IMPACT: International Journal of Research in Applied, Natural and Social Sciences (IMPACT: IJRANSS)
ISSN(P): 2347-4580; ISSN(E): 2321-8851
Vol. 5, Issue 1, Jan 2017, 31-38

DETECTING A CANAL UNDER A DEPTH OF 5 METERS HOLY MOSQUE IN KUFA USING GPR

NISREEN M. AL-MAQRAM

Assistant lecturer, Education Ministry, Najaf, Iraq

ABSTRACT

Many important and historical sites were studied as they are religious and visiting sites. Search conducted through 4 profils from west to east, the delegation used ground penetrating radar and GPS device. Rad Explorer as well as GPS was used in the processing data and for the purpose of getting rid of the noise, from here I could prove practically revealing of positive results for the Canal. Many air gaps were found under the ground which was buried cellar extends under the ground of the mosque as it was said in the news and novels.

KEYWORDS: GPR, GPS, Holy Mosque, Rad Explorer, Canal

INTRODUCTION

It is known that developing became tremendous in many fields specially in the technology and techniques which led to create new tools and aparatus which fascilitated the developing of the scientific researches by use the new aparatuse among them the penetrating ground radar which became so important in the researching and drilling underground without any damage for the buildings exist on the ground. The research is going on to develop those systems aiming to get techniques which has done a revolution in technology world puplicly and geophysics specifically.

This method depended on the revealing the differences of the magnetic and electrical feauters of the soil underground [1]. Among the geophysic techniques is GPR technique which is an apparatus transfers short pulses of the electric – magnatic energy with the pulse time of the high frequency waves to the deep ground by the sending antenna [2].

THEORY OF GPR

The base of penetrating ground radar is sending the electric magnatic wave high frequency (10MHz, 1000MHz) by the sending antenna to aims or objects underground. After these wares hit those aims they reflect to be received by the antenna them the data will be analysed and processed to get that aim features. The most important factor, depended on the received waves, is the difference of the electrical features between the fallen wave and the aim where a part of the wave is reflected and another part is fracted or distracted. The reading is accurate, when the medium with two low attenuation, i.e., the electrical joint is low too (sand, pure water). The Figure (1) explains the base rork of GPR [3]. When the electromagnetic waves are sent by the transmitting antenna and reflect from the inhomogenow materials for the underground layers, those waves will be received by the receiving antenna to be recorded as a function of time which be called trace. These waves indicate to the survery. These recorded lines collection with the survery path (i.e.,) the profile called the collective surveyeries [4].

Maxwell's equations mathematically describe the physics of EM fields, while constitutive relationships determination article properties. Combining the two provides basis for quantitatively describing GPR signals in mathematical terms, EM

Fields and relationships are expressed as follows:

$$\nabla \times E = -\frac{\partial B}{\partial t} \quad (1\text{-}1)$$

$$\nabla \times H = J + \frac{\partial D}{\partial t} \quad (1\text{-}2)$$

$$q = \nabla . D \quad (1\text{-}3)$$

$$\nabla . B = 0 \quad (1\text{-}4)$$

Where E is the electric field strength vector (v/m); q is the electric charge density (c⁄m^3); B is the magnetic flux density vector (T); J is the electric current density vector (A⁄m^2); D is the electric displacement vector (c⁄m^2); t is time (s); and H is the magnetic field intensity (A/m) [5]. Figure (1) Basic principle of GPR

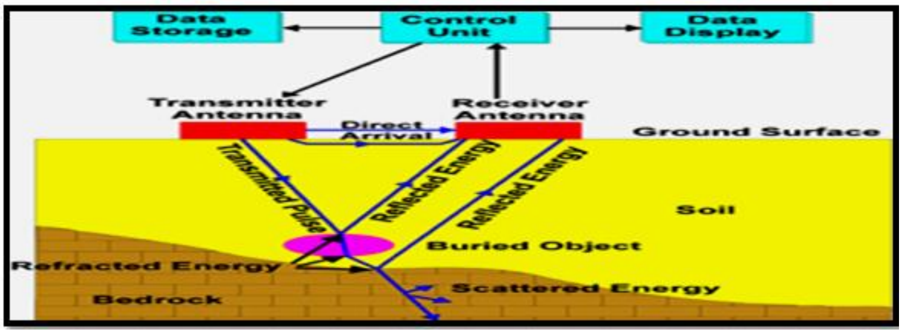


Figure 1: Basic Principle of GARR [6]

