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Preliminary Archaeogeophysical Survey of the Construction Site in the Vicinity of the Narikala Citadel

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ABSTRACT

Due to the construction and rehabilitation works in the territory of "Old Tbilisi", one of the historically ancient and archaeologically very important places in the capital of Georgia, Tbilisi, there was a need to carry out a preliminary reconnaissance archaeogeoradiolocation survey. The pre-marked area for the archaeogeoradiolocation survey was intended as a place for the operation of construction equipment. During the construction process, it was possible to damage multi-ton construction equipment and cause accidents as a result of underground voids, as well as destroy possible archaeological monuments.
The archaeogeoradiolocation survey revealed a number of voids, signs of the presence of possible archaeological sites, and mapped their locations. The archaeogeoradiolocation work was performed using a Zond 12e georadar, the data was collected, processed and interpreted using the Prizm 2.6 software. The aim of the task was to conduct a georadiolocation survey to identify voids in the subsurface and near-surface areas.
It turned out that the study area is loaded with objects containing cavities of various shapes and contents. The continentality of the soil is disturbed by numerous cavities. Their depth ranges from 0.5 m to 5 m and their length is 1-5 m. A boundary between geological layers has been identified, on which a radio image of a man-made object could be located, such as: a foundation, tunnel, culvert or other cylindrical object located above the foundation and with a width of 1–1.5 m. The presence of a geological object is not excluded.
From an archaeological-geological point of view, the study requires further continuation of detailed archaeogeoradiolocation works.
Keywords: *archaeogeoradiolocation survey, georadar works, radio image*

Introduction

Due to the construction and rehabilitation works in the territory of "Old Tbilisi", one of the historically ancient and archaeologically very important places in the capital of Georgia, Tbilisi, there was a need to conduct a preliminary reconnaissance archaeogeoradiolocation survey. The pre-marked area for the archaeogeoradiolocation [1, 2, 3] survey was intended as a place for the operation of construction equipment. During the construction process, it was possible to damage multi-ton construction equipment and cause accidents as a result of underground voids, as well as destroy possible archaeological monuments.

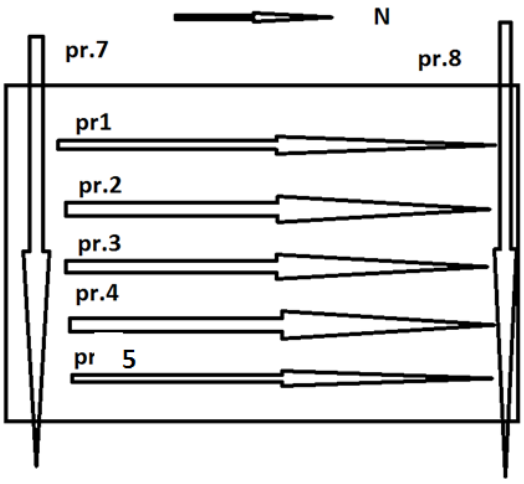
The archaeogeoradiolocation survey revealed a number of voids, signs of the existence of possible archaeological monuments, and mapped their locations.

Archaeological georadar works were performed using the Zond 12e georadar, data were collected, processed and interpreted using the software - Prizm 2.6.

Task/Objective

The purpose of the task was to conduct a georadiolocation survey to identify voids in the subsurface [4, 5, 6, 7] of the underground.

Environment and Instrumentation



Scheme 1.

In the vicinity of the "Old Tbilisi" citadel, "Nariakala", in geographically difficult terrain, in a pre-marked area, a georadar Zond-12e, with its standard 150MHz dipole antenna, and software Prizm-2.6, was used to conduct a georadiolocation survey to identify voids in the underground near-surface layout.

The schematic drawing (Scheme 1) shows the conditional placement of geo-radiolocation profiles and their directions.

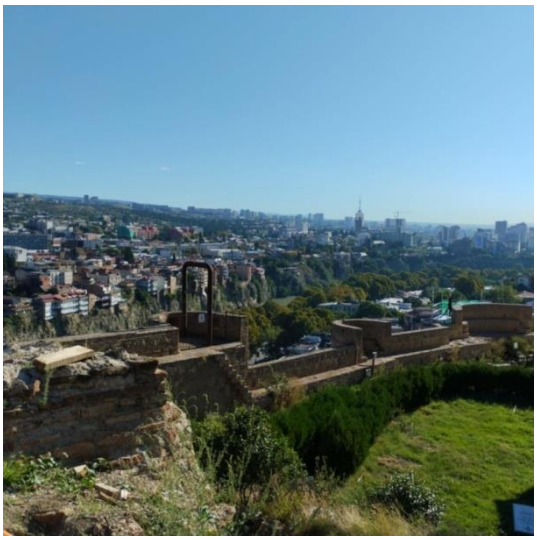


Photo 1.
View from Narikala Citadel

Photo 2.
Environment for placing geo-radiolocation profiles.

