1st International Scientific Conference "Modern problems in Geophysics", Proceedings,
ISBN 978-9941-36-434-1, ISSN 3088-4349, Tbilisi, Georgia, November 6-8, 2025

RECONNAISSANCE ARCHAEOGEORADIOLOCATION STUDY OF THE TERRITORY OF THE NINOTSMINDA MONASTERY COMPLEX

Odilavadze D. T., Chelidze T. L., Ghlonti N. Y., Kiria J. K., Yavolovskaya O. V.

Ivane Javakhishvili Tbilisi State University, Mikheil Nodia Institute of Geophysics
odildavit@gmail.com

Abstract. *Georgia, Kakheti, Sagarejo, Ninotsminda Monastery Complex. Ninotsminda Cathedral is a notable monument dating back to the 6th century. It was built on an old idol site [1, 2] during the time of Saint Nino. Within the framework of the Ninotsminda Complex Geophysical Expedition, archaeogeoradiolocation work was carried out using the Zond-12e georadar, 500MHz screened and 150MHz dipole staff antennas [3, 4, 5, 6]. Georadiolocation data were collected, processed and interpreted using the Prizm 6 staff software. Georadiolocation profiles/GPR-sections were conducted in the inner courtyard of the monastery and on the territory of the monastery itself. This paper presents the results GPR-section obtained and interpreted by the 500 MHz antenna conducted in the inner courtyard of the monastery complex.*

Keywords: *georadiolocation, georadar Zond-12e, radar images, Ninotsminda Monastery Complex.*

Introduction

Fig. 1. Remains of the walls and surroundings of the Ninotsminda Cathedral in the territory of the complex

Fig. 2. Remains of the walls and interior of the Ninotsminda Cathedral

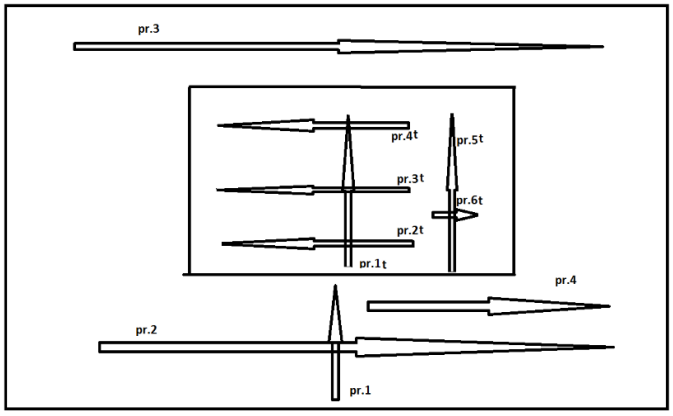

Fig. 3. Schematic drawing 1.

To create a large dome space, an additional small stall was inserted on the diagonal axes between the four apses in the corners of the central square. From the outside, the temple was a star-shaped building in plan, with semicircular apses arranged alternately according to size. Only the altar apse in the middle, where the windows are cut, has a pointed shape (Fig. 1- Fig. 3). The building was a developed form of the tetra-conch and a direct predecessor of the cross-type monuments. The temple was extensively renovated many times (XI-XII centuries, XVI centuries). It was destroyed during the earthquakes of 1824 and 1848.

Environment and Instrumentation

A schematic drawing 1 of shows the location of the archaeo-geo-radiolocation profiles/GPR-section conducted on the territory of the Ninotsminda complex.

The small rectangle corresponds to the territory of the temple, and the large rectangle corresponds to the temple courtyard. The arrows show the approximate directions of the conducted geo-radiolocation cuts.

The Zond-12e georadar and the Prizm-2.6 software used.

The geo-radiolocation profiles were conducted with 500 MHz shielded and dipole 150 MHz antennas, three areas were allocated on the outer and inner territories of the temple.

