

THE IMPERIAL VILLA OF PUNTA EOLO (VENTOTENE) BETWEEN ARCHAEOLOGICAL EVIDENCE AND GEOLOGICAL ASSETS IN A CONSERVATION PERSPECTIVE

ALESSANDRA PEGURRI^(*), FEDERICO FELIZIANI^(**), GUGLIELMO GRECHI^(**), GIAN MARCO MARMONI^(**),
SALVATORE MARTINO^(**), CHIARA ARRIGHI^(***), CHIARA DELPINO^(***) & ANTONIO F. FERRANDES^(*)

^(*)Sapienza University of Rome - Ancient World Studies Department - Rome, Italy

^(**)Sapienza University of Rome - Earth Sciences Department - Rome, Italy

^(***)Soprintendenza Archeologia, Belle Arti e Paesaggio (SABAP) for the provinces of Frosinone and Latina, Italy

Corresponding author: alessandra.pegurri@uniroma1.it

EXTENDED ABSTRACT

L'isola di Ventotene, parte dell'Arcipelago Pontino, ospita i resti di una sontuosa residenza romana imperiale situata a Punta Eolo. Dal 2023, quest'area è uno degli otto siti pilota del progetto europeo EU-H2020 TRIQUETRA, mirato alla conservazione del patrimonio archeologico minacciato da fenomeni idrogeologici. L'erosione costiera, l'azione del vento, le piogge e la formazione di concrezioni saline stanno compromettendo la stabilità delle strutture e delle superfici decorate della villa. Il progetto prevede l'analisi delle interazioni tra i fattori ambientali e il sito archeologico, con l'obiettivo di sviluppare strategie di mitigazione applicabili a contesti simili.

Nel presente articolo si descrivono le indagini geologiche e archeologiche condotte nel quadro del progetto. Le analisi geologiche, coordinate dal Centro di Ricerca per il Rischio Geologico (CERI) della Sapienza Università di Roma, hanno permesso di identificare le varie unità geologico-ingegneristiche e tramite misurazioni del rumore sismico ambientale che hanno fornito dati sulla stratificazione del sottosuolo, evidenziando il contatto tra lave e tufi a circa 60 metri di profondità e spessori variabili per i depositi di copertura tra 4 e 9 metri. Questi risultati sono fondamentali per comprendere la vulnerabilità del sito ai fenomeni di erosione e dissesto.

Parallelamente, le indagini archeologiche condotte dal Dipartimento di Scienze dell'Antichità (DSA) della Sapienza Università di Roma e dalla Soprintendenza Archeologia, Belle Arti e Paesaggio per le province di Frosinone e Latina (SABAP FR-LT) si sono concentrate sull'analisi strutturale della villa. La documentazione del complesso è stata aggiornata mediante rilievi fotogrammetrici ad alta risoluzione, generando ortofoto georeferenziate, modelli digitali di superficie (DSM) e una dettagliata ricostruzione tridimensionale. L'analisi dell'assetto architettonico della villa di Punta Eolo ha evidenziato una complessa sequenza stratigrafica con una serie di fasi edilizie databili tra la tarda età repubblicana e la fine del I secolo d.C. Particolare attenzione è stata dedicata alla mappatura delle varie tecniche edilizie e dello stato di conservazione degli intonaci e delle pavimentazioni, documentati mediante rilievi grafici e integrazione all'interno di un sistema GIS. L'erosione del suolo, favorita da pregresse attività estrattive di epoca borbonica e dall'azione dell'acqua meteorica, è stata individuata come una delle cause principali delle fratturazioni riscontrate nei settori residenziali della villa.

Al fine del progetto sono state condotte una serie di analisi chimico-fisiche e meccaniche sui materiali costruttivi, volte alla definizione di interventi di conservazione mirati. Le indagini termometriche su superfici murarie con rivestimenti hanno permesso di monitorare le fluttuazioni di temperatura e umidità, mentre la raccolta di campioni di intonaci e malte, coordinata dalla Soprintendenza, ha lo scopo di testare prodotti conservativi compatibili con le caratteristiche geologiche e climatiche del sito.

