquid with the effect of increased pressure substances that pass from state to solid emit energy. This released energy is external for liquid matter in the nucleus to begin convection motion usable. This motion is caused by the rotational motion around the axis of the Earth. It generates electric currents by interacting and is a bipolar one to the periphery of the

currents the magnetic field happens. Conversion of motion energy into electric current the result is this mechanism by which magnetic fields are produced “Dynamo theory” it is explained by the theory known as. Force lines related to the Earth's magnetic field, in the outer core "the Magnetic of the Earth," in the direction that connects the two points where it converges axis", where the axis cuts the surface of the earth to the points “Earth's magnetic the poles are called”. The magnetic axis is not coincident with the axis of rotation and 11o between them .There is an angle of 5. The middle of the distance between the two poles its point is called the” magnetic center". Passing through the magnetic center and the plane perpendicular to the magnetic axis is called the “magnetic equator”.

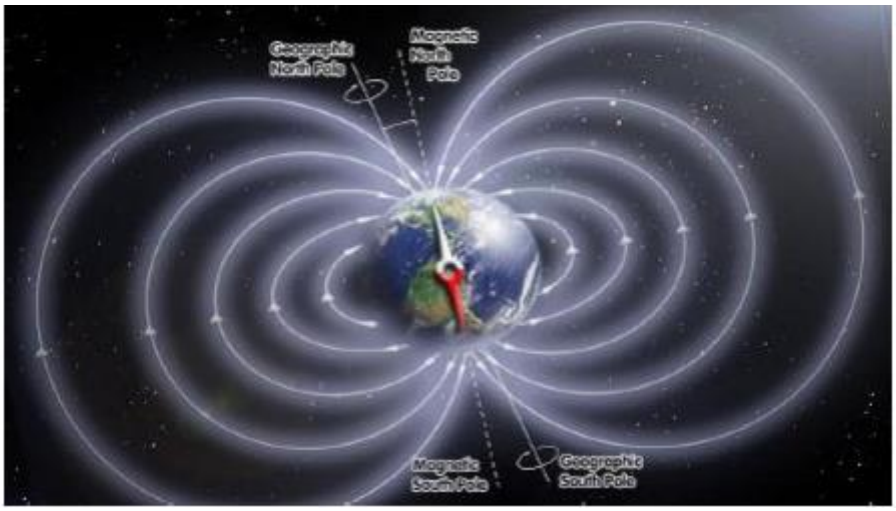


Figure 1: ground magnetic field lines.

1.1.Changes In The Earth Magnetic Field

The Earth's magnetic field is not always constant. These are in various periods the changes that occur. Some of these changes are in Applied Geophysics it is important.

1.1.1.Magnetic storms: annual and 11-year changes. From the sun, it is formed by emitted charged particles. About 1000 there is an exchange of gammality (1gamma=1nT).

1.1.2.Daily changes: the effect of The Sun on the ionesfer and also, the tidal effects of the sun and Moon on the atmosphere and the resulting are daily changes. The change is between 20-30 gamma.

1.1.3.Secular changes: long-term changes. Decades or it can occur over centuries. Usually liquid exterior fluid movements in the core are caused. Impact approximately 25 gamma.

1.1.4.Westward shift: magnetic field approximately slipping 0.1 towards westward. . This is because other rotational motion in the nucleus is slower than other regions.

1.1.5.Magnetic inversions: North and South magnetic poles in time, they are relocated. it has been observed that such rotation events also occur in the sun and other stars. There are 3 rotations per million years on average.

1.2.Types Of Magnetism

Magnetic properties of a rock, depends on the magnetic minerals contained in the type and the length of the grain. There are three major types of magnetism.

These;

1.2.1.Diamagnetism: can be seen in all matter. Diamagnetism to counteract the applied magnetic field of matter it is a enabling situation. Therefore, they are pushed by the magnetic field.

1.2.2.Ferromagnetism: paramagnetic in ferromagnetic materials it has unpaired electrons like substances. But these electrons magnetic moments parallel to the applied magnetic field as well as trends, magnetic moments state low energy. they try to parallel each other to protect. Therefore

Magnetic of matter even when there is no external magnetic their moments become parallel to each other simultaneously they try.

Common ones: iron , nickel , cobalt and their alloys. Also some rare metal alloys also show ferromagnetic properties.

In the Geophysical magnetic method ferromagnetic rocks yield anomalies.

1.3.Magnetic Method

It is one of the oldest branches of Geophysics. In the magnetic method, the Earth's magnetic field changes are examined. Vertical of the earth magnetic field slope and deviation angles with component, horizontal component or field vectorb measurable. Applications usually total area or vertical its components are measured. Magnetic permeability, a substance is the property of and the severity of magnetism caused by the external magnetic field determines.

1.3.1.Application Areas for locating pipelines

* Archaeological structure search

* Waste detection

Discovery of ancient oil wells

* Mine location determination

*Mineral exploration

* Oil exploration

*Fault line determination

*Continental gliding and seabed spread

* Basic rock research

Construction of

* In geological structure survey

* Finding karst structures

* In the study of sedimantological structures

* In soil analysis

* Investigation of fracture-crack systems in marble quarries

Current in forensics

In the study of volcanic movements

1.3.2.Advantages of the method

* Measuring is quite easy and fast.