The velocity of light in the material is always less than space. Many factors affect the velocity of electro – magnatic waves among them the electrical permittivity, magnatic permeability, polarization and the wave velocity which is between o.o77m/ns to 0.134m/ns. As in the following (3) table which explains the different velocities of the item [7]

Table 1: [8]

Material	ε	σ mS/m	V m/ns	α dB/m
Air	1	0	0.30	0
Ice	3–4	0.01	0.16	0.01
Fresh water	80	0.05	0.033	0.1
Salt water	80	3000	0.01	1000
Dry sand	3–5	0.01	0.15	0.01
Wet sand	20–30	0.01–1	0.06	0.03–0.3
Shales and clays	5–20	1–1000	0.08	1–100
Silts	5–30	1–100	0.07	1–100
Limestone	4–8	0.5–2.0	0.12	0.4–1
Granite	4–6	0.01–1	0.13	0.01–1
(Dry) salt	5–6	0.01–1	0.13	0.01–1

STUDY AREA

The studying site is Al-Kufa the greatest Mosque in Al-Kufa city Which is the oldest one in the world and it is visited by people from all over the world. Al-Kufa lies Iraq on the right bank of the middle Euphrates river to the east of Al-Najaf city about 16km and to the west of Baghdad the Capital about 165km. The height of Al-Kufa and its mosque is 22m from the sea level. The area coordinates area (443400S - 43813N) representing at Canal which is a cellar expanding under the mosque surface Figure (2) Study Area

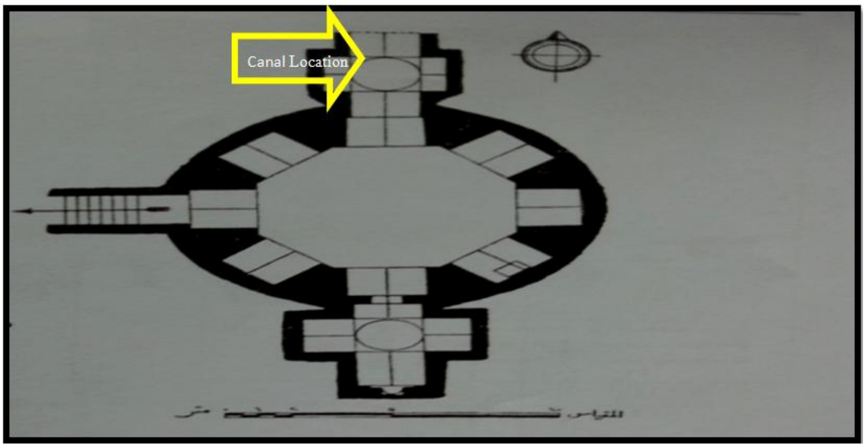


Figure 2: Study Area

DATA PROCESSING

The studied areas include two main layers; the first one is which includes (marble layer, cement layer, sand, and concrete layer) then the subase (gravel and stone) layer. All thes layer wit (1.5m) depth. Figure (3) explains these layers.

Based upon that the surveying is done by 4 paths as it is explained the (2) table which explains the description of the profile by surveying by the antenna 250MHz

