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The Radio Image of an Object with an Elongated, Face-Fragmented, Dielectrically Complex Structure was Studied Using the Method of Georadar Physical Modeling

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ABSTRACT

Georadiolocation method has been widely used in many fields with geological content. Important results are obtained in the solution of many problematic issues of urban engineering, the solution of many tasks has become possible in archaeogeoradiolocation.
For archaeological work, it is important to fix and decipher the radio image of the object as a result of the mutual distance between the target objects and the georadar antenna. During archaeological work, the distance of the target object is unknown, which distorts or even makes it impossible to fix the radio image of the object. Important information may not be received.
A radio view of the object is allocated, which embeds the location of the object and exceeds its geometric dimensions spatially by approximately three times. At the same time, the lower part of the object is connected to the radio image in general with the so-called feature of antennas. With the content of the diagram of the direction of the electromagnetic field, that is, it clearly defines and separates the location of the object considered as a secondary radiation antenna.
Thus, it is possible to determine the physical model of the foundation and, therefore, the radio image of the field object based on the theory of the similarity of geolocation electromagnetic fields. The depth of the model object is clearly defined by the location of the last horizontal synch axis recorded on the radio face on the radargram, both during horizontal and vertical georadiolocation exposure.
Keywords*: Archaeogeoradiolocation method, radio image, physical modeling, Zond 12-e.*

Introduction

The Radio Image of an Object with an Elongated, Face-Fragmented, Dielectrically Complex Structure was Studied Using the Method of Georadar Physical Modeling

The method of georadiolocation has found wide application in many areas of geological content. Important results have been obtained in solving many problematic issues of urban development, the solution of many problems has become possible in archeogeoradiolocation [1-9].

Problem

For archaeological work, it is important to record and decipher the radio image of an object as a result of the mutual arrangement between the target objects and the ground penetrating radar antenna, i.e., to solve the inverse problem of electrodynamics. In order for the radio image of an object to be fully recognized, the GPS antenna must be located in the far zone of the target object, i.e. the distance between the antenna and the object must exceed the wavelength of the radiation. In archaeological work, the distance to the target object is unknown, so the object can be located both in the near zone and in the middle and far zones relative to the antenna, which distorts or even makes it impossible to record and recognize the radio image of the object. As a result, important information may not be obtained during archaeological GPR work [10,11,12,13].

Methods and tools

In the sector of applied and experimental geophysics of the Institute of Geophysics, using a device for georadar physical modeling, studies were conducted to determine the radio features of objects located in the middle zone. Based on the theory of similarity using three-dimensional scaling coefficients, it is possible to calculate the frequency and geometric dimensions for detecting natural target objects and recording their radio images [2,3,4,5,11,12,13,14,15].

Model

For archaeological research we have chosen such an important object as a model of a fragment of the foundation of the wall. The model is made of basalt parallel-faced blocks of irregular shape with a thickness of about 0.05-0.06m, the average length varies within 0.25-0.35m, the gaps between the blocks are filled with the material that makes up the model environment - sand. The model itself is presented in the form similar to a parallelepiped with curvature. Its uneven dimensions are on average 0.7x0.3x0.2 m, and the curvature of the surface varies by 0.05-0.10m.[2,4,14]

Ground penetrating radar from the day surface.

For the sand-covered object, seven parallel profiles were drawn across the foundation-object/wall. Below is a diagram of the relative position of the longitudinal model object and the ground penetrating radar profiles.

The ground penetrating radar profiles were drawn using the Zond 12-e ground penetrating radar, a 2GHz receiving and transmitting standard antenna, data search, processing and interpretation were carried out using the Prizm-2.70 software.[.]

Georadar physical model of a parallelepiped of complex dielectric and fragmentary composition (Scheme 1).

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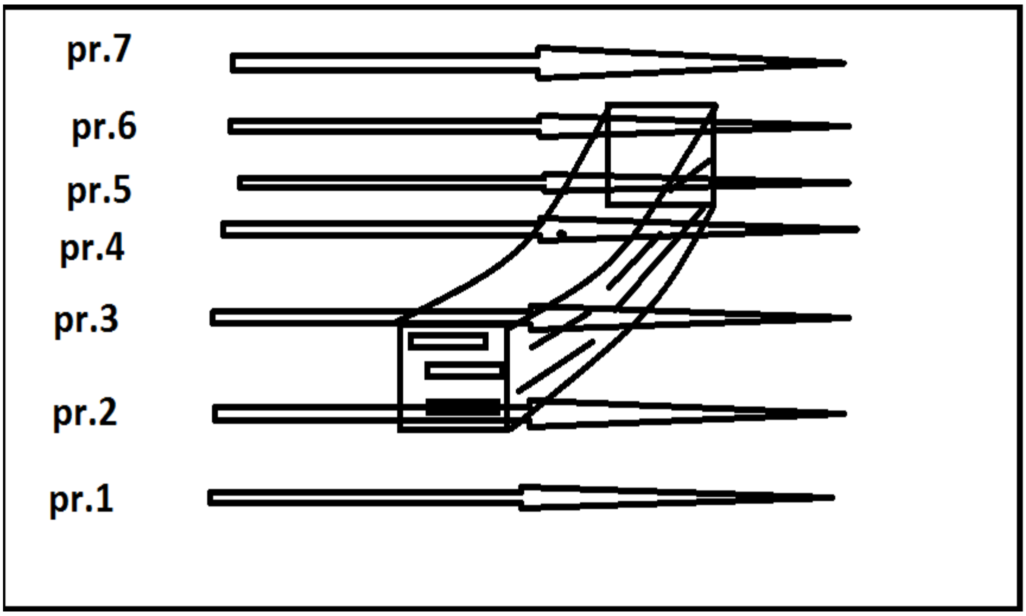


Scheme 1.

An object composed of basalt blocks with uneven boundaries, having the shape of a curved parallelepiped with parallel edges, the spaces between which are filled with sand, which constitutes the modeling environment, was chosen as a model. The dimensions of the object are approximately 0.7x0.3x0.16m. The object is located 0.05-0.10m below the air-sand horizontal surface.

The model is placed inside the model area of the sand-containing environment measuring 2.4x1.4x1.4m. With horizontal ground penetrating radar exposure, the profiles are parallel and are spaced from each other at a distance of 0.12m.

When exposed from a vertical wall, the profiles pass through the surface of the submerged model, covering only the air-containing space, the second profile covers the part containing the object, and the third passes through the lower part, where the radio image of the object should be located.

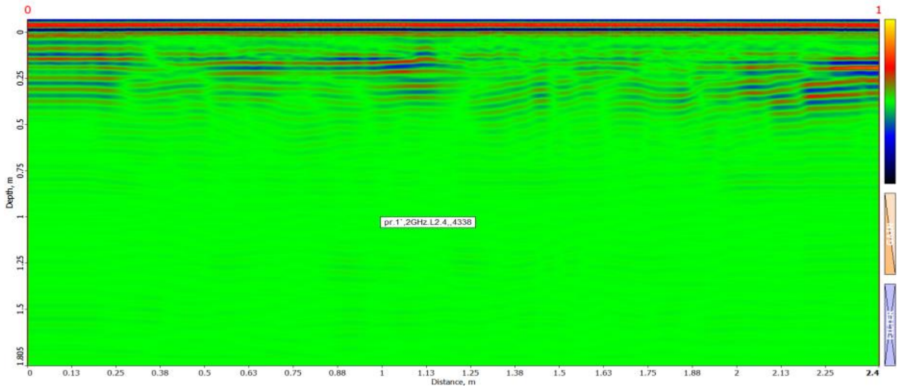


Fig. 1. Shows the corresponding radargram Prof-1, obtained with the transmitting-receiving antenna of the ground penetrating radar "Zond 12-e", 2 GHz.