We present radargrams of geo-radiolocation cuts conducted on the territory of the Ninotsminda temple courtyard, area-1, for 7-8 meter penetration using a 500 MHz antenna. In addition, Prof-1 and Prof-2 intersect each other at a distance of approximately 10m for Prof-1 and 17m for Prof-2.

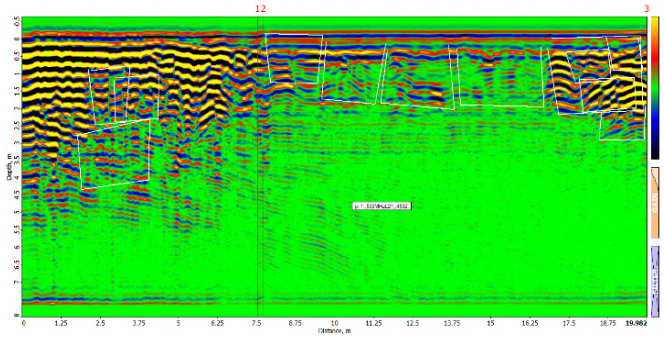

Fig. 4. Profile-1 was performed with a 500 MHz shielded GPR antenna. Profile length -21 m.

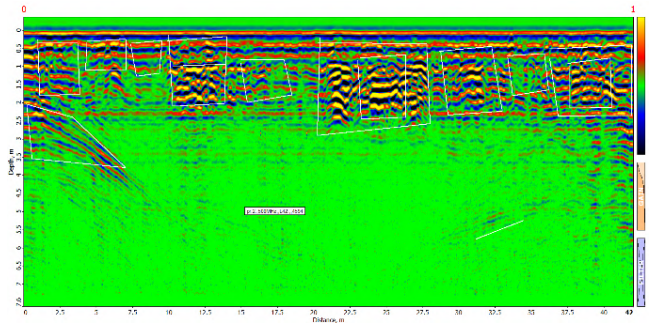

Fig. 5. Profile-2 was performed with a 500 MHz shielded staff GPR antenna. Profile length -42 m.

On the presented radargram (Fig. 4) the radio faces of objects containing vertical, mutually parallel surfaces containing a cavity are marked with white lines [7, 8, 9, 10], presumably of anthropogenic origin, e.g., a burial ground, an underground storage room, etc. The radio faces of objects, including those with a structurally complex structure, are located on the radargram at distances: 2-5m, 6-9m, 9-16m. At distances of 17-20m, a cavity containing a complex structure (17-18.75m) built of a strongly reflective material was marked. The radio face of this object also rests on the radio face of the object containing the cavity on its right side. Three meters below, at distances of 1.25-6.5m, a deformed radio image of an object, presumably of anthropogenic origin, was also noted.

On the presented radargram (Fig. 5) the radio faces of objects containing vertical, mutually parallel surfaces containing a cavity are marked by white lines, presumably the cavities are of anthropogenic origin, e.g., a burial ground, an underground storage room, etc. The radio faces of objects, including those of structurally

complex construction, are located on the radargram at distances: 10-15m, 21-27m. Also, a 38-40m cavity containing a complex, arched structure built of a strong reflective material. At a depth of 2 m, at distances of 0-5m, the radio image of the object of the foundation part was also marked.

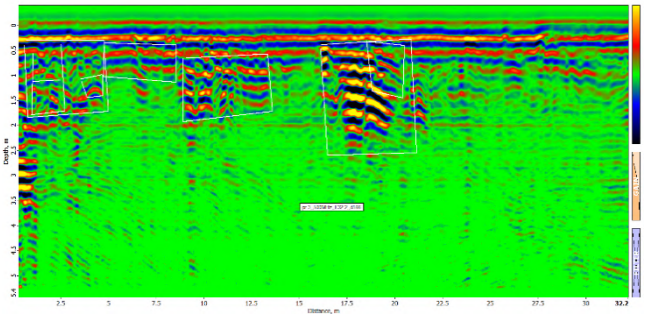

Fig. 6. Profile-3 was performed with a 500 MHz shielded staff georadar antenna. Profile length -32m.