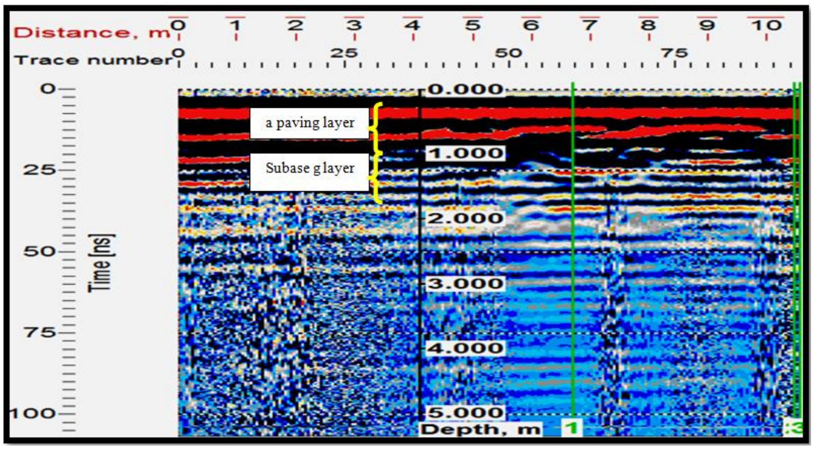


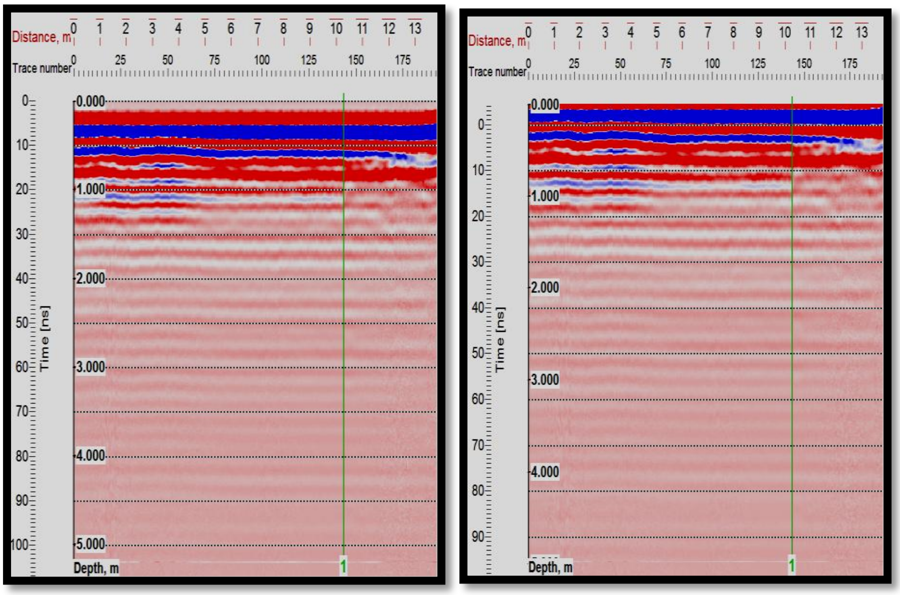
Figure 3: Profile No. 313

Table 2: Some Physical Data

Direction Profile	Profile Length	Number Profile
East - West	13m	313-316

When the 313 profile is processed by the filter Time – Zero we notice the penetration depth with depth of 5.4m before processing to be of 5.1m after processing as it explained in the (4) Figure

When the 313 profile is processed Back ground Removal Filter we notice there a distort and revealing of hyperbola with a distance of 3.34m from the path beginning with a depth of 4.72m. when the features of the path with of 20.9cm/ns and isolation consonant of 2.1, are compared with the (1) table we find hyperbola is an air gap as it is explained in the (5 a & b)figure