The location of the object of study on the course of profile-1 (Fig. 1) is not marked, therefore its influence on the radargram is not visible. The radio image of the model object against the background of the existing lateral anomalies is not clearly readable, but the part of the radio image caused by the “bow-tai” type of “hole” /model space, wall-wall model/ is poorly distinguishable but easy to read.

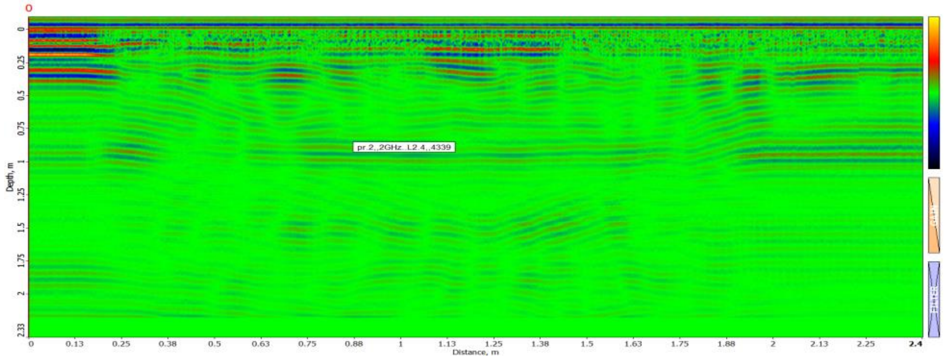


Fig. 2. Shows the corresponding radargram of profile-2, obtained using the receiving and transmitting antenna of the Zond 12e georadar, 2 GHz.

The location of the object of study along profile-2 is poorly marked (Fig. 2), so its influence on the radargram is partially visible. The radio image of the model object is not clearly read against the background of the existing lateral anomalies.

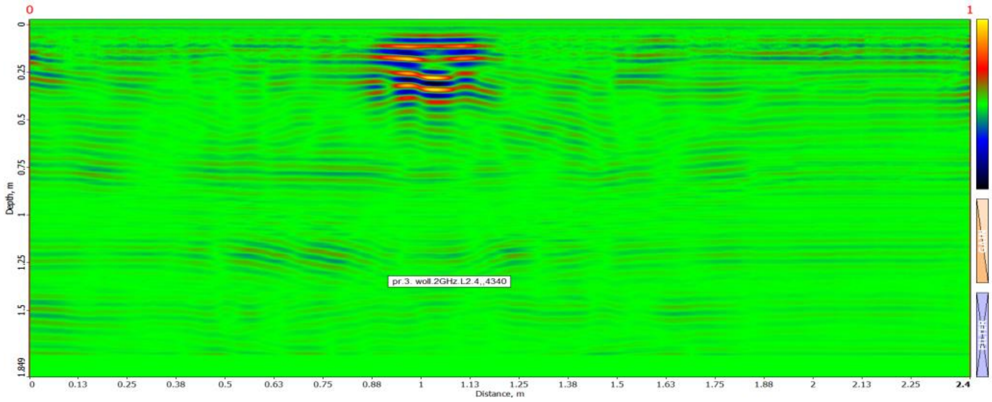


Fig. 3. Shows the corresponding Prof-3 radargram obtained using the Zond 12e 2 GHz range ground penetrating radar transceiver antenna.

The location of the object under study is clearly marked on the Profile-3 course (Fig. 3), so its influence on the radargram is visible. The radio image of the model object is well readable against the background of minimal lateral anomalies. The location of the object is limited from below by the last clear continuous section of the in-phase axis at distances of 0.9-1.25m and a depth of 0.2m. The object is made of uneven slabs and is unevenly located, which often happens when working in field conditions with archaeological sites. Directly under the object, on the radio image, at a distance of 1.05-1.13m, a spatial area is observed, decompressed from the in-phase axes, with the center at a depth of 0.25m.

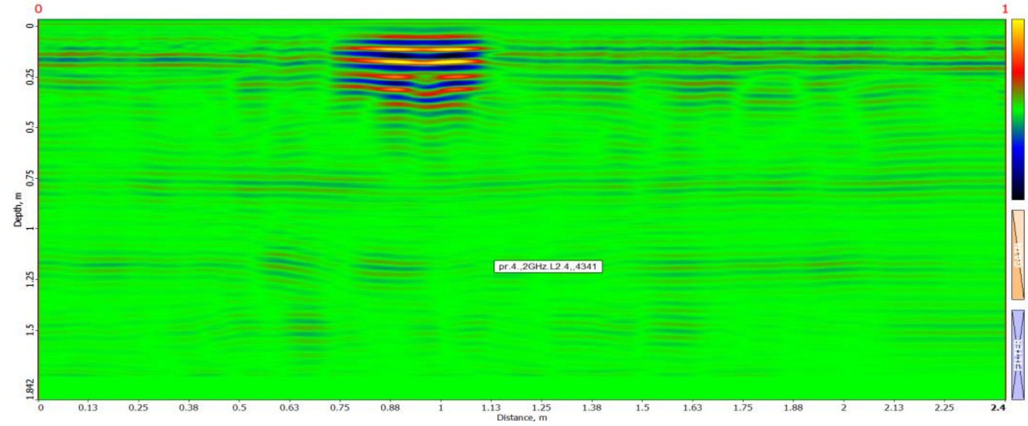


Fig. 4. Shows a radargram corresponding to Profile-4, made with a receiving and transmitting antenna of the Zond 12e 2 GHz georadar.

The location of the object of study is clearly marked on the Profile-4 course (Fig. 4), so its influence on the radargram is visible. The radio image of the model object is well readable against the background of minimal lateral anomalies. The location of the object is limited from below by a section of the last clear continuous in-phase axis at distances of 0.9-1.13m and a depth of 0.2m. The object is made of uneven slabs and is unevenly located, which often happens when working in field conditions with archaeological sites. The increase in the depth of the object's radio surface is caused by its curvature. Directly under the object, on the radio image, a spatial area is visible, decompression from the in-phase axes at a distance of 0.9-1.1m, with a depth center of 0.27m.

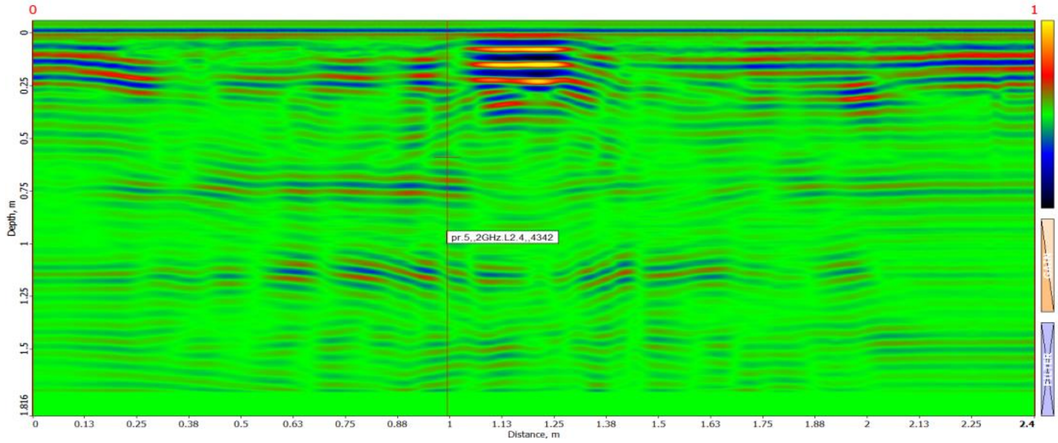


Fig.5. The location of the object under study is clearly marked on the profile-5 course, so its influence on the radargram is visible.