* Is an economic method.

* Has no direct contact with the location.

* Is sensitive only to ferromagnetic metals.

1.3.3.Disadvantages of the method

* Change measurements, in depth according to total area measurements it is less sensitive to objects.

* Magnetic measurements such as steel pipes, fences, vehicles and buildings it is susceptible to disruptive effects.

* Total field measurements to changes in the magnetic field of the Earth he's sensitive. A base station to destroy this effect should be used.

1.4.Magnetic Corrections

As in the gravity method, in order to obtain the anomalies which is caused by objects underground, a number of changes that affect the measures needd to be eliminated.

1.4.1.Daily Corrections: returning to base point every 2-3 hours these changes can be remedied. Another way to fix these changes are by recording the base point of magnetic field changes continuously. In extraordinary cases (magnetic storms) that day's measurements can be cancelled.

1.4.2.Heat correction: depending on the heat change of the device, correcitons can be made. In Modern measuring devices there is no such problem.

1.4.3.Topography correction: in places covered by some volcanic rocks magnetizations of surface rocks can be very important. There isn't a solution. The measurement point being in a pit or hill can cause significant differences in our data. the correction process is very difficult due to the lack of information of rocks' magnetization

1.4.4.Height correction: vertical gradient of Earth magnetic field 0.03 nT/m at the poles and half of it at the equator. Rather this effect is insignificant. An average of -0.024 nT/m can be taken for Turkey.

1.4.5.Latitude-longitude correction: the magnetic field of the Earth can be altered in terms of Latitude and Longitude. Earth magnetic field also varies yearly. These changes have been calculated according to the International ground magnetic reference field (IGRF). Corrections can be calculated and done according to the measurement time at each latitude and longitude.

1.5. Effects Of 50 Hertz Frequency Electromagnetic Fields

The voltage of the electricity produced in a power station is well raised (30,000-300,000 volts), remote locations, high voltage lines (HVL), we know from physics that it is transmitted with minimal heat loss. The transformer stations, which are build at different locations in cities, can reduce the high voltage, which is between 10,000-36,000 volt, to 400-220 volt to be used in offices and houses. Thus, from transformers to buildings with underground cables, usually at 50 Hertz frequency and high current intensity (Amper) 220 volt alternating electric current is reaching. Both high voltage lines (HVL) and transformers, they are creating electromagnetic fields in their surroundings. Secondary circuit of the transformer and from this the variable electric current distributed to the houses by

underground cables electromagnetic fields produced in all kinds of conductors around them they create electric currents. Relevant international institution (ICNIRP), today the limit is 50 Hertz as value for frequency electromagnetic fields, the magnetic flux density limit is value of 100 microtesla (μT) and boundary value of electrical field intensity it is set at 5000 volts/meter. According to the conducting researches, being uncertain, it has been realised that the technical features of underground scanning devices are affected by this high voltage lines. When working at the outer walls and around the underground cables of transformers, it is very important to stay below these measures. Few meters away from the transformer the intensity of magnetic flux is dropping. If the transformer is inside of a building, it has to be taking consider not exceeding the limit values, in the rooms next to it or below it right there. While " The Effect of variable magnetic fields" is significantly decreasing (5-10 meters away from the Transformers) the effect of human beings are also continously reducing. Measurements which we conducted near various Transformers with a portable instruments, while these measurements shows a maximum value of 2 microtesla (μT) on their walls, these values goes down to one-tenth of a distance of 1-2 m. The internal walls of substations, high permeability for electrical charges, usually they are armored with an alloy called Mu-Metal material: (80 % nickel, 15% iron, 5% molybdenum and very small amounts of Silicon, it can be composed of manganese and carbon, as well as 77% nickel, 5% copper and 2% it can also be chromium or molybdenum).

2.GEOPHYSICAL DATA

Geophysical data is the reaction caused by a physical parameter. For example when measuring the magnetic field underground, the natural magnetic of the Earth the presence of magnetic material in the area that would affect the value of the field creates a negative or positive effect. Measurable geophysical data drawn as a function of time or distance.

2.1.Geophysical Symptom(Anomaly)

Measured geophysical data differently from "known background impact" is called an anomaly.

2.1.1.Magnetic Anomaly

Magnetic Anomaly is the result of deterioration caused by local changes in the earth magnetic field or anomalies by change of ferromagnetic materials' concentrations which are located near magnetometer's sensor. Magnetic data square / rectangular grid in terrain the layout is measured along a profile.

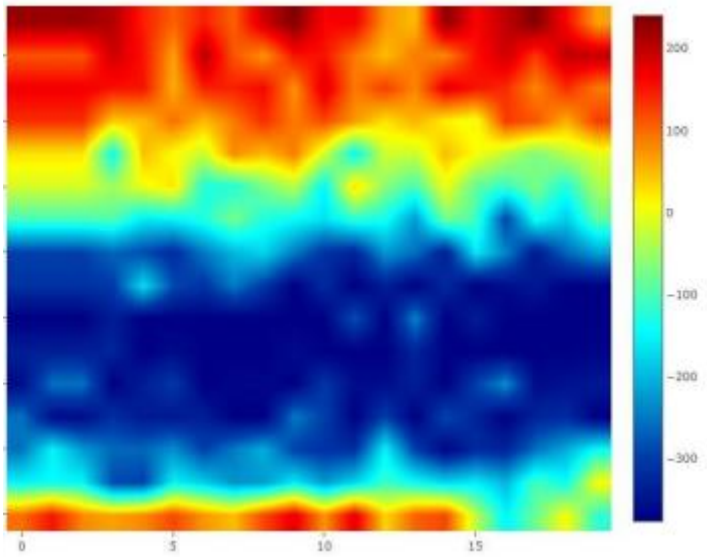


Figure 2: Space Structure anomaly example.

