2023 IMEKO TC-4 International Conference on
Metrology for Archaeology and Cultural Heritage
Rome, Italy, October 19-21, 2023

Geophysical surveys at the Roman Aqueduct "Aqua Virgo" (Roma, Italy)

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***Abstract* – Aqua Virgo is the oldest Roman aqueduct still functioning in the city of Rome. It has never stopped working and still today it supplies some of the most famous fountains of the capital. The aqueduct was inaugurated in 19 B.C. and presents an almost entirely subterranean route. Geophysical measurements were undertaken with the aims to acquire further data about the water intake system of Aqua Virgo in Salone. The ancient aqueduct did not catch the water only from one single source but from a complex of springs and feeder channels located in the area. This project intents to bring light on the possible connections between the main underground specus of Aqua Virgo and its tributary channels, many of which are still unknown. The objectives are detecting and localising the underground feeder channels referring to the existing cartography of the area and to the airshafts visible on the surface. Once the conduits have been recorded using geophysical prospections, the further aim is to understand their dimensions, their constructive features, and their depth from the surface.**

I. INTRODUCTION

Aqua Virgo is the oldest Roman aqueduct still functioning in the city of Rome. It has never stopped working and still today it supplies some of the most famous fountains of the capital. The aqueduct was inaugurated in 19 B.C. and presents an almost entirely subterranean route [1].

Aqua Virgo starts in a marshy area, about 20 Km east from the city centre of Rome, in the locality known as Salone (Figure 1.). According to Frontinus (De aquaeductu Urbis Romae I, 10) the springs were located at the lower part of the Lucullus estate (Ager Lucullanus), at the eight milestone of the ancient road Via Collatina, which approximately corresponds to the 10,5 kilometre of the modern Via Collatina [2]. The area is owned by the Municipality of Rome and managed by ACEA SpA (Water Municipality Utility of Rome).

Despite that the aqueduct has been thoroughly described by numerous scholars, the water intake system has never been properly studied in a systematic and scientific way.

In the swampy ground, at an average of 23 m above sea level, there were several separate springs, each one of them with its own reservoir [3]. Four sources are still active, but the precise number of springs collected under Agrippa is currently unknown [4].

Since the water intake system is entirely subterranean and the continuous activity of the aqueduct has not allowed analytic research inside the underground channels [5], it is difficult to understand the dimensions and the general planning of the Roman water catchment system.

The overall topography of the sources area has been left almost entirely unchanged since the antiquity (Figure 2). Between the end of the 19th century and the beginning of the 20th century, when the area became property of the Municipality of Rome, some precautions were taken to safeguard the sources. Little brick constructions, still visible on the surface, have been built on top of the springs in order to help keeping the water clean and to provide an easier access to the conduit itself. Barely any new information about the sources area has been added through the centuries. In ancient times, as well as during the Renaissance and in the following Baroque period, the aqueduct was considered for its functional aspect and its capacity to provide an abundant and constant flow of fresh water to the city of Rome. Therefore, even at the end of the 16th century, when the main sources in Salone were restored and the aqueduct was entirely reactivated [6], the attention was mainly directed to the practical and technological aspects of the aqueduct instead of its archaeological and historical features. Consequently, the information is very scarce or incomplete and even in the 19th century, with the growing interest in ancient water supply systems and the increasing attention towards Roman aqueducts, the springs of Aqua Virgo have never been the subject of deeper investigations. Several researchers have been writing about the area, but in most cases, without being supported by an autoptic survey. In fact, archaeological surveys of the entire area have never been conducted. aims to acquire further data about the water intake system of Aqua Virgo in Salone.

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The objectives are detecting and localising the underground feeder channels referring to the existing cartography of the area and to the airshafts visible on the surface. Once the conduits have been recorded using geophysical prospections, the further aim is to understand their dimensions, their constructive features, and their depth from the surface.