The radio image of the model object (Fig.5) is well readable against the background of minimal lateral anomalies. The location of the object is limited from below by the last clear continuous section of the in-phase axis at distances of 1.08-1.25m and a depth of 0.22m. The object is made of uneven slabs and is unevenly located, which often happens when working in the field with archaeological sites. The increase in the depth of the object's radio image is caused by its curvature. Directly under the object, on the radio image, a spatial region is visible, decompressed and separated from the in-phase axes at distances of 1.15-1.25.1m, with the center at a depth of 0.29 m.

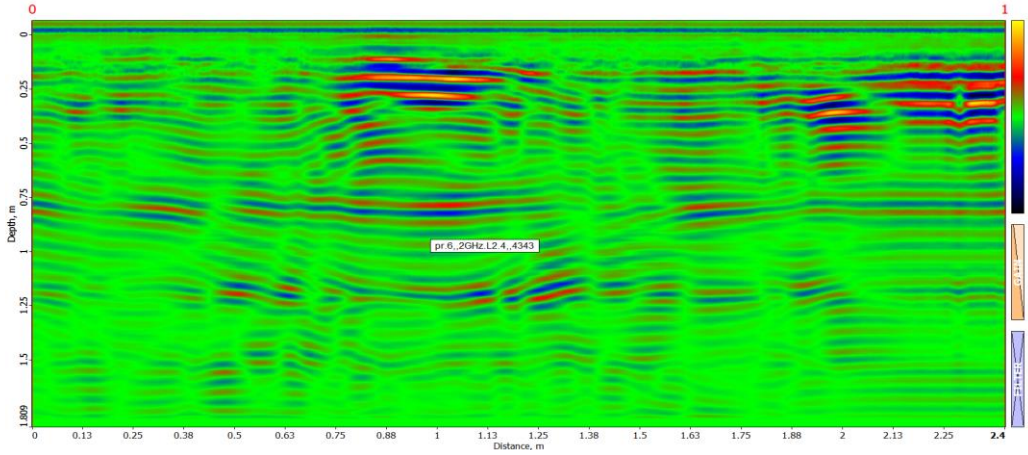


Fig. 6. Shows a radargram corresponding to Profile-6, made with a receiving and transmitting antenna of the Zond 12e 2 GHz georadar.

The location of the research object is weakly manifested during Profile-6 (Fig. 6), so the distorted radio image partially shows its influence on the radargram. The radio image of the model object is still well readable against the background of lateral anomalies.

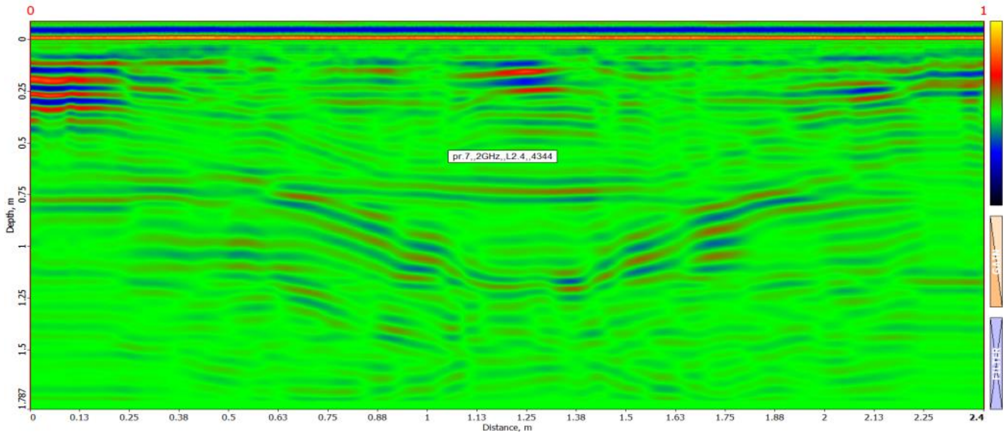


Fig. 7. Shows a radargram corresponding to profile-7, made with a Zond 12e, 2 GHz georadar receiving and transmitting antenna.

Along profile-7 (Fig. 7), the location of the research object is less noticeable, so its influence on the radargram is minimal. The radio image of the model object is weak and less legible against the background of existing lateral anomalies.

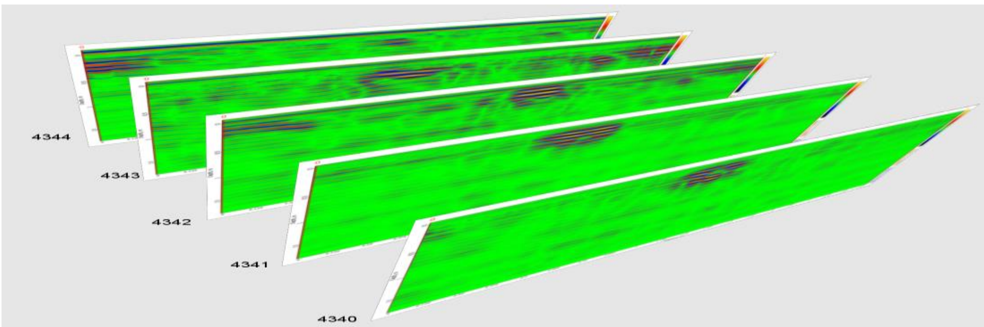


Fig. 8. Shows five profiles (profiles 3-7), constructed by Voxler 4.

Fig. 8 shows five profiles (profiles 3-7), constructed by Voxler 4, which sequentially depict the spatial arrangement of the radio image and their feature in the form of separation of the in-phase axes. Which is presented in the form of obliquely located in-phase axes, after parallel horizontal in-phase lines, determining the depth of the object, in accordance with the unevenness of the image of the object.

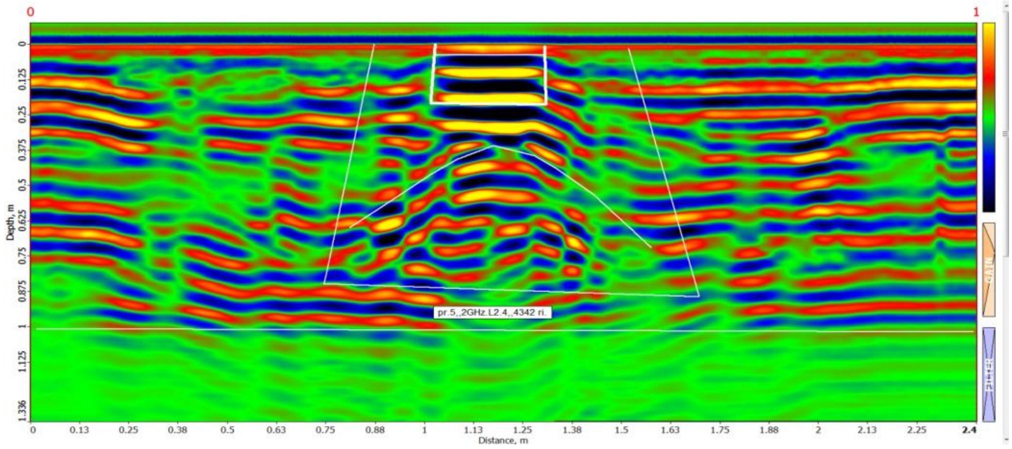


Fig. 9. Shows the depth-encompassing radio image of the object on the prof-5, outlined with a white line.

The radio image of the object (Fig. 9) is distinguished, which imprints the location of the object and exceeds its geometric dimensions in space by about three times. In this case, the lower part of the object is connected with the radio image as a whole by the content of the so-called electromagnetic field pattern, characteristic of antennas, that is, it clearly defines and separates the location of the object, which is considered as a secondary radiation antenna. Thus, based on the theory of similarity, the foundation model and, consequently, georadar electromagnetic fields, it is possible to clearly and unambiguously record the radio image of a field object in accordance with the numerical calculation using the model coefficients.