3. INTERPRETATION OF DATA WHICH OBTAINED FROM MAGNETIC FIELD MEASUREMENTS

There are many factors in the interpretation of anomalies in geophysics; an accurate way of measuring, to have information of the geology of the area, to be able to know of external factors which can affect the measure determination, such as the experience of the commentator. But the interpretation of the data and the process of it, which we obtained from the magnetic field measure, is considerably easier than other geophysic methods.

3.1.Magnetic anomaly samples and what needs to be considered by interpretation

3.1.1.Effect of gap structures on Anomaly:

Eventhough the studies which conducted in this field are limited, we observed that the holes those are opened in deeper locations are producing more powerful anomalies than those are opened at wide but shallow locations. Since the distances between magnetic dipoles vary, the deep one has longer interpolar distance, while the other has an opposite property illustrates. This is a condition that affects the magnetic anomaly.

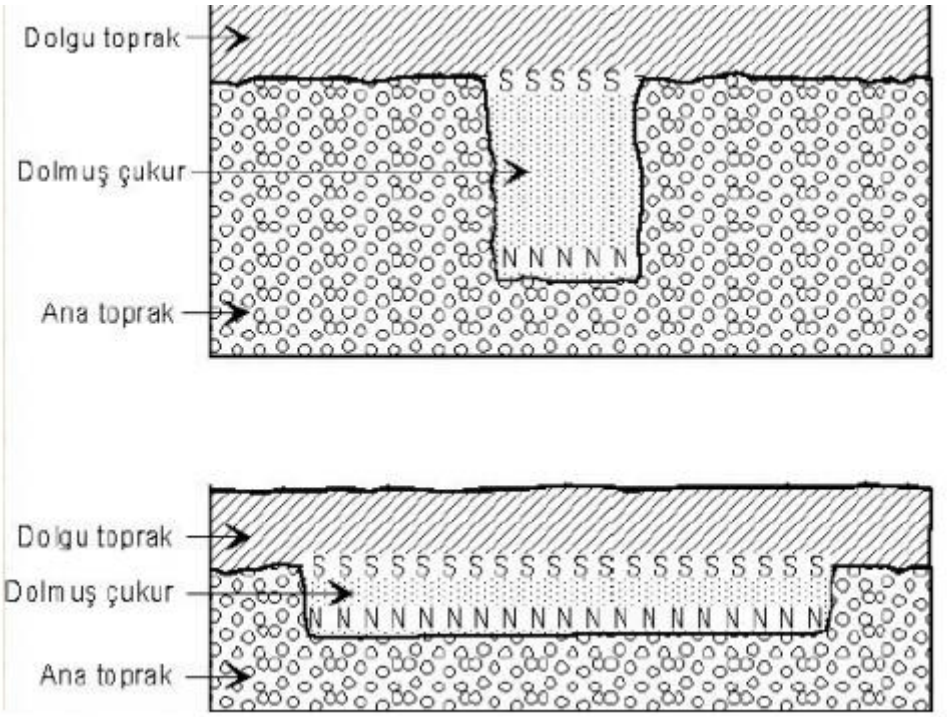


Figure 3: two different spaces and magnetic polarization.

3.1.2.Effect of depth on anomaly:

At different depths underground the effect of the same material on the measured magnetic field by depth differs. As the depth at which the material is buried increases, it shows the anomaly shrinks.

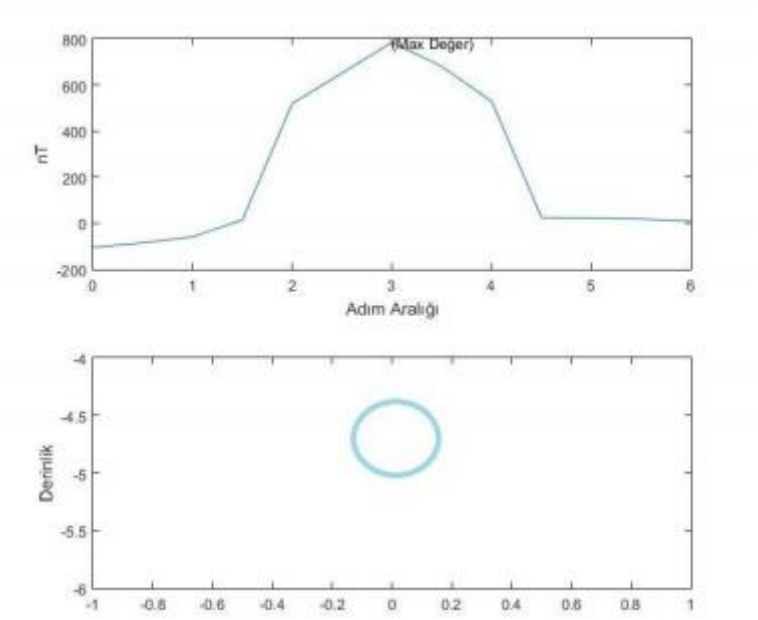


Figure 4: magnetic field anomaly of a material buried at 4.5 meters the value is approximately 800nT.