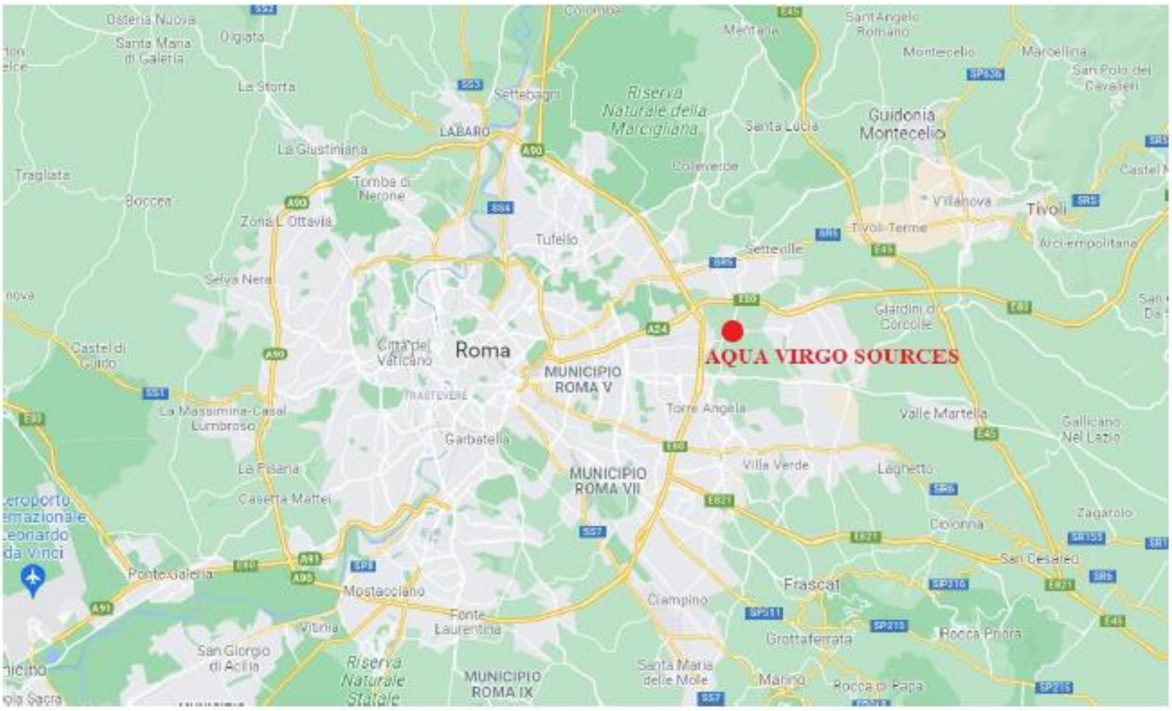

Fig. 1. Rome and its surroundings with the indication of the springs area in Salone. From Google Maps

Fig. 2. Salone. General overview of the sources area. From National Geoportal (year 2012)

II. GEOPHYSICAL DATA ACQUISITION AND PROCESSING

The GPR surveys were performed with a Sir 3000 System of GSSI equipped with a 270 MHz antenna mounted on a survey cart equipped with an incremental encoder. The 270 MHz data were acquired in continuous and reflection mode with a time window of 110 ns, samples per scan set at 512 with a resolution of 16 bits and a transmit rate of 100 kHz. (Figure 3)

The GPR acquisition was supported by a topographic survey that gave the possibility to georeference the obtained data that were managed with a Gis software.

GPR raw data have required some processing operations addressed to reduce the noise of the measurements and attenuation phenomena. A Gpr-slices software was used (GPR-SLICE Software (gpr-survey.com)). The surveyed area is shows in Fig. 4.

Fig. 3. photo relating to the measurement phases with a GPR

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Fig. 4. georeferenced surveyed area.

In the GPR data identified very interesting reflections within the depth ranging between 0.70 and 1.10 m as the radargram of Figure 5 shows. The reflection event labelled A could be related to the aqueduct.

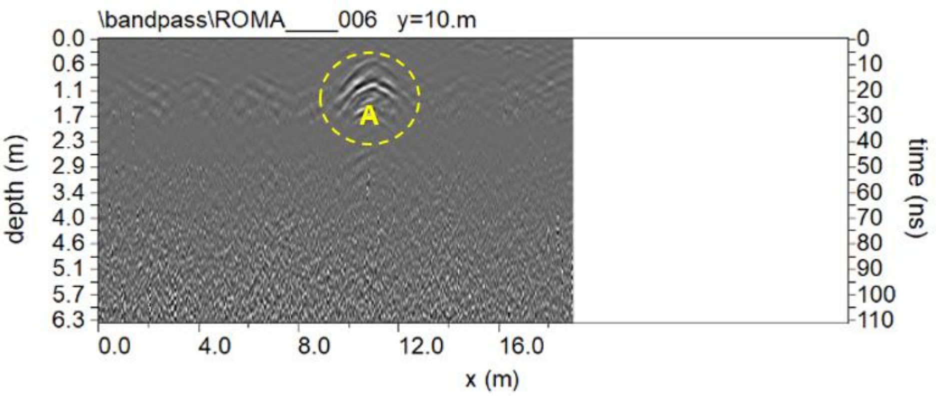

Fig. 5. processed radar sections

As plotted the time slices GPR images [7] in Figure 6, despite a inhomogeneous distribution of reflections, it was possible to define the shape, depth and direction of the aqueduct. In the depth slices is possible to see the the anomaly A and, at depth between 1.6 m and 3.2m the anomaly B that coud be related to structures of archaeological interest.