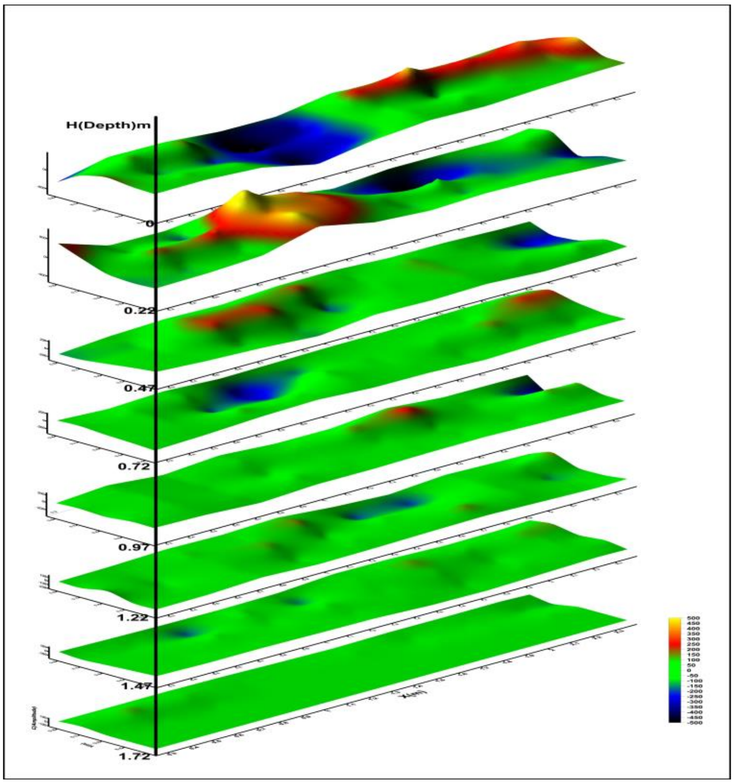


Fig. 10. Shows a spatial 3D radio image constructed using profiles Prof.3-7 (by Surfer 9 software), depending on the depth of the object relative to the ground penetrating radar antenna in the near and middle zones.

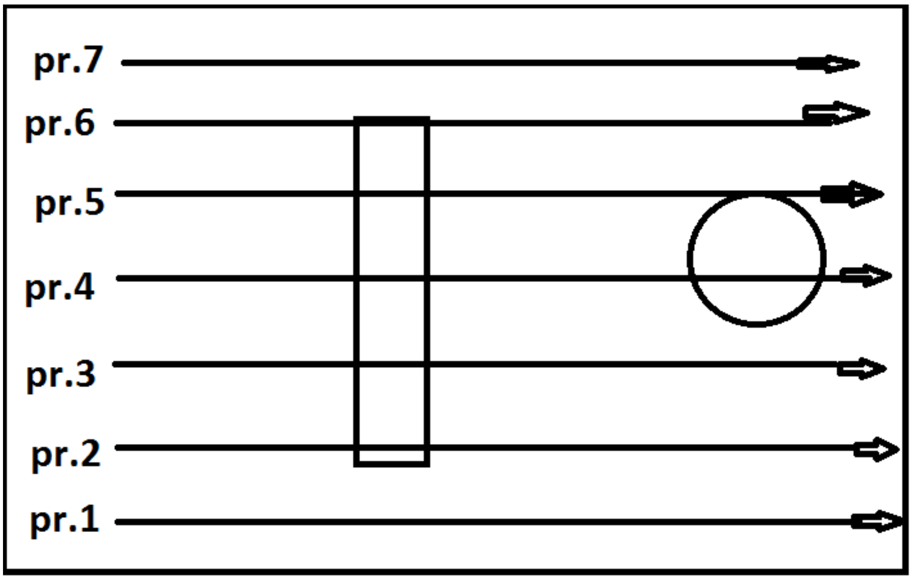
The presented 3D radio image corresponds to the geometric dimensions of the object location, composed of fragmentary elements of the "wall foundation" for depths of 0.22-0.25m. The boundaries of the model location are clearly outlined, and the vertices correspond to the uneven ridges of the object fragments. The longitudinal size of the minimum area of the object, from which the reflected wave is proportional to the order of a quarter of the incident wave, was recorded.

The depth of the model object is clearly defined by the position of the last horizontal synphase axis, recorded at the radio boundary on the radargram. Reflected and refracted electromagnetic rays are recorded by the radar and the Prizm 2.7 software. The radio image is clearly distinguished on the radargram by three intensity levels of the electromagnetic wave synphase axes: the first is the upper part of the physical position of the object itself, the second is a clearly horizontal axis of the last synphase, limiting the location of the lower part of the object, after which the presence of the upper part of the radio image appears, i.e. the radio image itself, exceeding the width and depth of the object by about three times. From the lateral side, it is an isosceles trapezoidal shape.

Composite physical model

Let's consider the same object - a fragmentary model of a foundation, with a clearly defined metal insert in the surrounding medium of a disk-insert, located 0.3-0.7m away from the foundation model.

The physical model of the study consists of a parallelepiped of uneven curvature (Scheme 2) and a metal disk with a diameter of 0.4m at a distance of 0.7m from it with a concave cavity of 0.04m. In field conditions, the model corresponds to the reality of objects similar to a metal hatch near archaeological or urban development works.



Scheme 2. Representation of the layout of a composite model of a dielectric parallelepiped and a metal disk.

Fig. 11 shows Prof-1 F+D. The corresponding radargram obtained using the antenna of the Zond 12e 2GHz ground penetrating radar transceiver for the physical model of the foundation+disk. The radargram corresponds to the ground penetrating radar section with background effects, the presence of model objects is not recorded by the radio image.

Fig. 12 shows prof-2 F+D. The corresponding radargram made with the help of the antenna of the Zond 12e 2GHz ground penetrating radar transceiver for the physical model of the foundation+disk and spaced from prof.1 at a distance of 0.12m.

The radargram corresponds to the ground penetrating radar section with a partial influence of the effect of the presence of the model.

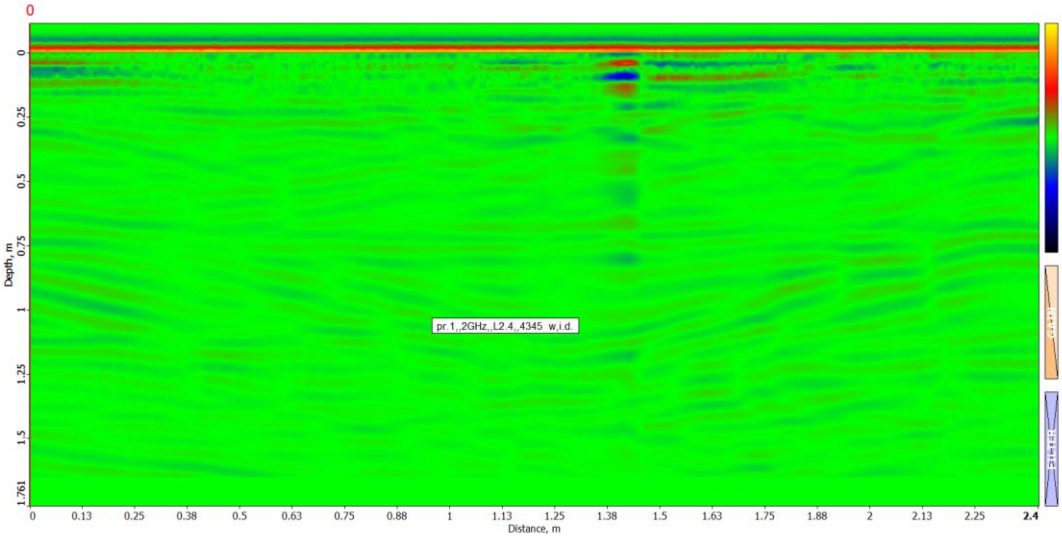


Fig. 11. Prof.1 F+D.