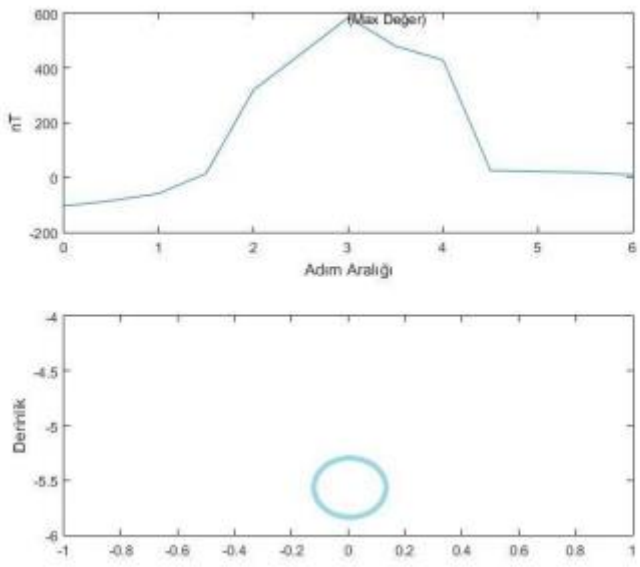


Figure 5: magnetic field anomaly value of embedded material at 5,5 meters about 600nT.

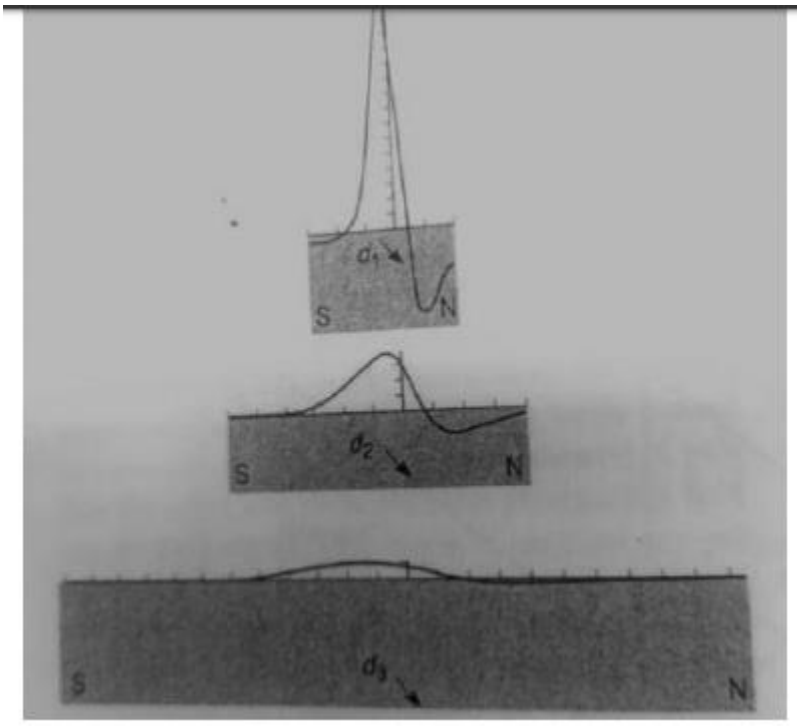


Figure 6: anomaly of a single dipole at different depths.

3.1.3.The effect of Angle on the anomaly in the plates: the value of magnetic field anomaly gets higher when it is located at the right angle.

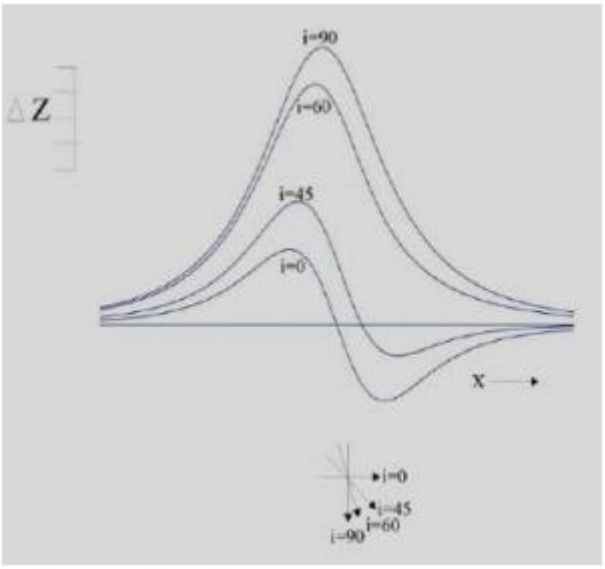


Figure 7: anomaly size according to the slope angle of the plate.

3.1.4.Effect of different latitudes on Anomaly: the natural magnetic field of the Earth is 70000nt at the poles and 25000nt around the equator. Therefore magnetic field measurements give different values at different latitudes.