Photo 3. The location of one of the geo-radiolocation profiles.

Results and Discussion

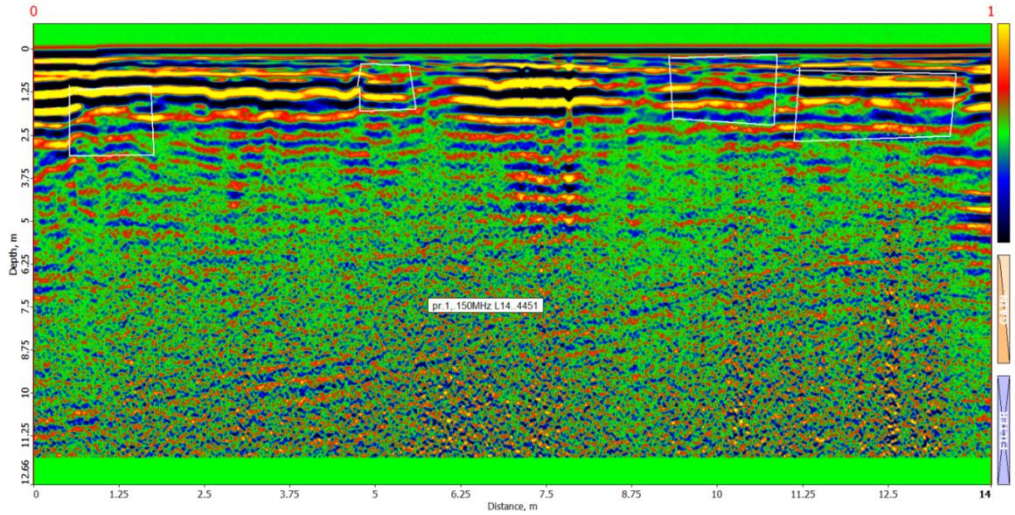


Fig. 1. Georadiolocation profile 1 was made with a 150 MHz georadar antenna. The length of the profile is 14 m.

Georadiolocation profiles are presented, with anomaly locations marked and separated by white lines. Anomalies were separated according to their radio features/amagine [7].

Georadiolocation profile 1 (Fig. 1) shows pit-type cavities at distances of 1.25 m with a size of 1-1.5m, as well as at a distance of 5m, in addition, at a distance of 10m and a distance of 12.5m there areradio images of pit-type cavities filled with waste material, their depths are from 1m to 2m.

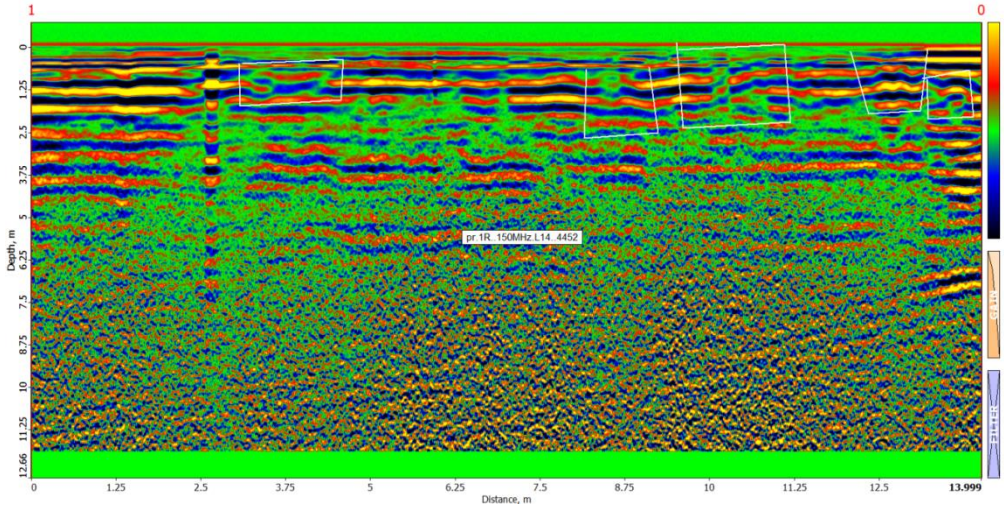


Fig. 2. Georadiolocation reverse profile-1R is made with a 150 MHz georadar antenna. The length of the profile is 14 m. Parallel and separated from profile 1 by 0.5-1 m.