Before apply the Time-Zero (b) **After apply the Time-Zero (a)**

Figure 4: Profile No. 313

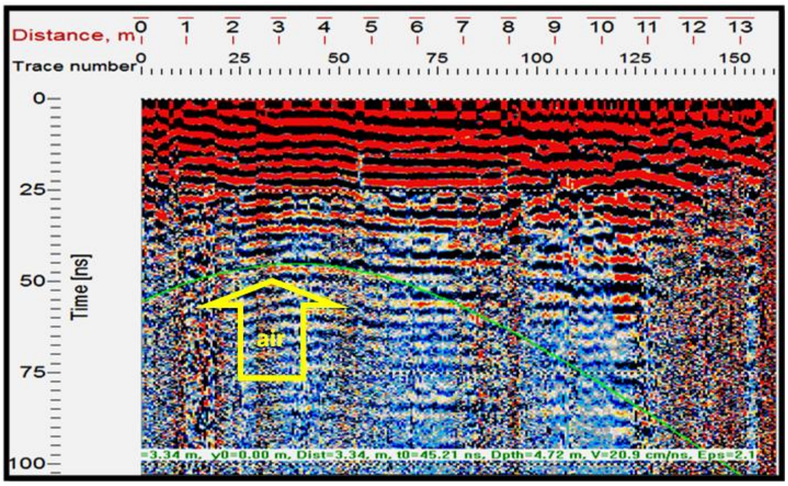


Figure 5a: Profile N0.313 after the Apply Background Removal

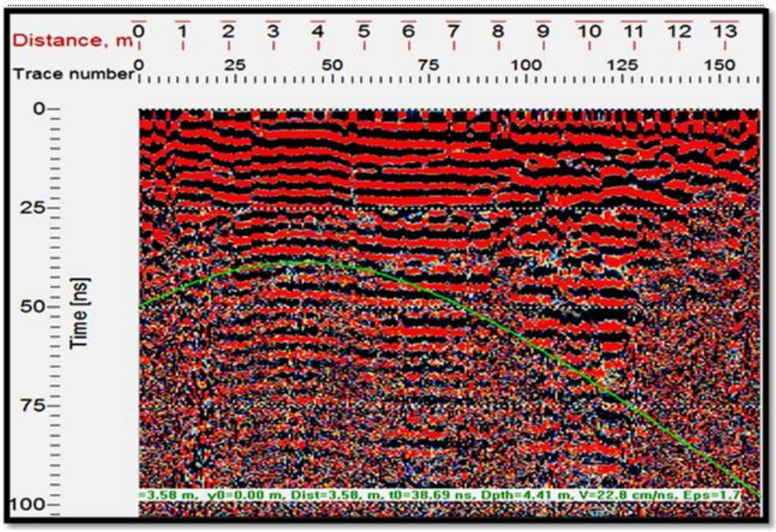


Figure 5b: Profile N0.313 after the Apply Amplitude Correction

Also, we notice air gap in the 314 profile while processing with the Background Removal filter and that gap is in the middle of the path with depth of (4.77m) When putting the curve on this hyperbola we notice appearance of the profile features with 21.1cm/ns vielocity and isolation constant of 2.0 as it is explained in the (6) figure.

When applying the Background Removal filter on the 315 profile, we notice there a distort and revealing of hyperbola with a distance of 7.45m from the path beginning with a depth of 5.99m. When putting the curve on this hyperbola we notice appearance of the profile features with 20.4cm/ns vielocity and isolation constant of 2.2 and with a depth of 4.33m as it is explained in the (7) figure.