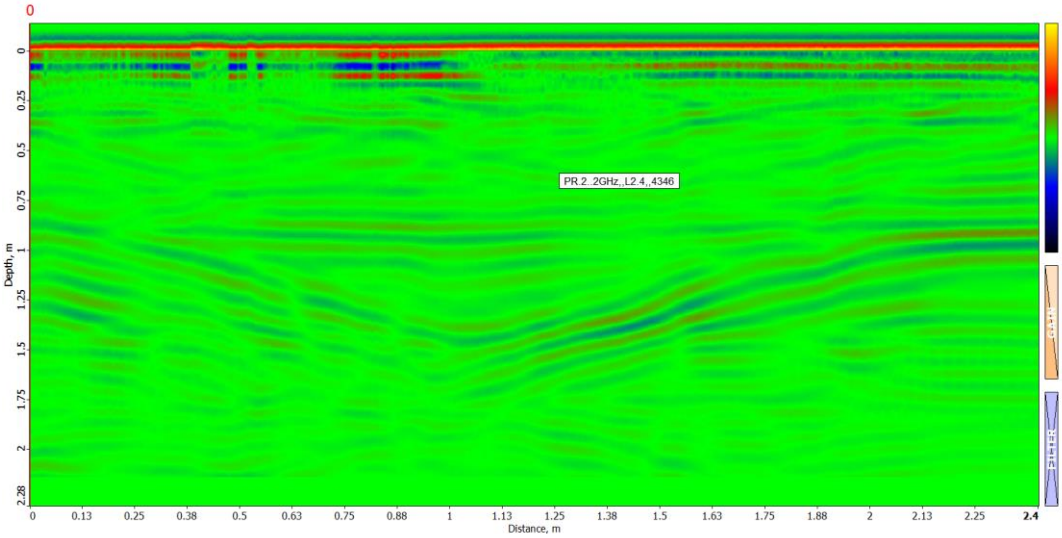


Fig. 12. Prof.2 F+D

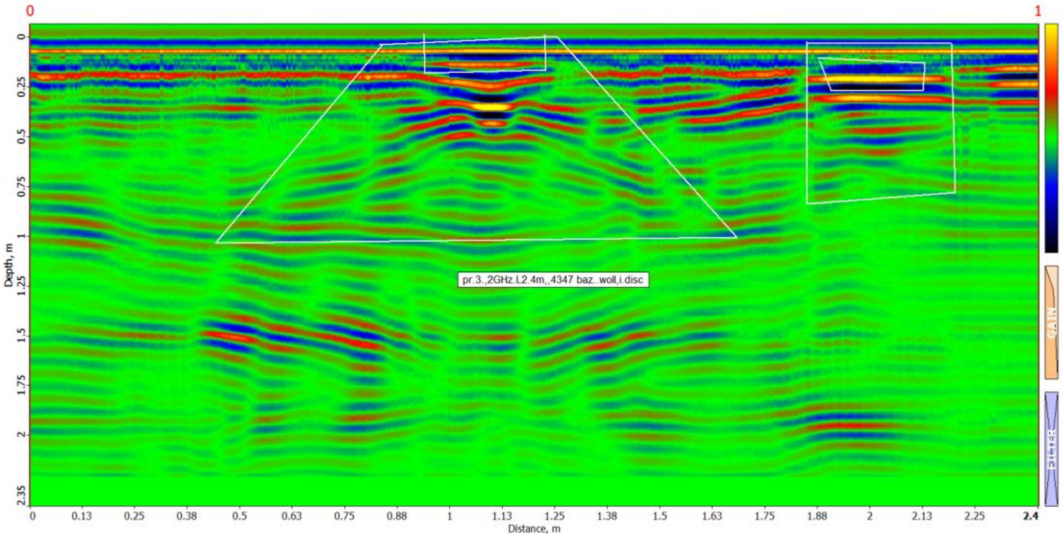


Fig. 13. Prof.3 F+D presented.

The corresponding radargram (Fig. 13) made with the help of the antenna of the Zond 12e 2GHz ground penetrating radar transceiver for the physical model of the foundation+disk and spaced from prof.1 at a distance of 0.24m.

The radargram corresponds to the ground penetrating radar section with the radio image of the foundation model and the influence of the disk.

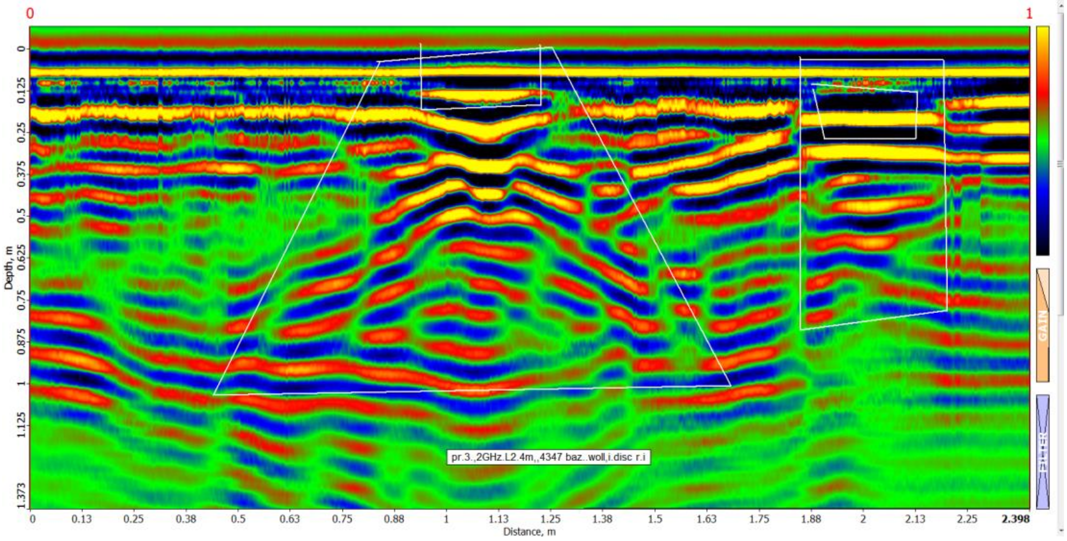


Fig. 14. Shows prof.3-F+D.

The corresponding radargram (Fig. 14) obtained using the antenna of the Zond 12e 2GHz ground penetrating radar transceiver for the physical model of foundation + disk and spaced from prof.1 at a distance of 0.24m. The digital gain option is used when processing the lower side of the radio image on the radargram. The radargram corresponds to the ground penetrating radar section with the representation of foundation + disk as a single radio image consisting of a model radio image and a disk radio image. The constituent radio images are highlighted with white lines. The influence of the void under the disk on its radio image is revealed.

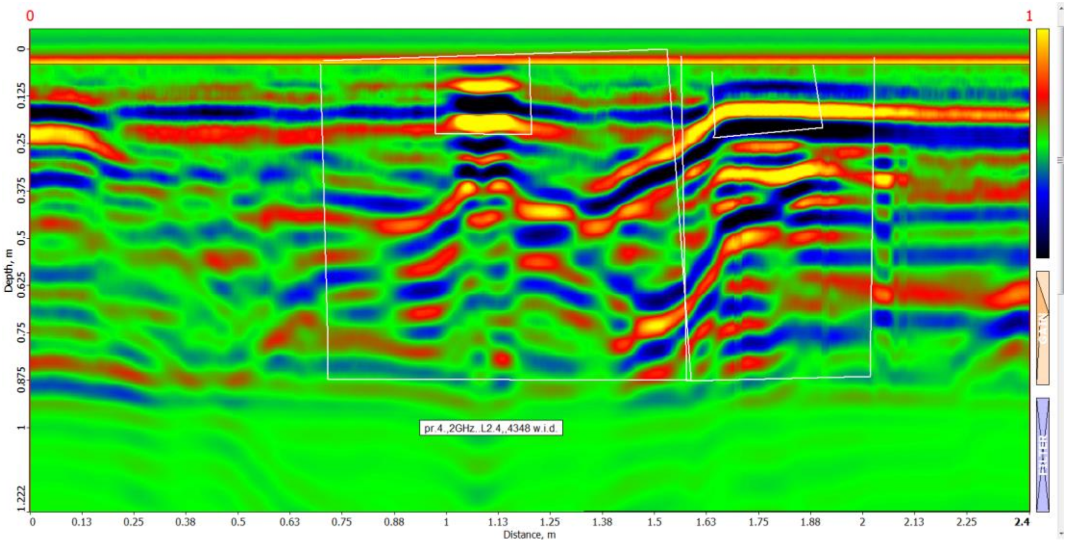


Fig. 15. Shows prof.4 F+D.