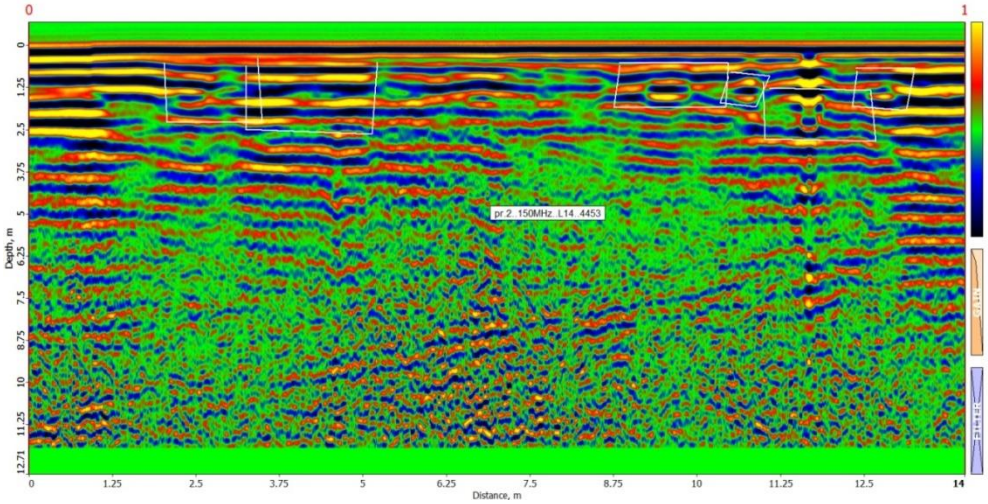


Fig. 3. Georadar profile-2 was performed with a 150MHz georadar antenna. The length of the profile is 14m.

On profile 1R (Fig. 2) at distances of 3.75, 8, 12, 13m, radio features corresponding to the depth of the depression were marked with depressions of 2-2.5m. The radio features of the marked objects continue on profile 1, therefore they are of a volumetric type and their length is not less than 1m.

On profile 2 (Fig. 3), characteristic radio features of the pit and cylindrical cavity were marked at distances of 2.5, 10, 12.5m with a depth of 2.5m.

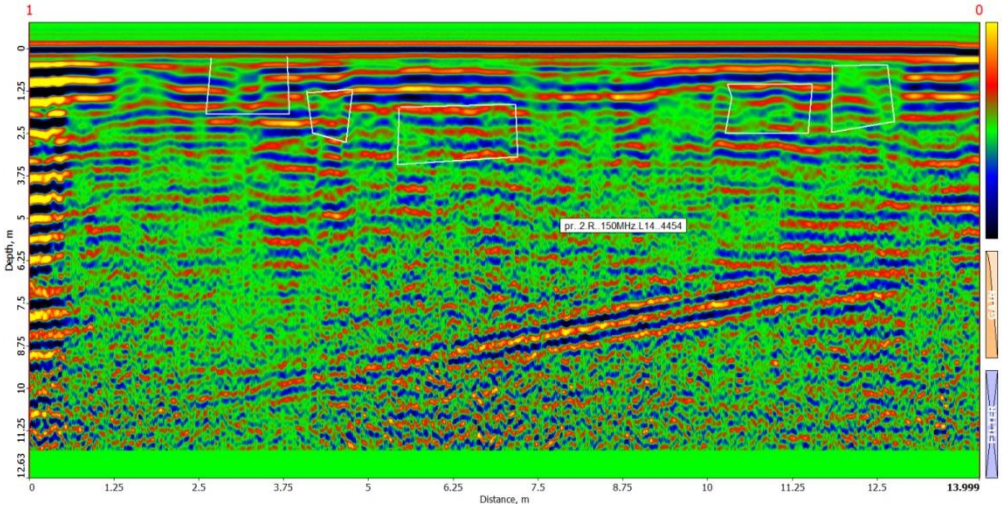


Fig. 4. Georadiolocation reverse profile-2R was performed with a 150MHz georadar antenna. The length of the profile is -14m. Parallel and separated from profile-2 by 0.5-1m.

On profile 2R (Fig. 4), characteristic radio features of the pit and cylindrical cavity were marked at distances of 2.8, 10, 12.5m with a depth of 2.5m. They extend continuously on profile 2. Thus, they are dimensionally up to 1m wide.

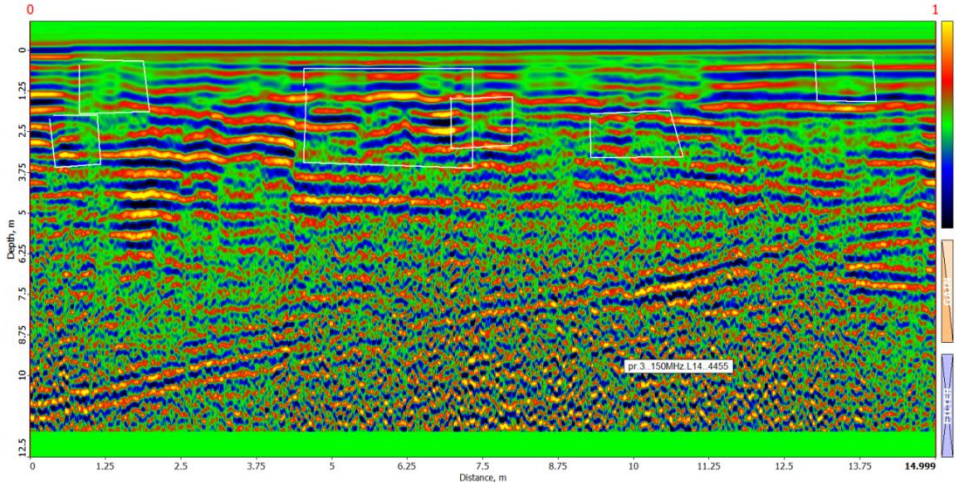


Fig. 5. Georadar profile -3 was performed with a 150 MHz georadar antenna. The length is 15m.