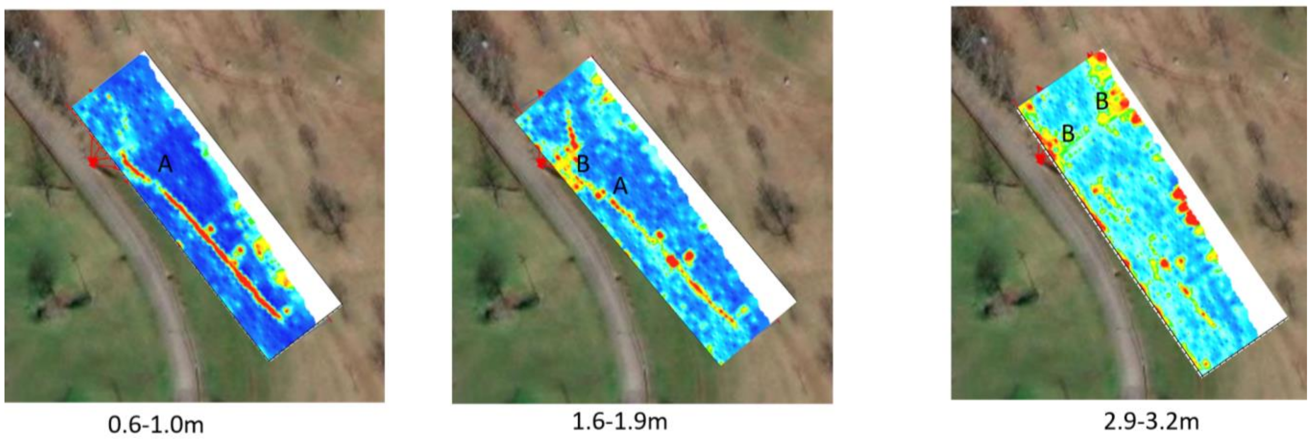

Fig. 6. Georeferenced depth slices.

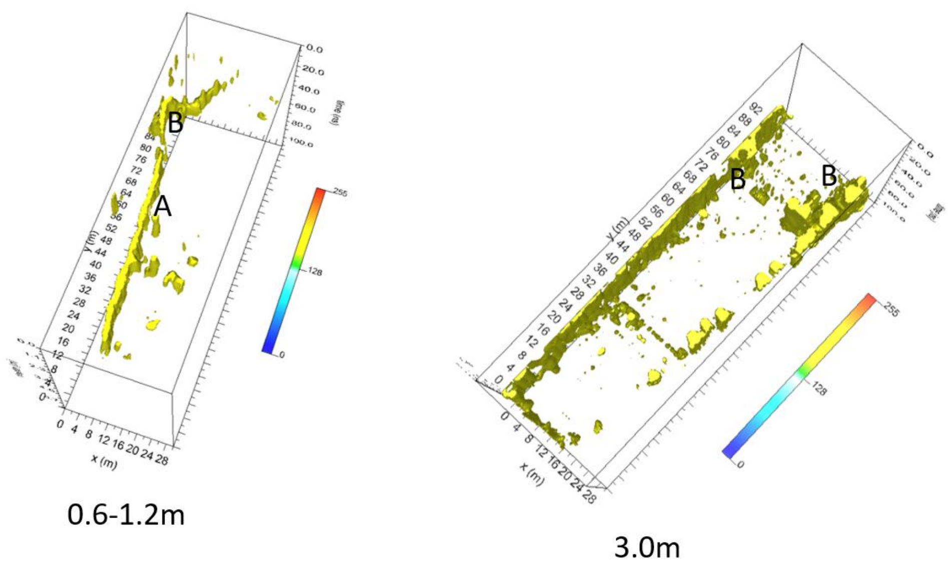

Fig. 7. Area 2B: 3D visualization of amplitude isosurfaces.

Figure 7 illustrates another way to visualize the GPR data. It is the isosurface representation [7]. It is possible to see better the anomalies related to aqueduct (A) and other archaeological structures.

III. CONCLUSIONS

In the investigated area, the results made it possible to identify anomalies referable to probable structures of archaeological interest buried at a depth of several meters (anomaly B). Shallow subsurface anomaly (A) is attributable, for shape and dimensions, to a part of the aqueduct.

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