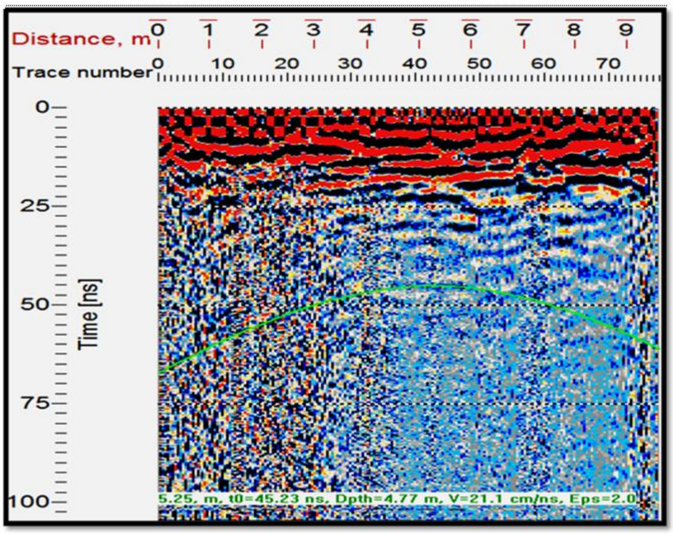


Figure 6: Profile N0.314 after the Apply Background Removal

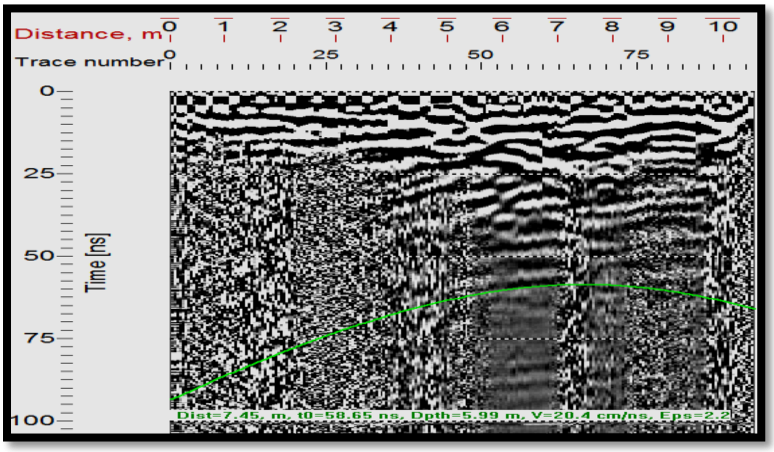


Figure 7: Profile N0.315 after the Apply Background Removal

When applying the Background Removal filter on the 314 profile, we notice there a distort and revealing of hyperbola with a distance of 8.5m from the path beginning with a depth of 3.10m. are compared with the (1) table we find hyperbola is a clay When putting on this hyperbola we notice appearance of the profile features with 7.2cm/ns velocity and isolation constant of 17.3 as it is explained in the (8) figure.

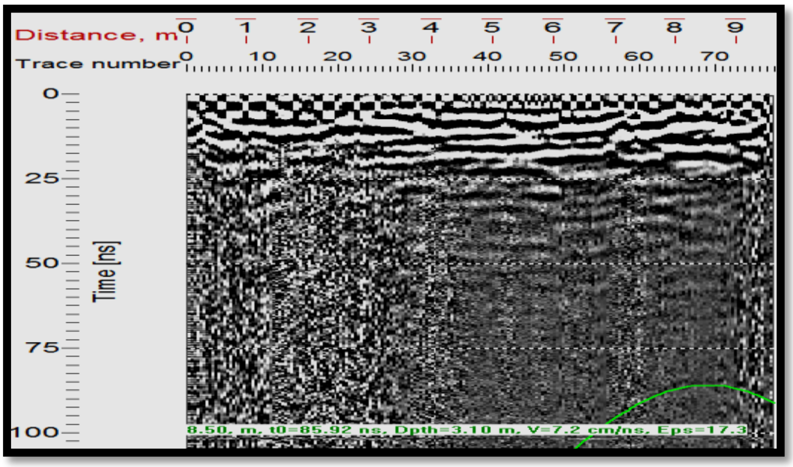


Figure 8: Profile N0.314 after the Apply Background Removal

When putting the clay on this hyperbola we notice appearance of the profile features with 8.5cm/ns velocity and isolation constant of 12.4 and with a depth of 0.93m as it is explained in the (9) figure, applying the band - pass filter on the 315 profile.

When applying the Background Removal filter on the 316 profile, we notice there a distort and revealing of hyperbola with a distance of 9.36m from the path beginning with a depth of 2.79m. When putting the clay on this hyperbola we notice appearance of the profile features with 7.3cm/ns velocity and isolation constant of 16.7 as it is explained in the (10) figure.