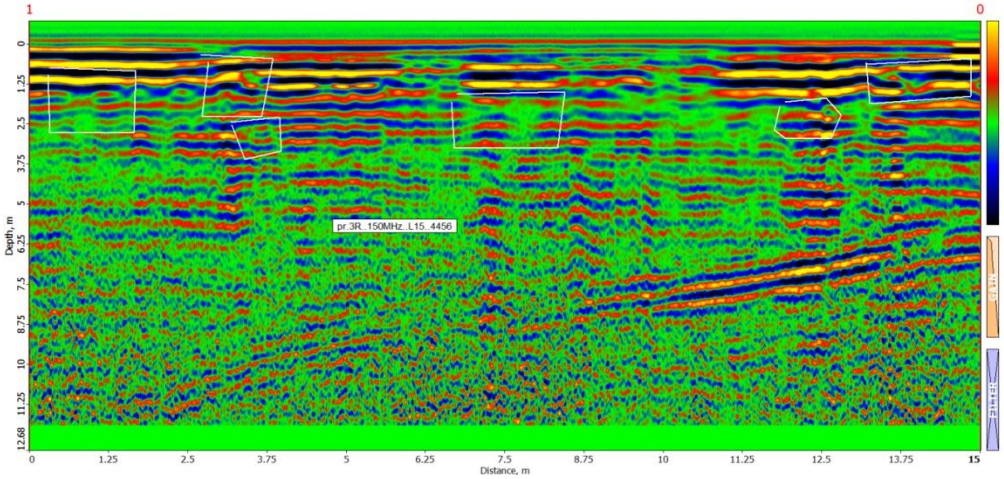


Fig. 6. Georadiolocation reverse profile-3R is performed with a 150Hz georadar antenna. The profile length is 15m. Parallel and is separated from profile 3 by 0.5-1m.

On profile 3 (Fig. 5) the radio images of pit-like objects were marked at distances of 1.25, 6, 10, 13.75m. In addition, they represent radio images of continuous objects and extend to profiles 2-2R.

On profile 3R (Fig. 6) dimensional cavities 1, 3, 3.75, 7.5, 12.5, 13.75m were marked. In addition, the radio image of a cylindrical object and at a distance of 7.5m continues on the previous profiles.

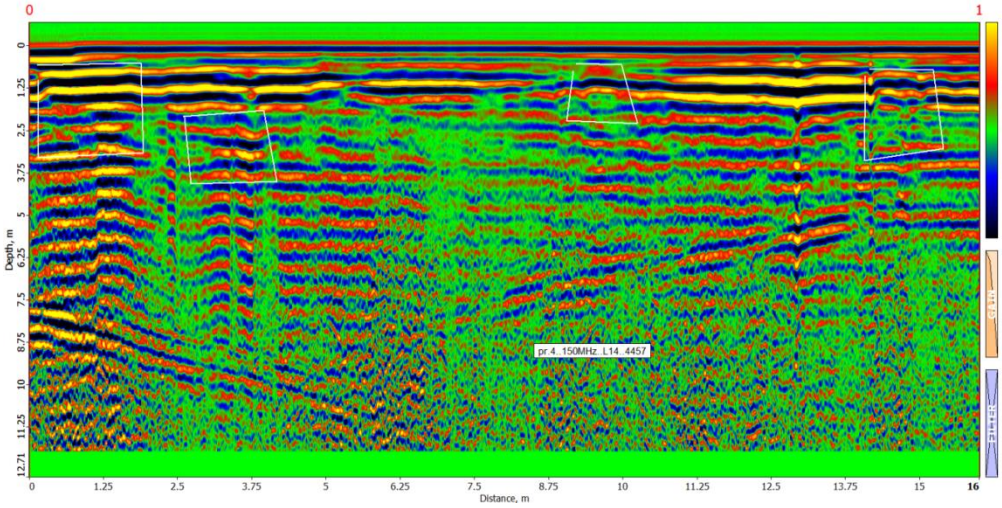


Fig. 7. Georadar profile-4 was performed with a 150 MHz georadar antenna. The length is 16m.