Il lavoro qui presentato mette in luce l'approccio interdisciplinare adottato nel progetto TRIQUETRA che si fonda sull'integrazione dei dati archeologici e geologici per sviluppare strategie di conservazione sostenibili. Le metodologie applicate sul sito ventotenese di Punta Eolo, inoltre, possono essere estese ad altri contesti archeologici caratterizzati da analoghe criticità idrogeologiche, contribuendo alla tutela del patrimonio culturale in ambienti ad alta vulnerabilità.

ABSTRACT

The island of Ventotene, part of the Pontine Archipelago, is home to the remains of an imperial Roman villa at Punta Eolo promontory, a site threatened by severe hydro-geological risks. Since 2023, this site has been a key focus of the EU-H2020 TRIQUETRA Project, which aims to analyze and mitigate environmental threats to cultural heritage. The research integrates geological and archaeological investigations, combining high-resolution photogrammetry, geophysical surveys, and material analysis to assess the site's conditions. Geological studies reveal a complex stratigraphy of lava and tuff formations, influencing coastal erosion and landslides, which endanger both the site and its historical structures. Archaeological surveys reassess the villa's

architectural evolution, identifying multiple construction phases and previously undocumented features. The project also evaluates material degradation, particularly in wall plasters, frescoes, and pavements, correlating deterioration patterns with environmental stressors. Through GIS-based mapping and laboratory testing of building materials, the study aims to develop tailored conservation strategies, ensuring the long-term safeguarding of this invaluable site. The TRIQUETRA Project represents a multidisciplinary effort to establish conservation models applicable to other heritage sites facing similar geological and climatic challenges.

KEYWORDS: cultural heritage, archaeology, geological risk, conservation strategies.