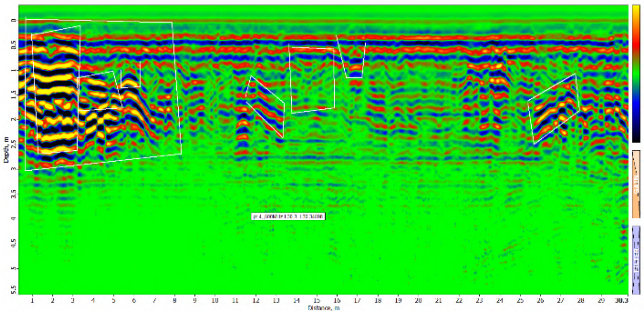

Fig. 7. Prof-4 was performed with a 500 MHz shielded georadar antenna. Profile length-30m.

On the presented radargram (Fig. 6) the radio faces of objects containing vertical and deformed, mutually parallel surfaces containing cavities are marked with white lines, presumably of anthropogenic origin, located on the top of each other, for example, burials, radio faces of objects, including those of structurally complex construction, are located on the radargram at distances: 1-5 m, 10-12 m. At distances of 17-20m, a complex cavity built of a strong reflective material, with an overlap, containing a structure (17-18m) cavity was marked. The radio face of this object is shifted and deformed on the right side. Three meters below, at distances of 0-1m, a radio image of the remnant part of the foundation was also marked.

On the presented radargram (Fig. 7), the radio faces of objects, including those of structurally complex construction, Prof-4, are located at distances: 0-9m. At distances 11-13m, 26-27m, oblique planes containing a complex recess structure were marked. The radio face of this object rests with its right side on the radio face of an object containing a recess oval-like cavity at 28-39m.

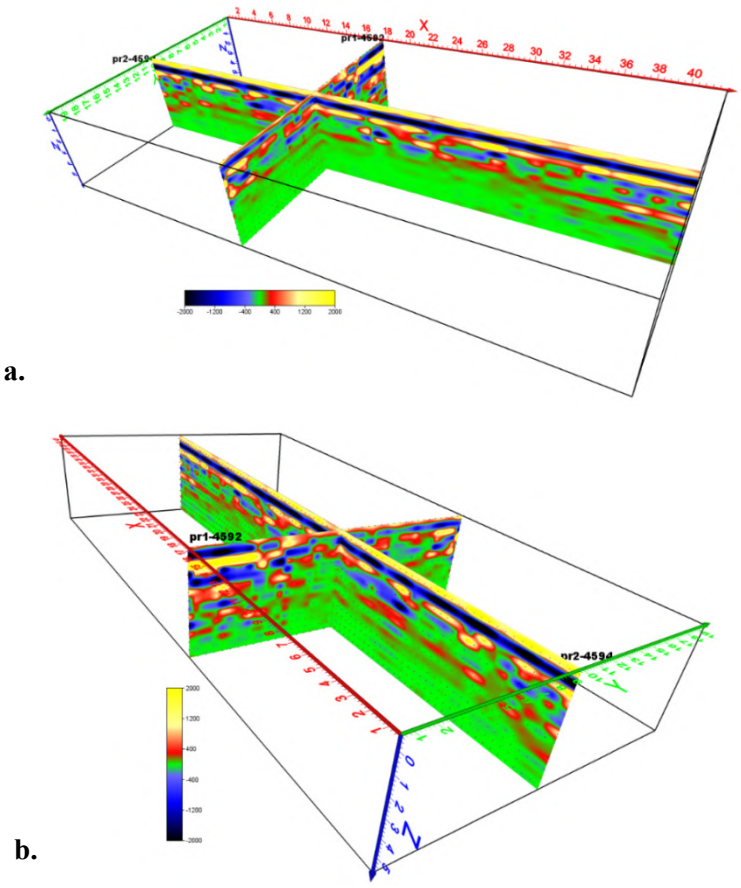

Fig. 8. Intersecting profile-1 and profile-2.