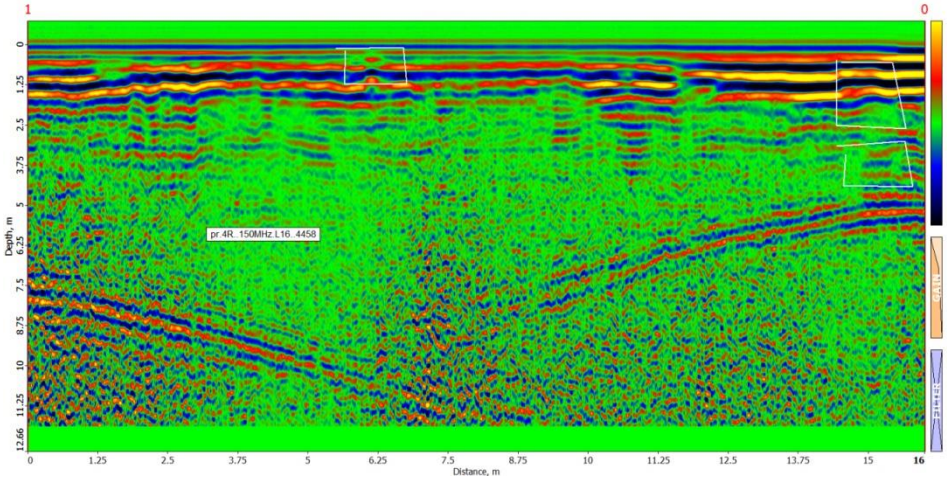


Fig. 8. Georadar reverse profile-4R is made with a 150Hz georadar antenna. The length of the profile is 15m. Parallel and separated from profile 4 by 0.5-1m.

On profile 4 (Fig. 7), radio features of pit-like objects were marked at distances of 1.25, 3.75 m, and cylinder-type at 10 m. At distances of 13-15 m, radio features of partially collapsed sided cavities. Their depth is up to 4 m.

Profile 4R (Fig. 8)shows the radio faces of the objects recorded in profile 4, as well as the radio faces of partially collapsed pit-type objects at distances of 2.5, 6, 11.25, 15 m.

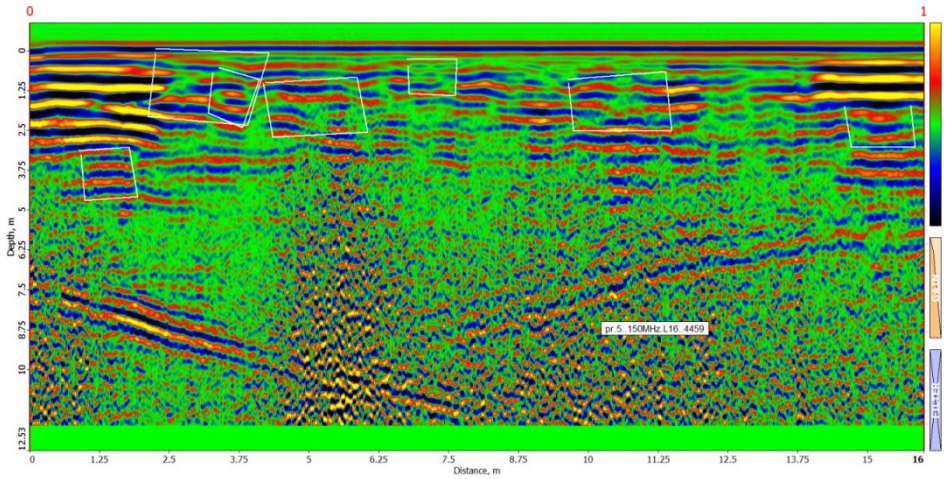


Fig. 9. Georadiolocation profile-5 was made with a 150MHz georadar antenna. The length is 16m.

On profile 5 (Fig. 9), at distances of 1.25, 3.75, 7.5, 11, 15m, radio images of objects containing cavities were marked, possibly of anthropogenic origin. They continue continuously on profile 4. Their depth is 5 m.

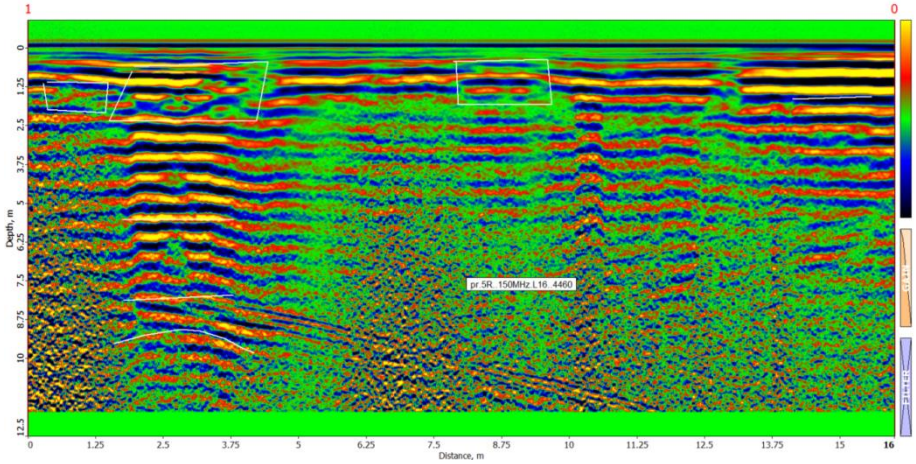


Fig. 10. Georadiolocation reverse profile-5R is made with a 150Hz georadar antenna. The length of the profile is 16m. Parallel and separated from profile 5 by 0.8-1.5m.