The corresponding radargram (Fig. 15) obtained using the Zond 12e ground penetrating radar transceiver antenna, 2 GHz for the physical model of foundation + disk and spaced from pr-1 at a distance of 0.48m.

The radargram corresponds to the ground penetrating radar section with strong foundation + disk influences on the in-phase axes of a single radioimage consisting of the model radioimage of the foundation and the disk radioimages. The constituent radioimages are highlighted with white lines. The influence of the void under the disk on its radioimage and the radioimage of the foundation model is clearly visible. The in-phase axes are sharply curved at distances of 1.13-1.75m. Despite the strong influence in the form of curvature, the in-phase axes clearly show the location of both the base of the dielectric wall and the metal/iron disk on the radargram.

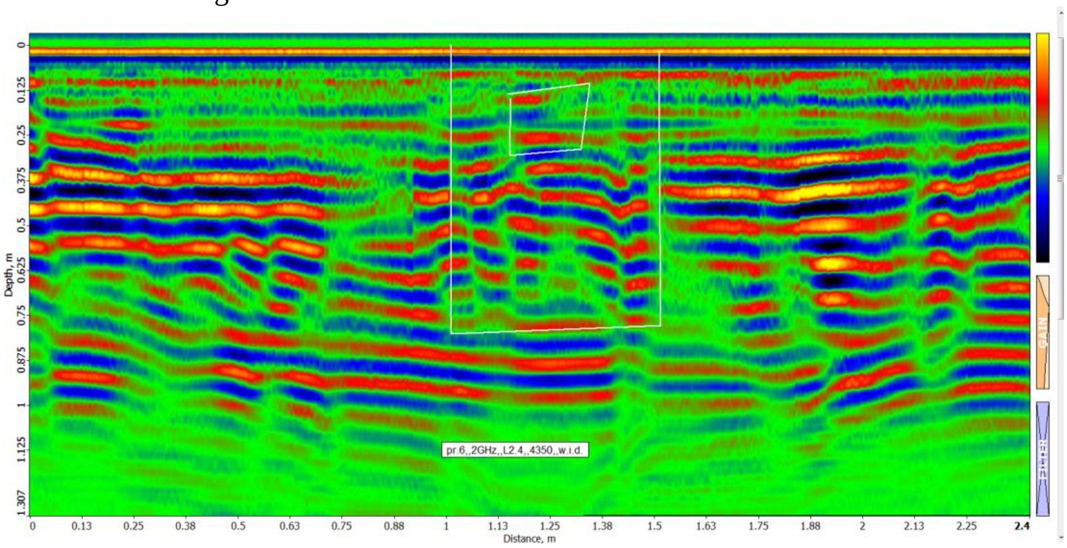


Fig. 16. Shows prof- 6 F+D. The corresponding radargram obtained using the antenna of the Zond 12e 2 GHz ground penetrating radar transceiver for the physical model of foundation+disk.

Prof-6 is less informative (Fig. 16), although it accurately reflects the dimensions of the foundation model.

Based on the above, the radio image of the disk contains additional information about the presence of a disk cavity and fragmentation of the foundation base.

We can propose “Borrowing” from antenna theory the term “antenna directivity patterns” for the secondary radiation objects observed on the radargram, which, like the receiving and transmitting ground penetrating radar antennas, will depend on the exposure of the ground penetrating radar antennas.

The radargrams obtained during vertical exposure of the ground penetrating radar section.

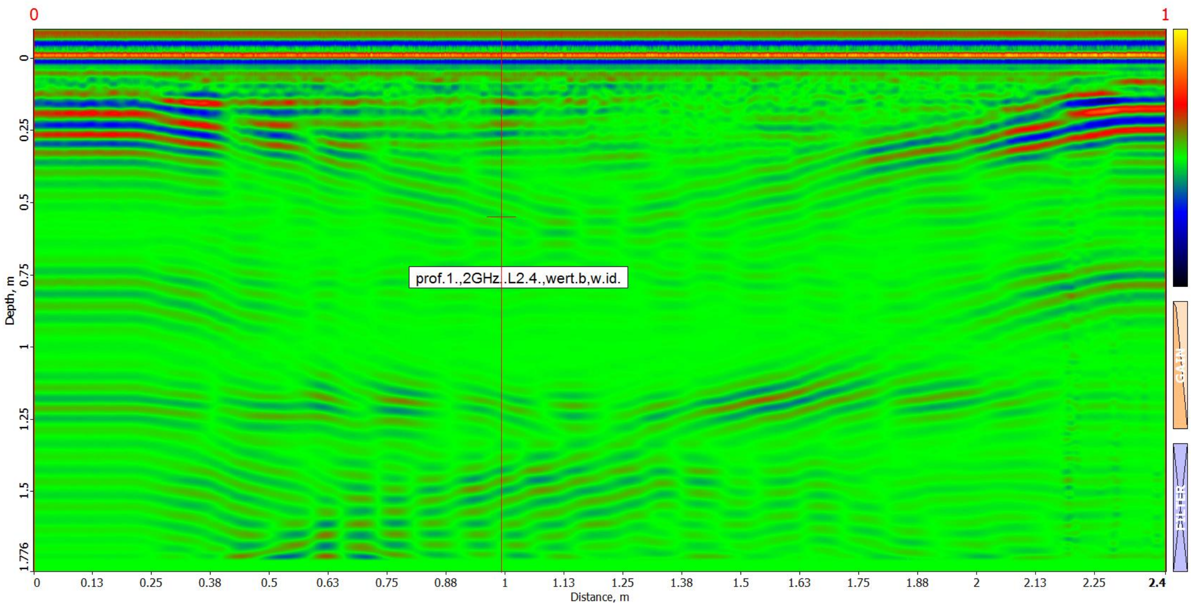


Fig. 17. Prof-1 F+D shows a georadar section of vertical exposure with a foundation model and a metal disk insert.

The profile (Fig. 17) did not reflect the anomaly, since the receiving and transmitting antenna passed above the daylight surface.