Fig. 8(a,b) shows the intersecting profile-1 and profile-2. It follows from the joint interpretation that the intersection point will clearly show the dimensions of the 3D spatial object, which is well confirmed by presenting the intersection from two different perspectives, according to the radio images.

Area-1. Conclusion

At the intersection of Prof-1 and Prof-2, a common radio feature is recorded, which probably corresponds to an anthropogenic cavity with dimensions of 2x2m, at a distance of 10.5m for Prof-1 and 17.5m for Prof-2. When cross-sectioning profiles 1 and 2, the presence of a three-dimensional underground object was revealed at the intersection, which is well confirmed by presenting the intersection from two different perspectives.

The georadar Zond-12e with its 500MHz shielded antenna revealed multiple georadiolocation radio features representing various types of cavities, which correspond to anthropogenic objects. Their location Prof-1, 2, 3, 4, 5, and depth are determined by the corresponding coordinates at the distances and depths indicated by the radar images.

References

1. Ioseliani P., Description of the antiquities of the city Tiflis. 1866, pp. 132-133 (in Russian).
2. Georgian Soviet Encyclopedia, T. 7, Tbilisi., 1984, P. 440, (in Georgian).
3. 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.
4. Chelidze T., Odilavadze D., Pitskhelauri K., Archaeogeophysics in Georgia-New Results, New Prospects. Journal of Georgian Geophysical Society. // Proceedings OF THE GEORGIAN NATIONAL ACADEMY OF SCIENCES. Series of History, Archeology, Ethnology and Art History, №.15, 2013, pp. 24-34.
5. Odilavadze D. T., Chelidze T.L., A Preliminary GPR investigation of Metekhi Cathedral and the surrounding area. // Journal of Georgian Geophysical Society, 2010, № 14, pp.32-38.
6. Kofman L., Ronen A., Sam Frydman. Detection of model voids by identifying reverberation phenomena in GPR records. // Journal of Applied Geophysics. (59), 2006, pp.284-299.
7. Odilavadze D., Chelidze T., Yavolovskaya O., Some georadiolocation images of cylindrical bodies built with different dielectric fillers, placed in a dielectric environment. // M. Nodia Institute of Geophysics of I. Javakhishvili Tbilisi State University, Tbilisi, Georgia, 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.
8. Odilavadze D. T., Chelidze T. L., Ghlonti N.Y., Yavolovskaya O. V., Determining the Presence and Structure of a Subsurface Radioactive Burial when Interpreting the Results of the GPR Method by Analyzing a Three-Dimensional Rotating Radio Image. // Journal of the Georgian Geophysical Society, e-ISSN: 2667-9973, p-ISSN: 1512-1127. Physics of Solid Earth, Atmosphere, Ocean and Space Plasma, v. 25(1), 2022, pp.21-28.
9. Odilavadze D. T., Chelidze T. L., Yavolovskaya O. V., THE RADIO IMAGE OF AN OBJECT WITH AN ELONGATED, FACE-FRAGMENTED, DIELECTRICALLY COMPLEX STRUCTURE WAS STUDIED USING THE METHOD OF GEORADAR PHYSICAL MODELING. // Journal of the Georgian Geophysical Society, e-ISSN: 2667-9973, p-ISSN: 1512-1127, Physics of Solid Earth, Atmosphere, Ocean and Space Plasma, v. 27(2), 2024, pp.15–28.
10. Odilavadze D. T., Chelidze T. L., Yavolovskaya O. V., Preliminary archaeogeophysical survey of the construction site in the vicinity of the Narikala Citadel. // Journal of the Georgian Geophysical Society, e-ISSN: 2667-9973, p-ISSN: 1512-1127. Physics of Solid Earth, Atmosphere, Ocean and Space Plasma, v. 28(1), 2025, pp. 27-35.