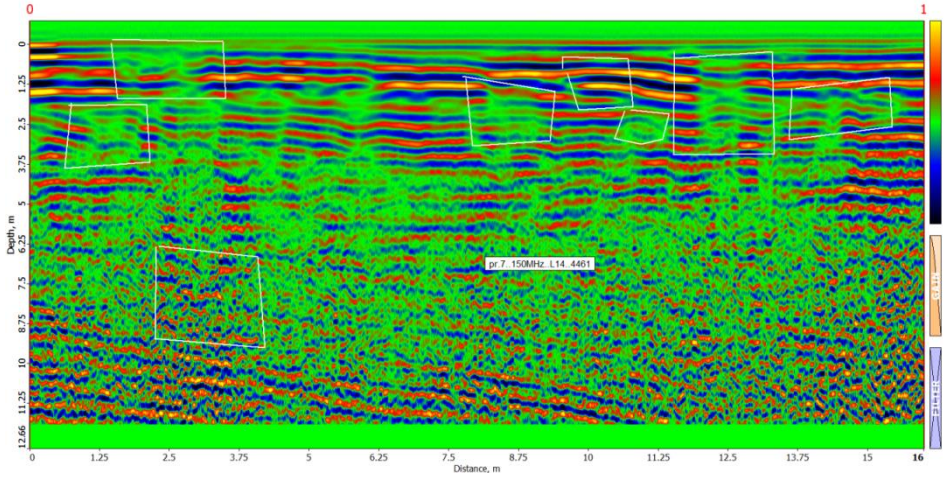


Fig. 11. Georadar profile-7 was made with a 150 MHz georadar antenna. The length of the profile is 16 m.

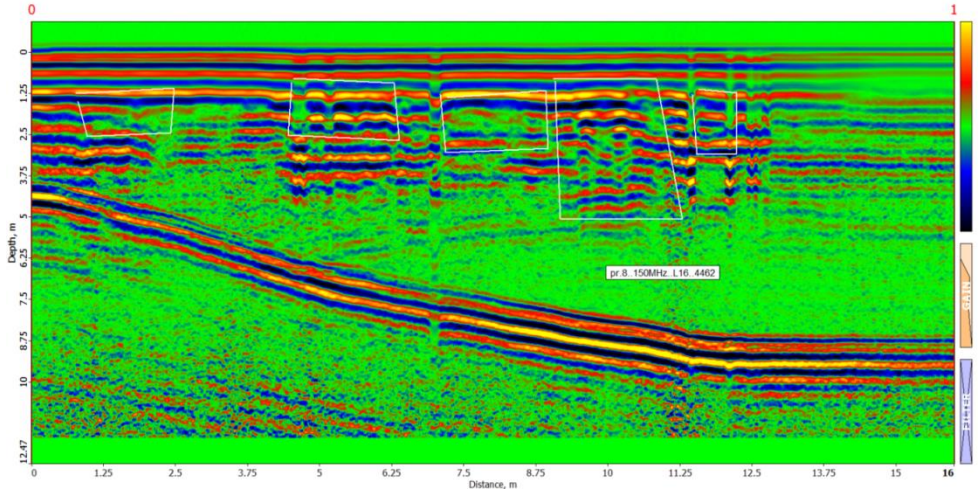


Fig. 12. Georadiolocation profile-8 was performed with a 150MHz georadar antenna. The length of the profile is 16 m.

Profile 5R (Fig. 10) marks hollows at distances of 1.25, 3, 4, 9, 12.5, 15m, their deepening is 2.5 m.

On profile 7 (Fig. 11), radio features with depth signs were marked at distances of 1.25, 3, 8.75, 10, 11.25, 12.5, 15m. Their depth is mainly 4m, and the depth of the object of the type that was destroyed at a distance of 3 m is 9m.

On profile 8 (Fig. 12) cavities were marked at distances of 2, 6, 8, 10, 12.5m, their deepening is 5 m.