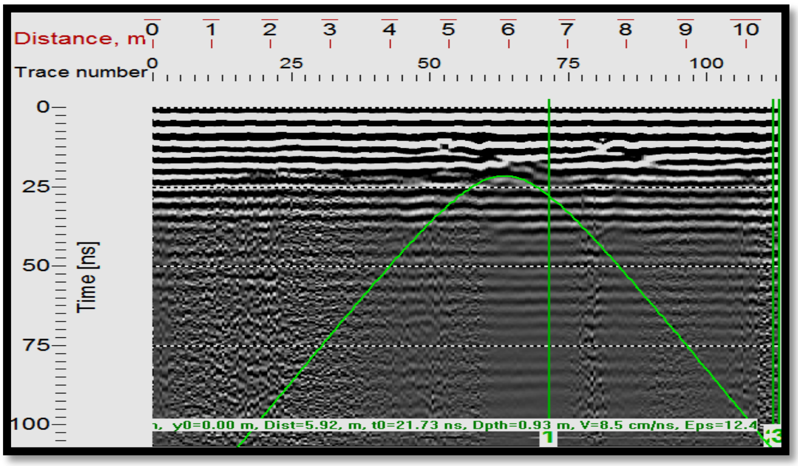


Figure 9: Profile N0.314 after the Apply Band – Pass

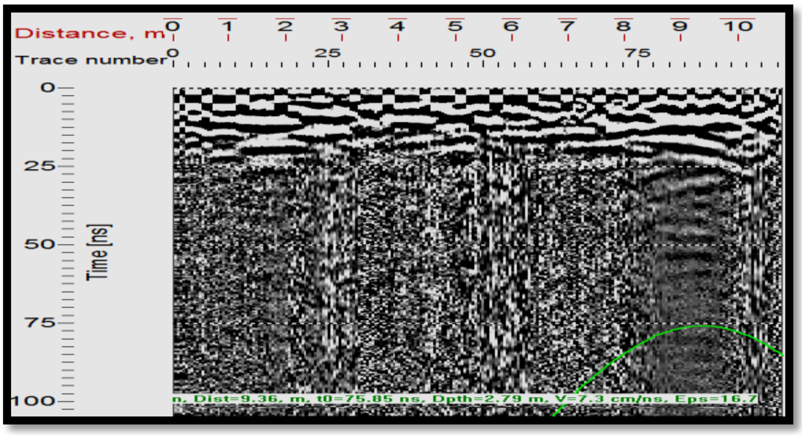


Figure 10: Profile N0.316 after the Apply Background Removal

We conclude the profile after the processing with some filters are dominated by revealing of air gaps as in the profile of (313,314,315,316) with similar profiles and the distort concentrates in the middle, there many air gaps exist in it. At the end of the profiles (313,315,316) and the beginning of the profile (313,316) we notice effects of the clay. When the features of this clay compared with the velocity, Represent the profile related with the canal as it is explained in the (11) figure.

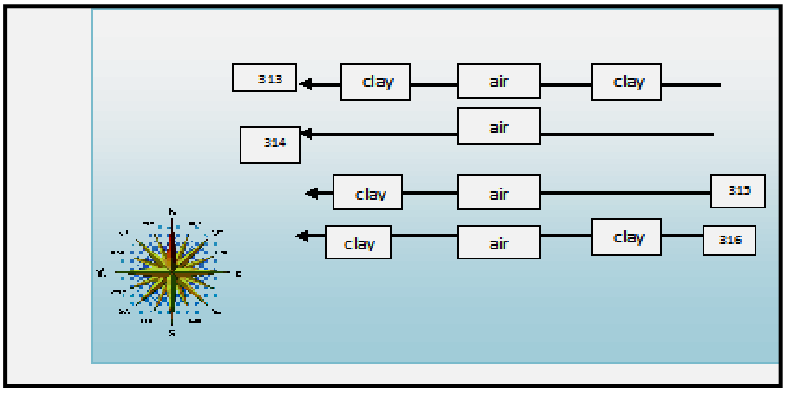


Figure 11: Represent the Profile Related with the Canal

CONCLUSIONS

- Abilies of GPR system were discovered by this research to detect the air gaps under the ground which proved the existence the ground which proved the existence of Canal cellar site.
- Using 250MHz antenna in start of the antenna high frequency to check and study of the under face layers with 5m width inside the study.
- It was difficult to dig the area as the building at the great mosque of Al-Kufa was built due to the Ftimi style therefore, it was important to use geophysic GPR apparatus to detect the landmarks of the buried shrines.

REFERENCES

1. Daniels, J. J., 2000. "Ground Penetrating Radar Fundamentals, report to the U.S.EPA, Region V. pp. 1-21.
2. Harry, M. Jolt., 2009, "Ground penetrating radar (GPR): theory and Applications", First edition, Elsevier's Science and Technology, Amsterdam,pp. 4-6.
3. Topp, G.C., Davis, J.L. and Annan, A.P., 1980, "Electromagnetic determination of soil water content: Measurements in Coaxial Transmission Lines, Water Resources" Research, Vol. 16, No. 3, pp. 574–582.
4. Ziaqian, Zhu, Xianqi He, Guangyin Lu, Geomatics and lufo-Phyics school, "Ground Penetrating Radar Exploration for Ground Water and Contarnination", Central South University, Changsha, China.
5. Olhoeft, G.R., 1981, Electrical properties of rocks, in Touloukian, Y.S., Judd, W.R. and Roy, R.F. (eds), "Physical Properties of Rocks and Minerals", Vol. II, McGraw-Hill, New York, 548 p.
6. Schematic, (from Environmental Protection Agency, Website).
7. Fall, 2007. "An Introduction to Applied Geophysics", Electromagnetic Methods: Ground Penetrating Radar. (Published book). 695p.
8. Milsom, J., 2003, "Filed Geophysics", third addition, University College London.