



## New data on buried archaeological ruins in Messina area (Sicily-Italy) from a ground penetrating radar survey



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### ABSTRACT

A ground penetrating radar survey was performed in a small area located near the Messina harbor, northeast Sicily, with the aim of discovering the presence of archaeological remains.

Numerous findings, dating from the seventh and sixth centuries B.C., have been discovered in the neighboring areas over recent years.

A survey grid of longitudinal and transverse scans, covering an area of about 400 m<sup>2</sup>, was designed.

Two-dimensional radar sections (distance – depth) have been obtained from data processing. The reflections observed are often “isolated”, as though caused by fairly small objects or artifacts. Only through the comparative analysis between adjacent scans a lateral continuity of the reflections could be observed, thus allowing the correlation with possible remnants of walls.

The depth-slices, obtained by further processing, have allowed observing how the signal changes are distributed both in depth and laterally, showing numerous reflections, located between 0.30 and 1.10 m depth.

This survey revealed the presence of several possible archaeological remains. By correlating the data obtained from the GPR survey with the archaeological knowledge on the discoveries made in the surrounding areas, it was possible to interpret the linear reflectors as wall remains, probably dating back to the Hellenistic period.

### 1. Introduction

There are several non-invasive geophysical methods used to discover buried targets. For the archaeological research, the most often used is Ground Penetrating Radar (GPR), which allows investigating the subsurface by implementing an electromagnetic survey.

Many authors have shown that GPR, is a survey method enabling to acquire important preliminary information in various research fields, such as geological and structural studies, as well as environmental, sedimentological and engineering applications (Davis and Annan, 1989; Annan et al., 1991; Benson, 1995; Bano et al., 2000; Audru et al., 2001; Al-fares et al., 2002; Neal, 2004; Pujari et al., 2007; Imposa et al., 2015). In archaeological and cultural heritage studies, it is used to map the spatial extent of buried targets and structures (Dabas et al., 2000; Leckebusch, 2000; Conyers et al., 2002; Leucci, 2002; Nuzzo et al., 2002; Barone et al., 2004; Imposa et al., 2004; Barilaro et al., 2006, 2007; Capizzi et al., 2007; Castellaro et al., 2008; Imposa et al., 2009; Imposa, 2010; Drahor et al., 2011; Imposa and Mele, 2011; Conyers, 2013; Urban et al., 2014; Imposa and Grassi, 2015; Piro et al., 2015; Conyers, 2016); in particular the GPR survey has proven highly

effective for the archaeological investigations in urban area (Basile et al., 2000; Neubauer et al., 2002; Leucci and Negri, 2006; Piro and Goodman, 2008; Papadopoulos et al., 2009; Rabbel et al., 2015; Leucci et al., 2016). The main problem for the application of this technique is connected to the occurrence of numerous obstacles in the urban environments, which does not allow regular survey geometries. However, it is less affected by the disturbances caused by recent man-made structures in the subsoil (e.g. building debris, metallic pipes and cables) compared to the other geophysical methodologies usually used in archaeological investigations, such as earth resistance and inductive electromagnetic methods. The signal, related to buried archaeological remains, detected through these methodologies can be falsified by recent anthropic structures, that hinders the detection of the archaeological targets (Trinks et al., 2009; Piro and Zamuner, 2016).

This non-invasive and relatively fast technique allows detecting the presence and the relative position of objects, fractures, cavities and buried stratigraphic layers, using the electromagnetic wave reflection phenomenon.

The city of Messina, located in the northeastern corner of Sicily (Fig. 1), has been the home of a succession of settlements since the

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Fig. 1. Location of the investigated area; inset bottom right shows the location of Messina.

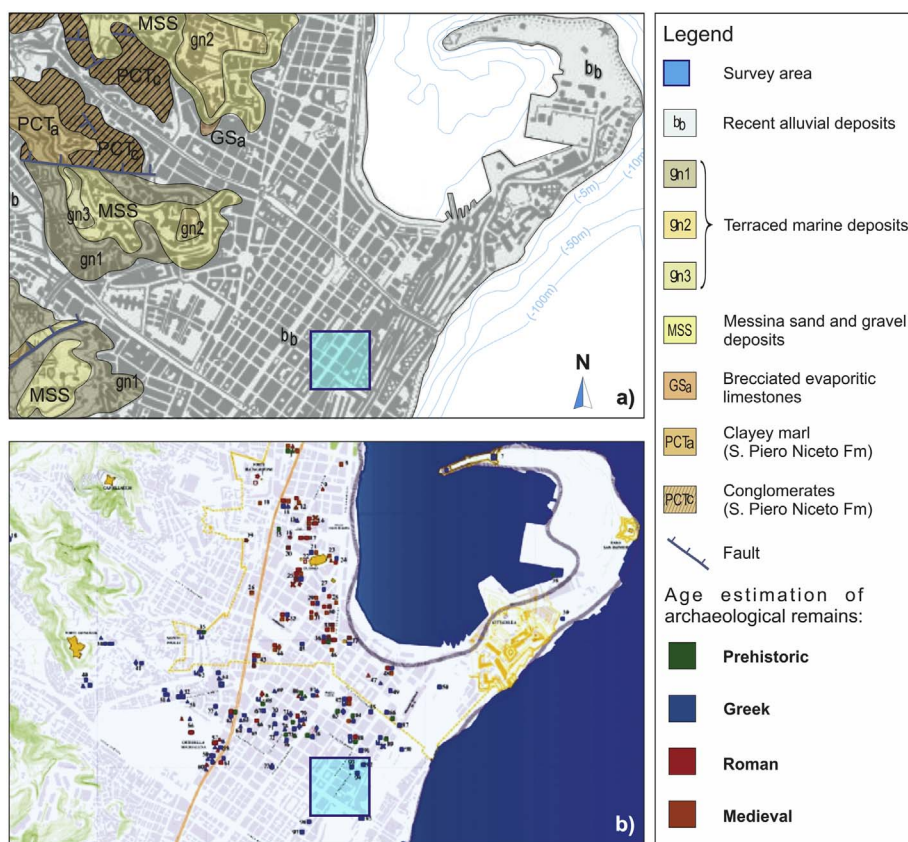


Fig. 2. a) Geological sketch map of Messina area (modified from Carbone et al., 2008); b) Archaeological map of Messina city (from Cucinotta and Burgio, 2003).

Neolithic age, largely owing to its strategic location in the center of the Mediterranean Sea.

The unfavorable geo-lithological and geomorphological characteristics, due to the torrential nature of this area, the high population and the high density of buildings, have caused the burial and, in some cases, the destruction of the buried archaeological heritage.

The archaeological surveys performed on building sites in the urban area and in particular during excavations carried out for new

constructions, have identified an average depth level hosting archaeological remains dating back to different ages. From 0.5 to 2.50 m, below the current ground level, there are the modern facies, Medieval, Late Antique and Byzantine; from 0.50 to 5 m, there is the classic facies (Roman, Hellenistic, Classical Greek, archaic Greek and Protoarcaica); from about 3 to 7 m there is the prehistoric facies of the first and middle Bronze Age. Finally, between 5 and 14 m, material belonging to the prehistoric facies of the Copper Age and Neolithic was found.

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