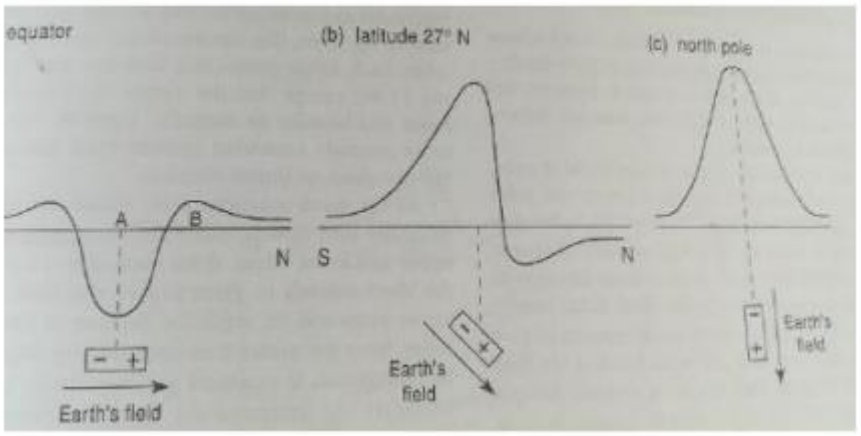


Figure 8: effect of a single dipole at different latitudes.

3.1.5.Effect of material shape on Anomaly: the shape of underground material has an effect on the anomaly. In figures 9 and 10 the effect of Sphere and cylinder can be seen.

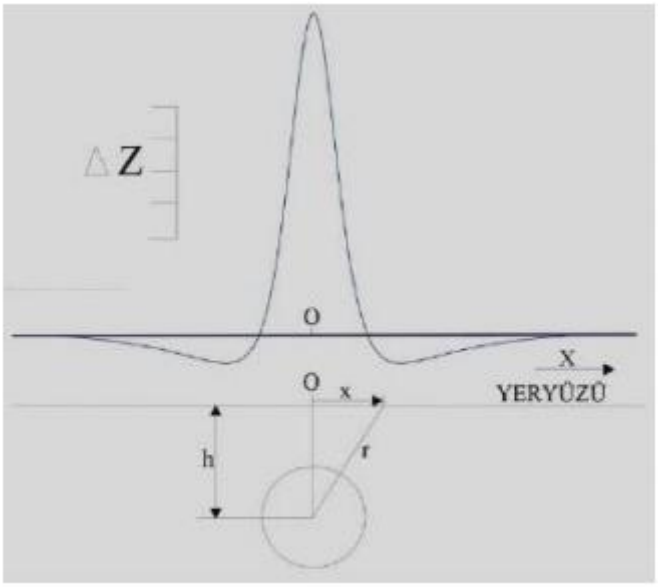


Figure 9: effect of sphere-shaped material on anomaly.

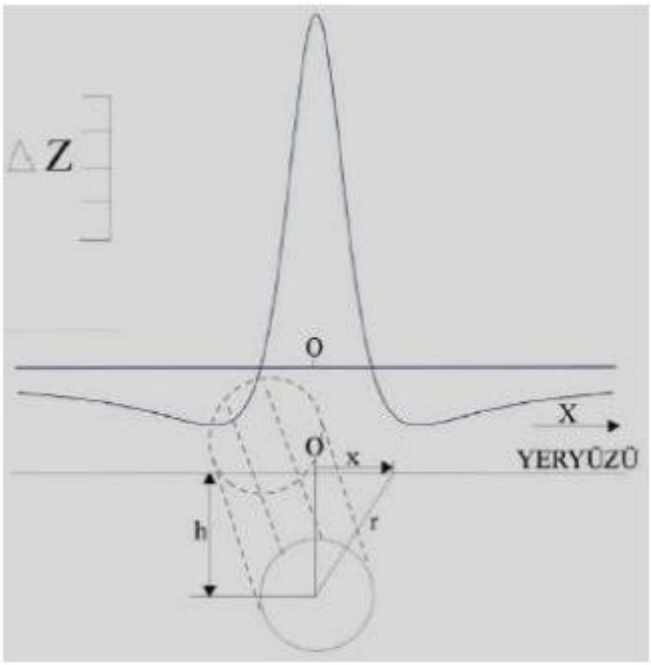


Figure 10: effect of cylinder-shaped material on anomaly.

3.1.6.Effect of underground structure on Anomaly: lack of material underground magnetic causes negative anomaly. In Figure 11 it appears that Graben formation negatively affects the anomaly.

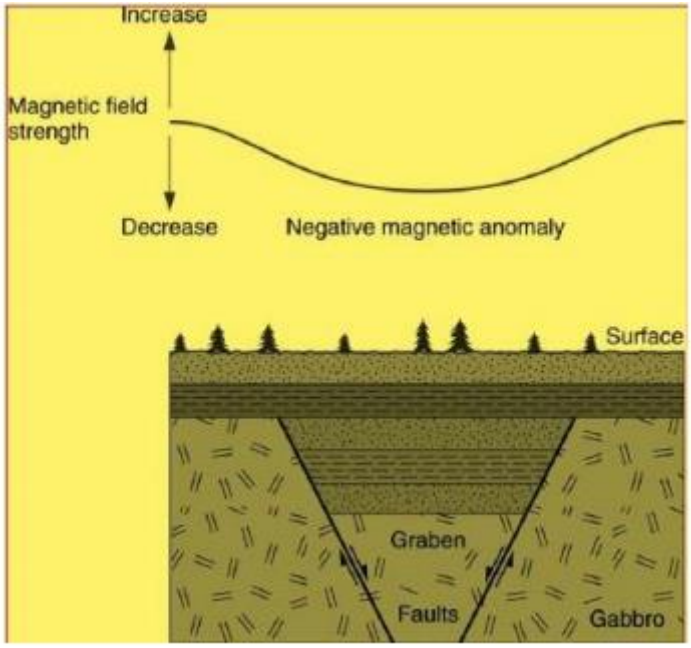


Figure 11: effect of Graben formation on anomaly.