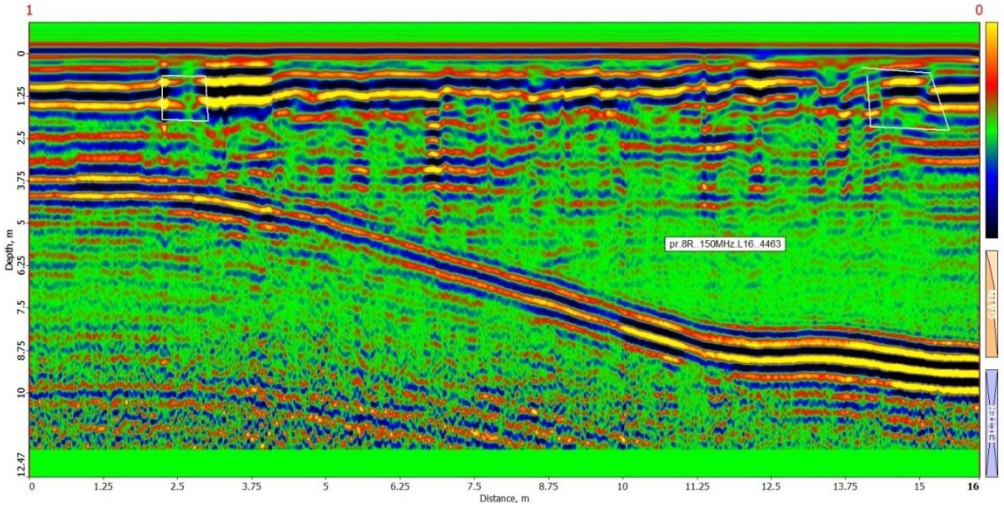


Fig. 13. Georadiolocation reverse profile-8R performed with a 150MHz georadar antenna. The profile length is 16m. Parallel and separated from profile 8 by 0.8-1.5 m.

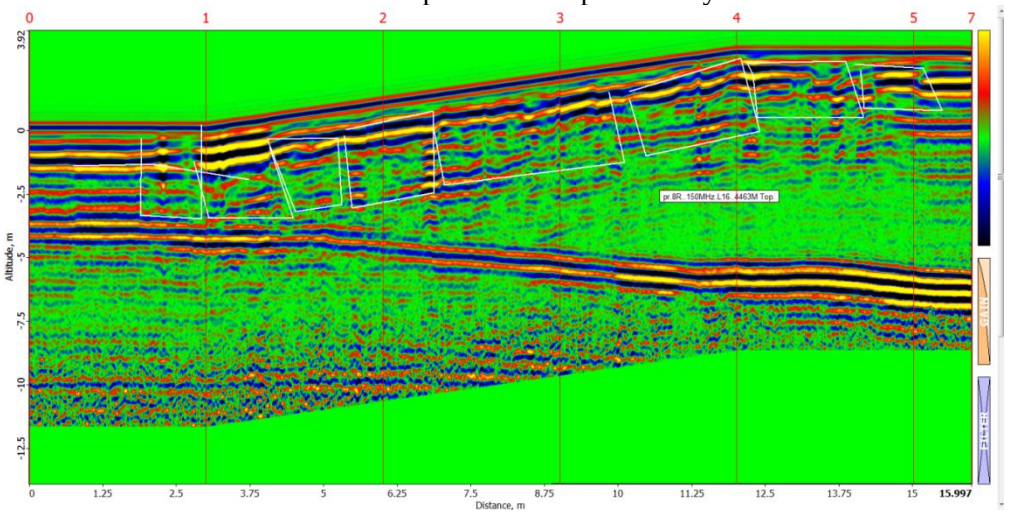


Fig. 14. Georadiolocation reverse profile-8R performed with a 150MHz georadar antenna. The length of the profile is 16 m. Parallel and separated from profile 8 by 0.8-1.5 m. Topographic representation.

Profile 8R (Fig. 13) revealed radio features of cavity-type objects at distances of 2.5, 3, 6, 12, 13, 15m, the maximum depth is 4m.

Fig. 14 shows profile 8R with topographic content, marked with radio images of cavities.

Profile 8 and profile 8R revealed the geological structure, the boundary between geological layers was distinguished, on which there may be a radio feature of an anthropogenic object, e.g. a watercourse or other cylindrical object with a width of 1-1.5m.

Prof-8 and Prof-8R have identified a continuous anomalous structure, a boundary between geological layers, on which a radio image of a man-made object can be located, for example: a foundation, tunnel, culvert or other massive cylindrical object located above the foundation and with a width of 1–1.5m. The presence of a geological object cannot be ruled out.

Conclusion

The study area is loaded with objects containing cavities of many shapes and contents, marked with white lines. The continentality of the soil is disturbed by multiple cavities. Their depth ranges from 0.5 m to 5 m and their length is 1-5 m.

Prof-8 and Prof-8R A geological structure has been identified, a boundary between geological layers has been identified, on which a radio image of a man-made object can be placed, for example: a foundation, tunnel, culvert or other cylindrical object located above the foundation and with a width of 1–1.5 m. The presence of a geological object is not excluded.

From an archaeological-geological point of view, the study requires further continuation of detailed archaeogeoradiolocation works.