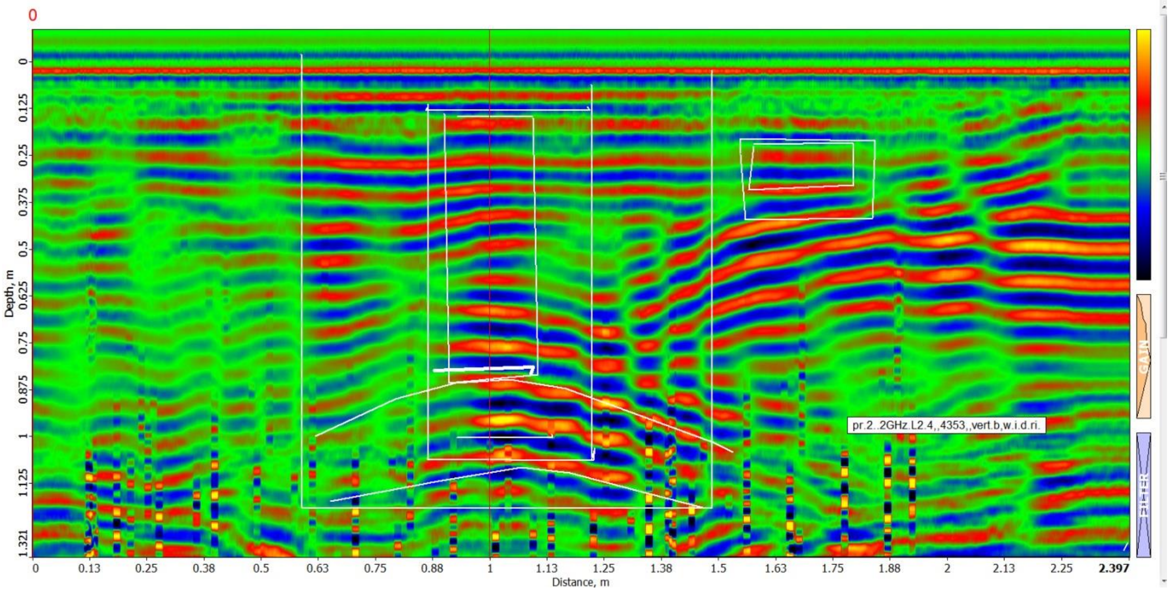


Fig. 18. Shows a georadar section, prof.-2 vert., made in vertical exposure with a foundation model and a metal disk insert.

A georadar section (Fig. 18) obtained by shooting from a vertical plane for a complex physical model of a foundation + an iron hollow disk is presented.

The radio image presented for the model (Fig. 18) shows a hyperbolic arc of the electromagnetic field observed in the vertical exposure of the foundation, marked with white lines.

The profile showed an anomaly, since the receiving and transmitting antenna passed below the day surface, although close to the surface.

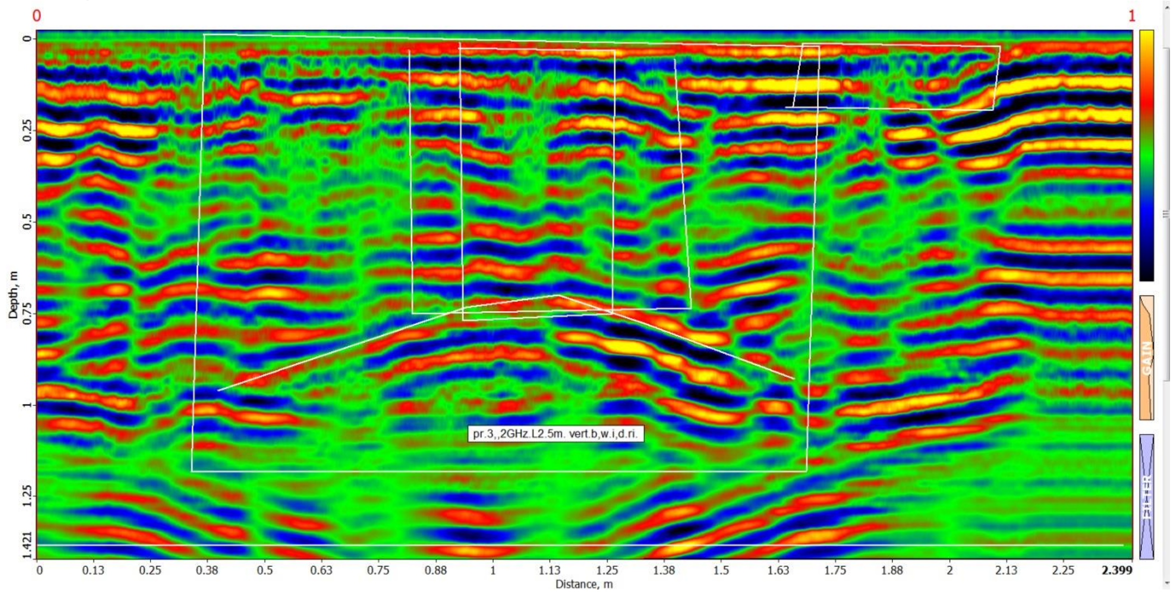


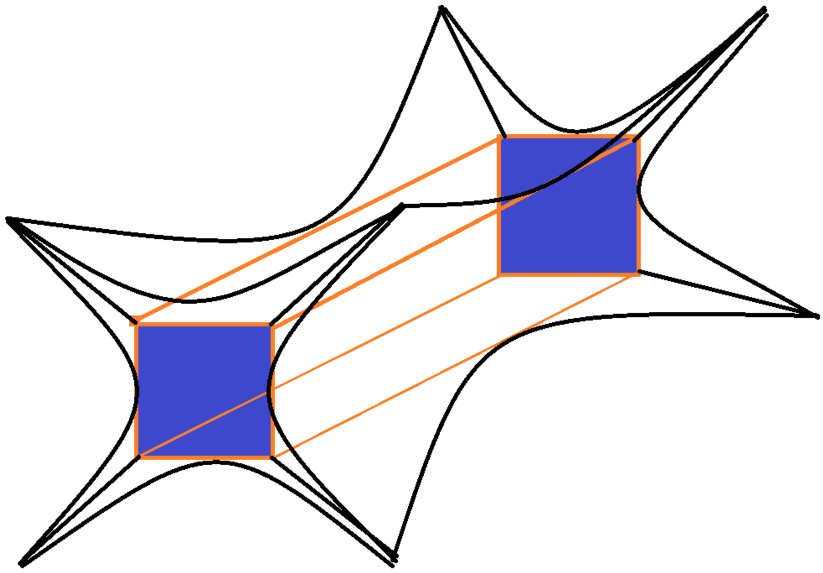
Fig. 19. Shows a ground penetrating radar section of profile 3 vert, in vertical exposure with a foundation model and a metal disk insert.

The anomaly was reflected in the profile (Fig. 19) when the receiving and transmitting antenna passed below the day surface, at a depth of 0.1m.

The radio image obtained for the physical model of a foundation + a hollow iron disk of complex heterogeneous composition, obtained during irradiation from a vertical plane, is clearly visible at a depth with the beginning of the object 0.25-0.3m away from the wall containing the host medium and below the day surface.

An arc in the form of a hyperbola separating the end of the object was clearly reflected. The dimensions of the object/foundation/body are recorded in the exposure.

We can offer a three-dimensional representation of the field distribution, made at a phenomenological level for ground penetrating radar irradiation of an ideal parallelepiped type. We can call this type of field representation a secondary radiation diagram of an object inserted into the environment, which is an additional characteristic of the radio image of the object and will give us an idea of the type of object.



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Scheme 3.

The illustration (Scheme 3) shows a schematic representation of the electromagnetic field diagram of the direction of a stylized parallelepiped in the GPR (georadar) field in the in-phase axes of the radio image, with the exposure of georadar profile in all directions, this time without taking into account lateral effects.

It is interesting to note that with a geometric length of the characteristic scale of 1 m and a model frequency of 2 GHz, the natural scale at 500 MHz will be 4m. Consequently, in field conditions, the size of the field parallelepiped will be 0.7x4 = 2.8m, 0.3x4= 1.2m, 0.2x4m = 0.8m, respectively, with an unchanged permittivity of the environment. We discussed the calculation of scale factors for GPR physical modeling in the articles.

Conclusion

The depth of the model object is clearly defined by the position of the last horizontal axis of the in-phase line, recorded on the radio image located on the radargram, both for horizontal and vertical ground penetrating radar exposure.

The radio image of the parallelepiped in the electromagnetic radiation field of the ground penetrating radar, recorded by the ground penetrating radar and software, is clearly distinguished on the radargram by three levels of in-phase axes intensity.