4.TORUK101 UNDERGROUND IMAGING AND FIELD SCANNING DEVICE

Toruk101; a gradiometer which is 1m tall, weighing 252gr manufactured and designed with domestic production and domestic software by Idem technology fully considering ease of use and ergonomics.. Data processing with distance between magnetic sensors in the gradiometer magnetic anomaly map obtained after the correct clarity it is proportional(Figure 12). Use of Idem technology, when

producing Toruk101, gave importance to its ease and achieved by not extending the length of the device handicap with the advanced algorithms used in the original software he must have.

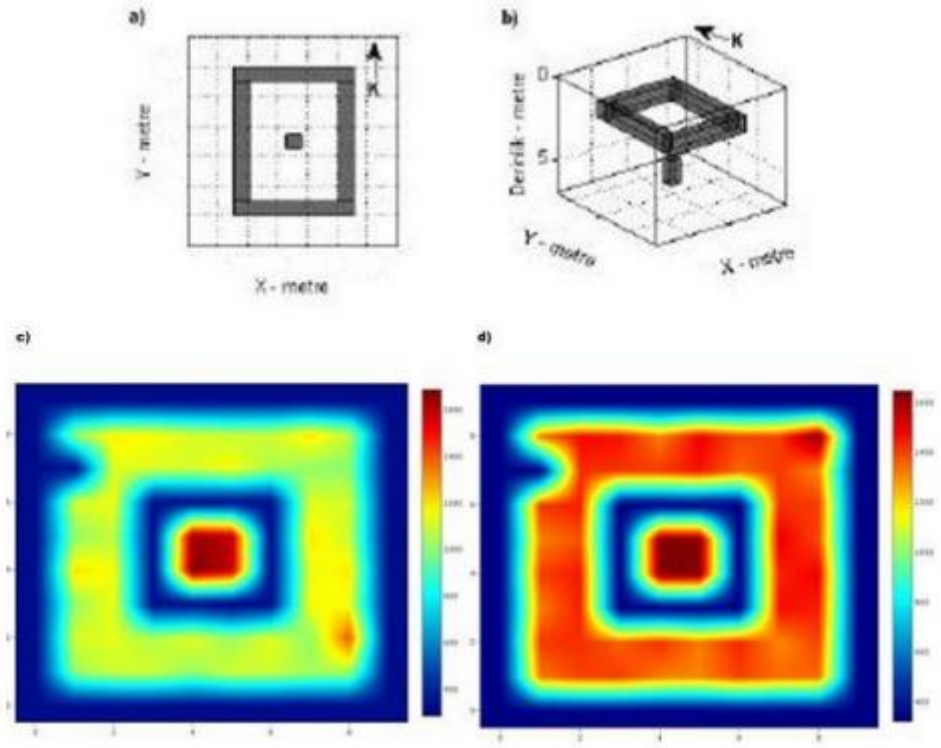


Figure 12: (a)Image of the Model, (b) 3D perspective image of the Model, (c) vertical magnetic gradient image calculated for 0.5 m receiver range map, (d)vertical magnetic gradient calculated for 1m receiver range image map

4.1.Toruk101 with underground imaging and field scanning device

Samples Of Anomalies From Taken Measurements

- Determine the measurement area in the study of the location of the buried pipe square grid layout is measured with. as seen in Figure 13, there are factors such as the vehicle and manhole cover which will affect the magnetic field, although our device provides very good result. In figures 14 and 15, the anomaly of the pipe is clearly seen. Color when commenting on the anomaly map you have to pay attention to the distinctions. As in this example generally warm colors (red and shades) of the magnetic field it shows the parts where it is positive. The material we're looking for is an archaeological building with metallic mines or burns red, dark red in our heat map, as in this example the fields are the anomaly of the material we're looking for. Cold colors are regions where the magnetic field value is low illustrates.

Figure 13: Measurement area.