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ნარიყალას ციტადელის მიმდებარე ტერიტორიაზე სამშენებლო მოედნის წინასწარი არქეოგეოფიზიკური კვლევა

დ. ოდილავაძე, თ. ჭელიძე, ო. იავოლოვსკაია

რეზიუმე

საქართველოს დედაქალაქ თბილისის ერთერთი, ისტორიულად ძველი და არქეოლოგიურად მეტად მნიშვნელოვანი ადგილის, ,,ძველი თბილისის" ტერიტორიაზე სამშენებლო-სარეაბილიტაციო სამუშაოების ჩატარების გამო გაჩნდა საჭიროება შესრულებულიყო დაზვერვითი არქეოგეორადიოლოკაციური წინასწარი კვლევა. არქეოგეორადიოლოკაციური გამოკვლევის წინასწარ მონიშნული ტერიტორია გათვალისწინებული იყო სამშენებლო ტექნიკის ოპერირების ადგილად. სამშენებლო პროცესის მიმდინარეობისას შესაძლებელი შეიძლება ყოფილიყო როგორც მიწისქვეშა სიცარიელეების შედეგად მრავალტონიანი სამშენებლო ტექნიკის დაზიანება და უბედური შემთხვევების გამოწვევა, ასევე შესაძლო არქეოლოგიური ძეგლების განადგურება.

არქეოგეორადიოლოკაციურმა კვლევამ გამოავლინა რიგი სიცარელები, შესაძლო არქეოლოგიური ძეგლების არსებობის ნიშნები, მოახდინა მათი ლოკაციების კარტირება.

არქეოგეორადიოლოკაციური სამუშაოები შესრულდა გეორადარ Zond 12e, მონაცემები მოიკრიბა, დამუშავდა და ინტერპრეტირდა პროგრამული უზრუნველყოფით - Prizm 2.6.

ამოცანის მიზანს წარმოადგენდა გეორადიოლოკაციური კვლევა მიწისქვეშა ახლოქვეზედაპირული განლაგების სიცარიელეთა გამოსავლენად.

აღმოჩნდა, რომ საკვლევი ფართობი დატვირთულია მრავალი ფორმისა და შინაარსის სიღრუის შემცველი ობიექტებით. ნიადაგის კონტინენტალურობა დარღვეულია მრავლობითი სიღრუეებით. მათი სიღრმეთა განთავსება მერყობს 0.5მ-დან 5მ-დე და განგრძობითობით 1-5მ.

იდენტიფიცირებულია საზღვარი გეოლოგიურ ფენებს შორის, რომელზედაც შეიძლება განთავსებულიყო ადამიანის მიერ შექმნილი ობიექტის რადიო გამოსახულება, ასეთებია: საძირკველი, გვირაბი, წყალგამტარი ან სხვა ცილინდრული ობიექტი, რომელიც მდებარეობს საძირკვლის ზემოთ და სიგანით 1–1.5 მ არ არის გამორიცხული გეოლოგიური ობიექტის არსებობა.
არქეოლოგიურ-გეოლოგიური თვალსაზრისით, კვლევა მოითხოვს დაწვრილებითი არქეოგეორადიოლოკაციური სამუშაოების შემდგომ გაგრძელებას.

საკვანძო სიტყვები: არქეოგეორადიოლოკაციური სამუშაოები, გეორადარი, რადიოსახე, რადაროგრამა.

Предварительное археогеофизическое исследование строительной площадки в районе цитадели Нарикала

Д. Одилавадзе, Т. Челидзе, О. Яволовская

Резюме

В связи с проведением строительно-восстановительных работ на территории «Старого Тбилиси», одного из исторически древних и археологически важнейших мест столицы Грузии города Тбилиси, возникла необходимость проведения предварительной рекогносцировочной археогеорадиолокационной съемки. Предварительно размеченная территория для археогеорадиолокационной съемки предназначалась для работы строительной техники. В процессе строительства существовала вероятность повреждения многотонной строительной техники и возникновения аварий из-за подземных пустот, а также уничтожения возможных археологических памятников.
Археогеорадиолокационное исследование выявило ряд пустот, признаков существования возможных археологических памятников, а также нанесло на карту их местоположение. Археологические георадарные работы выполнялись с использованием георадара «Zond 12e». Сбор, обработка и интерпретация данных осуществлялись с использованием программного обеспечения Prizm 2.6.
Целью задания было проведение георадиолокационной съемки для выявления пустот в подземной приповерхностной структуре. Оказалось, что исследуемая зона заполнена полыми предметами разнообразной формы и содержания. Континентальность почвы нарушена многочисленными понижениями. Их глубина колеблется от 0.5 до 5 м, а длина — от 1 до 5 м.
Выявлена граница между геологическими слоями, на которой может располагаться радио изображение искусственного объекта, например: фундамента, тоннеля, водопропускной трубы или другого цилиндрического объекта, расположенного выше фундамента и шириной 1–1.5 м. Наличие геологического объекта исключить нельзя.
С археолого-геологической точки зрения исследование требует дальнейшего продолжения детальных археогеорадиолокационных работ.

Ключевые слова: археогеорадиолокационные работы, георадар, радио образ, радарограмма.