The first is the upper part of the physical location of the object itself;

The second is a clear horizontal axis of the final in-phase, delimiting the location of the lower part of the object, above which the presence of the upper part of the object is manifested;

The third intensity level is the full radio image, exceeding the dimensions of the object several times both in depth and horizontally and having a shape close to an isosceles trapezoid. Based on the analysis of the radio images, in the case of 3D ground penetrating radar exposure, we will obtain truncated stylized cones.

In general, the radio image of a parallelepiped with a 6-sided georadar exposure corresponds to and contains the content of the antenna directivity diagram and expresses the directions of the predominant increase in the electric field intensity, which is presented in the form of an illustrated figure.

References

[1] Lezhava Z., Tsikarishvili K., Asanidze L., Chikhradze N., Karalashvili1 T., Odilavadze D., Tarkhnishvili A. The results of a complex study of the Turchu limestone hollow (polje). Western Georgia, Caucasus. European Journal of Geography, BeISSN 1792-1341, DOI: https: //doi.org: 10.48088/ejg.z.lez.12.3.006.020. Volume 12, Issue 3, 03-Nov-2021, pp. 6 –20.

[2] Odilavadze D.T., Chelidze T.L. Physical simulation of georadiolocation field in direct and inverse problems of electrodynamics. Geophysical Journal, Kiev, V.35, №4, 2013, pp. 154-160, (in Russian).

[3] Odilavadze D.T., Chelidze, T.L. Physical Modeling of Lava Tubes in the GPR. Transactions of Mikheil Nodia Institute of Geophysics, Publishing house of the Tbilisi State University, ISSN 1512-1135, vol. LXVII, 2017, pp. 129-142.

[4] Odilavadze D., Chelidze T., Tskhvediashvili G. Georadiolocation Physical Modeling for Disk-Shaped Voids. Journal of the Georgian Geophysical Society, Physics of Solid Earth, Tbilisi, vol. 18, 2015, pp. 26-39

[5] Odilavadze D., Chelidze T., Ghlonti N., Kiria J., Tarkhnishvili A. Physical modelling of a layered wedge type model in direct and inverse tasks of georadiolocation. Mikheil Nodia Institute of Geophysics Transactions, ISSN 1512-1135, vol. LXIX, Publishing house of the Tbilisi State University, Tbilisi, 2018, pp. 44-61.

[6] Odilavadze D., Kiria J., Ghlonti N., Yavolovskaya O. The Results of Archaeogeoradiolocation Investigations of the Territory Inside the Rampart of St. Sophia Church of Khobi. ,,Moambe" Bulletin of the Georgian National Academy of Sciences, V.14, n.4, 2020, pp. 51-56.

[7] Bigman D. GPR Basics. Bigman Geophysicsl, LCC, Suwanee, USA, 2018.

[8] Chelidze T., Odilavadze D., Pitskhelauri K. Archaeogeophysics in Georgia-New Results, New Prospects. Proceedings of the Georgian National Academy of Sciences, Series of History, Archeology, Ethnology and Art History, N1, 2012.

[9] Odilavadze D.T., Chelidze T.L. A Preliminary GPR investigation of Metekhi Cathedral and the surrounding area. Journal of the Georgian Geophysical Society, № 14, 2011.

[10] Neal A. Ground-penetrating radar and its use in sedimentology: principles, problems and progress. Earth-Sci. Rev. 2004, pp.66, 261—330.

[11] Negi J. G., Gupta C. P. Models in applied geoelectromagnetics. Earth Sci. Rev. 1968, pp 219—241.

[12] Sena D'Anna A. R. Modeling and imaging of ground penetrating radar data. Texas: The University of Texas at Austin, Repositories. Lib.Utexas.edu, 2004, 251 p.

[13] Sharma P.V. Environmental and engineering geophysics. Cambridge: Cambridge University Press, 1997.

[14] Kofman L., Ronen A., Frydman S. Detection of model voids by identifying reverberation phenomena in GPR records. Journal of Applied Geophysics, (59), 2006, pp.284-299.

[15] Odilavadze D., Chelidze T., Yavolovskaya O. Some georadiolocation images of cylindrical bodies built with different dielectric fillers, placed in a dielectric environment. Mikheil Nodia Institute of Geophysics of Ivane Javakhishvili Tbilisi State University, International Scientific Conference "Geophysical Processes in the Earth and its Envelopes". Proceedings, ISBN 978-9941-36-147-0, Tbilisi, Georgia, November 16-17, 2023, pp.217-220.

გეორადიოლოკაციაური ფიზიკური მოდელირების მეთოდით გამოკვლეული განგრძობითი, წახნაგოვან-ფრაგმენტული, დიელექტრიკულად რთული აგებულების ობიექტის რადიოსახე

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რეზიუმე

გეორადიოლოკაციური მეთოდის გამოყენება ფართოდ გავრცელდა გეოლოგიური შინაარსის მქონე მრავალ დარგში. მნიშვნელოვანი შედეგები მიიღება ურბანული ტექნიკის მრავალი პრობლემური საკითხის გადაწყვეტაში, მრავალი ამოცანის გადაწყვეტა გახდა შესაძლებელი არქეოგეორადიოლოკაციაში.
გამოყოფილია ობიექტის რადიოსახე რომელიც ჩასდევს ობიექტის განთავსების ადგილს და აღემატება მის გეომეტრიულ ზომებს სივრცულად დაახლოებით სამჯერ. ამასთან ობიექტის ქვედა ნაწილი რადიოსახესთან დაკავშირებულია ზოგადად ანტენების მახასიათებლის ე.წ. ელექტრომაგნიტური ველის მიმართულების დიაგრამის შინაარსით, ანუ მკაფიოდ განსაზღვრავს და გამოყოფს მეორადი გამოსხივების ანტენად მიჩნეული ობიექტის ლოკაციას.
ამდენად, შესაძლებელია საძირკველის ფიზიკური მოდელის და მაშასადამე გეორადიოლოკაციური ელექტრომაგნიტური ველების მსგავსობის თეორიიდან გამომდინარე საველე ობიექტის რადიოსახის დაფიქსირება.
სამოდელო ობიექტის დაღრმავება მკაფიოდ განისაზღვრება რადიოსახეზე დაფიქსირებული ბოლო ჰორიზონტალური სინფაზურობის ღერძის მდებარეობით რადაროგრამაზე, როგორც ჰორიზონტალურ ისე ვერტიკალური გეორადიოლოკაციური ექსპოზიციის დროს.

საკვანძო სიტყვები: აექეოგეორადარიოლოკაცია, რადიოსახე, ფიზიკური მოდელირება, Zond 12-e.

Исследование методом георадиолокационного физического моделирования радиообраза объекта сплошной, гранёно-фрагментарной, диэлектрически сложной структуры

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Резюме

Для археологических работ важна фиксация и расшифровка радиообраза объекта в результате взаимного расположения между целевыми объектами и антенной георадара, т.е. решение обратной задачи электродинамики. Для того, чтобы радиообраз объекта был полностью распознан, антенна GPS должна располагаться в дальней зоне целевого объекта, то есть расстояние между антенной и объектом должно превышать длину волны излучения. При археологических работах расстояние до целевого объекта неизвестно, поэтому объект может находиться, как в ближней зоне, так и в средней и дальней зоне относительно антенны, что искажает или даже делает невозможным фиксацию и распознавание радиобраза объекта. В результате при археогеорадиолокационных работах важная информация может быть не получена.
Метод георадиолокации нашёл широкое применение во многих областях геологического содержания. Важные результаты получены в решении многих проблемных вопросов градостроительства, решение многих задач стало возможным в археогеорадиолокации.
Ключевые слова: археорадиолокация, радиообраз, физическое моделирование, Zond 12-е.