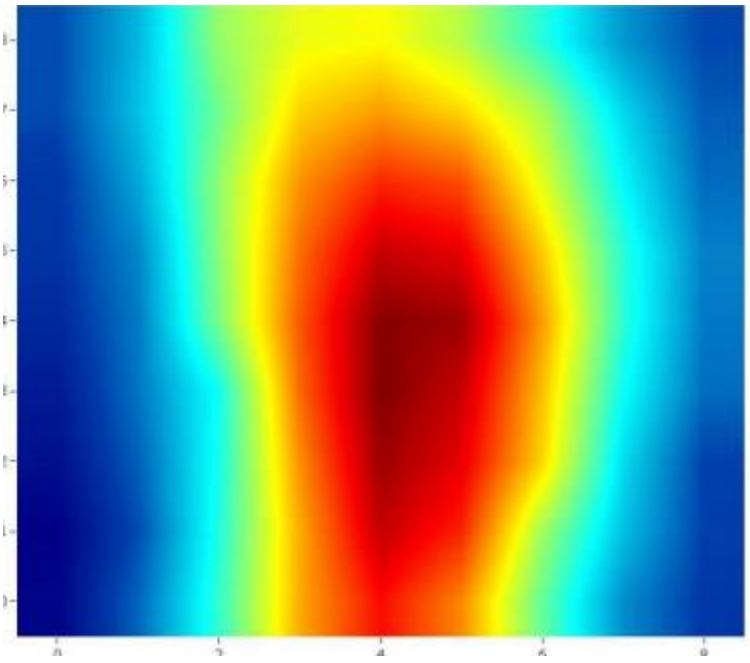


Figure 14: Steel pipe anomaly map with 2D.

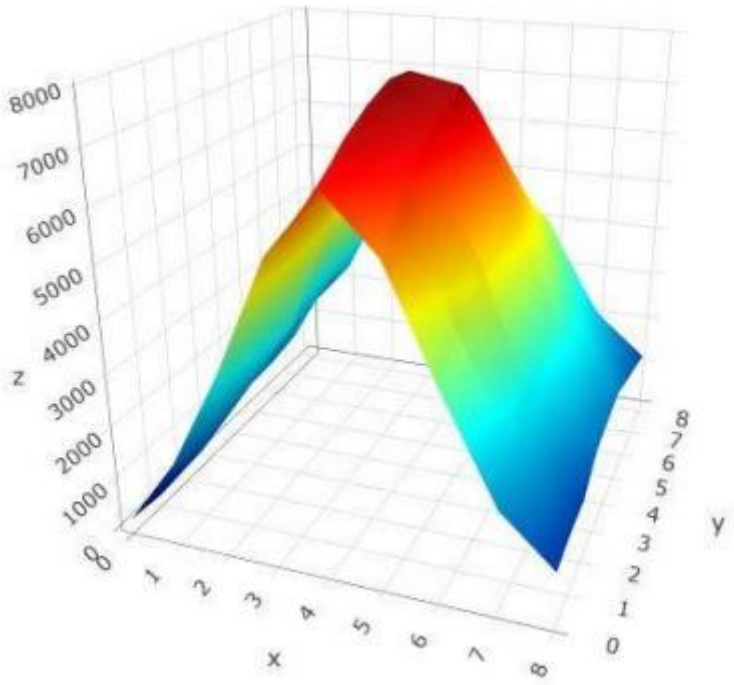


Figure 15: Steel pipe anomaly map in 3D.

Figure 16: measuring area.

*On ytong we buried in our test site in this study we took measurements and ran the results. Our measuring field in Figure 16, Figure 17 and in 18, we have a clear anomaly in 2D and 3D. As embedded material in this example in the composition of the quartzite rock contained in the ytong we used since metallic minerals such as magnetite and hematite are present, a as in the previous example, magnetic represented by the color red again the area value can be clearly distinguished

from its surroundings. Magnetic field value of medium -100nT to 0nT value magnetic field value of ytong between 500-600nT it measured around.

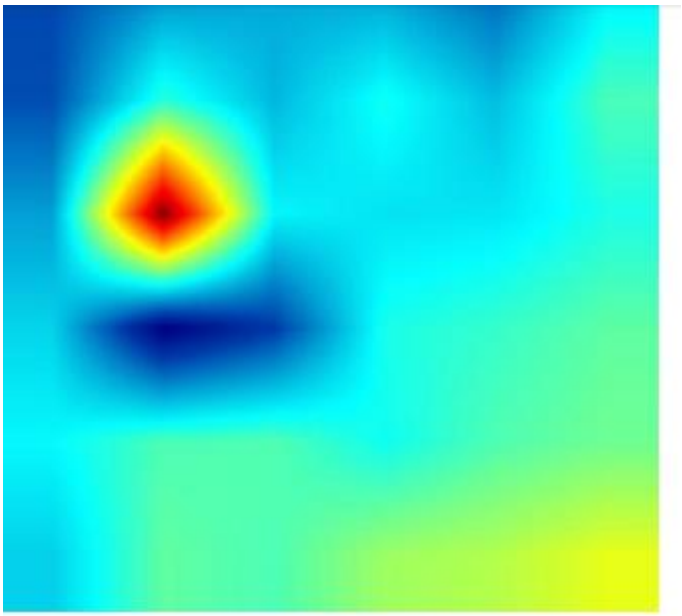


Figure 17: Ytong anomaly map with 2D.

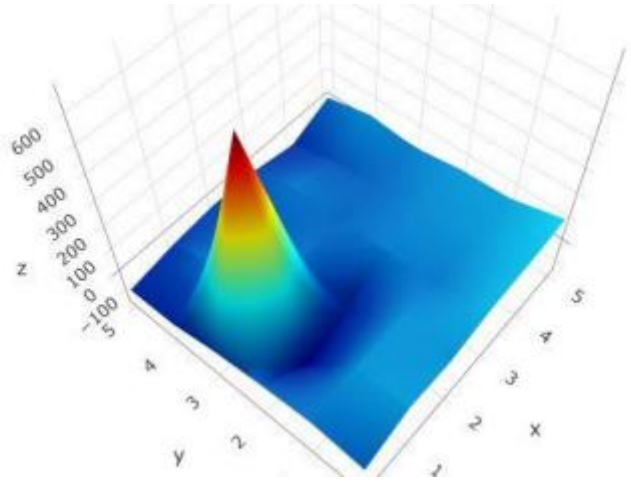


Figure 18: Ytong anomaly map with 3D.

Figure 19: Test pitch.

* As a result of the measurements taken at the test site in Figure 19

2D magnetic field map and 3D magnetic field maps Shown in Figure 20-21. The anomaly here when we examine it, we see a polarization in Figure 20. So here is a dipole with negative and positive pole (e.g.we can talk about the existence of a steel pipe or sheet form.

When we look at the 3D magnetic map in 21, it's also hot it seems a harsh transition from colors to cold colors. In this example cold colors the magnetic field of the medium or magnetic field it can be thought of as a material with a negative effect, but it is is not. The question that comes to mind at this point is how to make this distinction Could be. This distinction can be made as a result of experience gained through practice

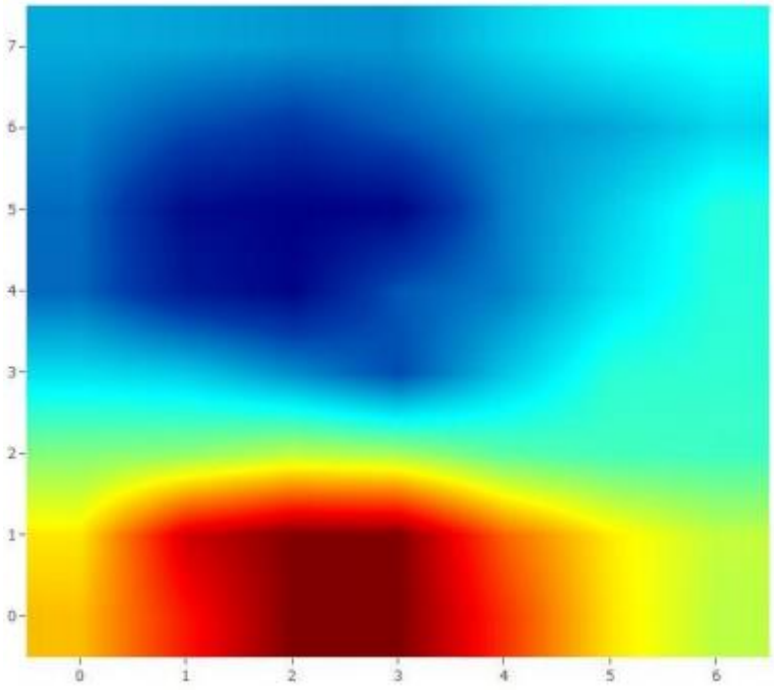
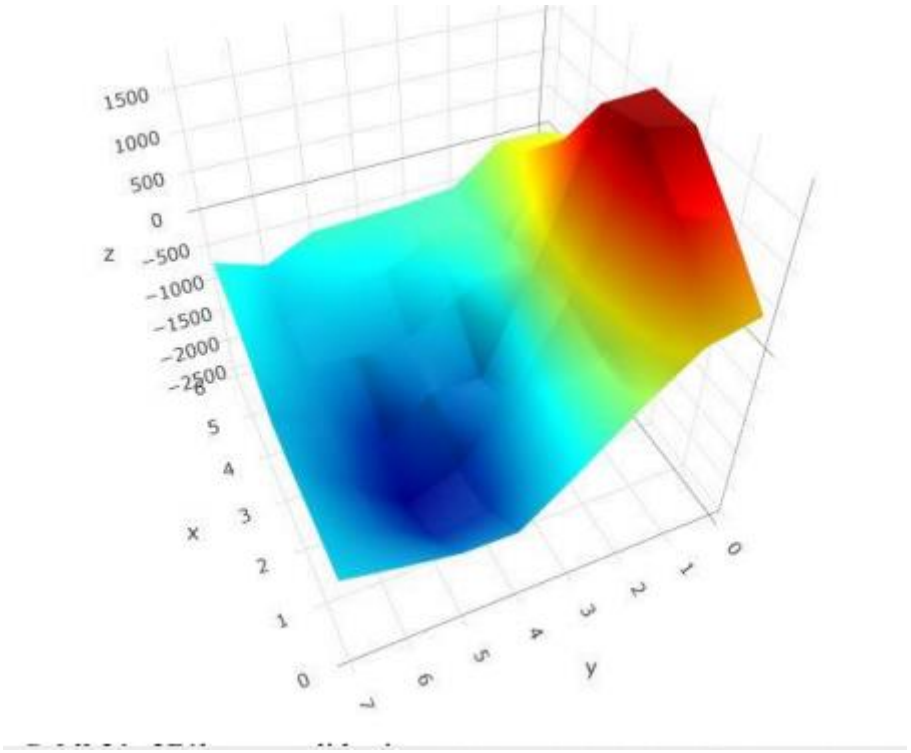


Figure 20: 2D anomaly map



* Figure 21: 3D anomaly map

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