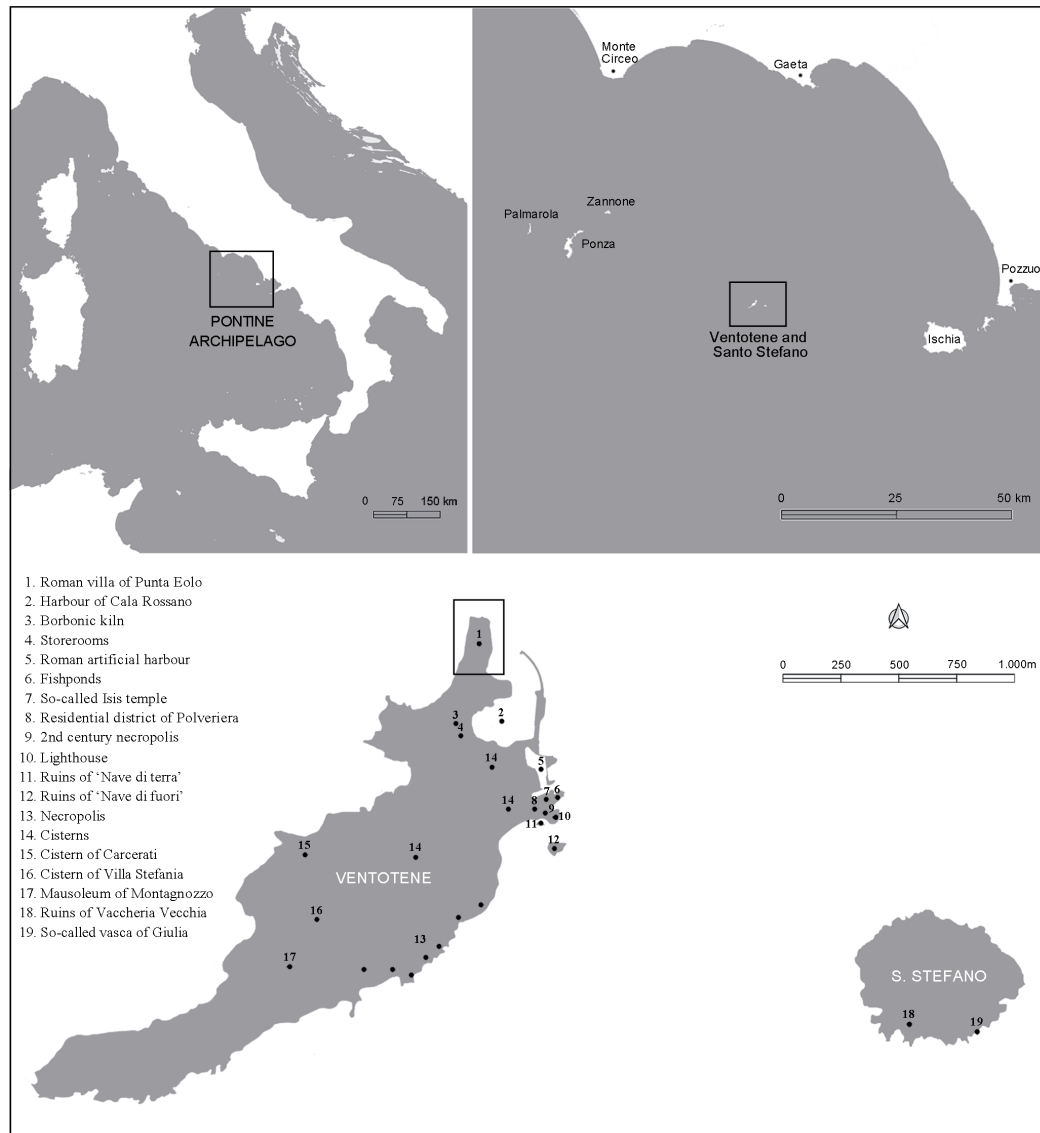


Fig. 1 - Location of the islands of Ventotene and Santo Stefano in central Tyrrhenian Italy and distribution of the main archaeological remains on the islands

INTRODUCTION

The island of Ventotene, part of the Pontine Archipelago, hosts the remains of an extensive and luxurious Roman residence, once belonging to the imperial family, located at the northernmost point of the island, on the Punta Eolo promontory (Fig. 1). Since 2023, this area has been selected as one of the eight pilot sites of the EU-H2020 TRIQUETRA Project (<https://triquetra-project.eu/>).

The inclusion of the Punta Eolo imperial villa ('di Giulia') in the project was driven by the significant hydro-geological threats facing the site, which are increasingly compromising its conservation. A combination of environmental factors – including wind, rainfall, sea storms, salt concretions, daily and seasonal temperature fluctuations, soil erosion, and landslides – are gradually degrading the site's structures and decorative coverings (frescoes, plasters and pavements), exposing foundations in several sectors.

To address these conservation challenges, the project builds upon the analysis of the complex physical, chemical, and mechanical interactions between the archaeological components and the environmental stressors. These investigations are

essential for developing mitigation strategies that can also be applied to other sites with similar hydrogeological dynamics. In pursuit of this goal, geological investigations are led by the Research Center for Geological Risk (CERI) of Sapienza, while archaeological research is managed by the Department of Ancient World Studies (DSA) of the University of Rome Sapienza and the *Soprintendenza Archeologia, Belle Arti e Paesaggio* for the provinces of Frosinone and Latina (SABAP FR-LT). These teams collaborate closely, combining their expertise to address the multifaceted challenges posed by the site, and integrating their efforts into a unified conservation strategy (first results in FELIZIANI *et alii*, 2024).

As part of this collaborative approach, the conditions of the site have been initially documented through high-resolution photogrammetric surveys, which produced a georeferenced orthophoto mosaic, a Digital Surface Model (DSM), and a detailed 3D reconstruction (Fig. 2). These cartographic products form the foundation for the morphological analysis of the promontory and its evidence, enabling precise spatial and altimetric interpretations.

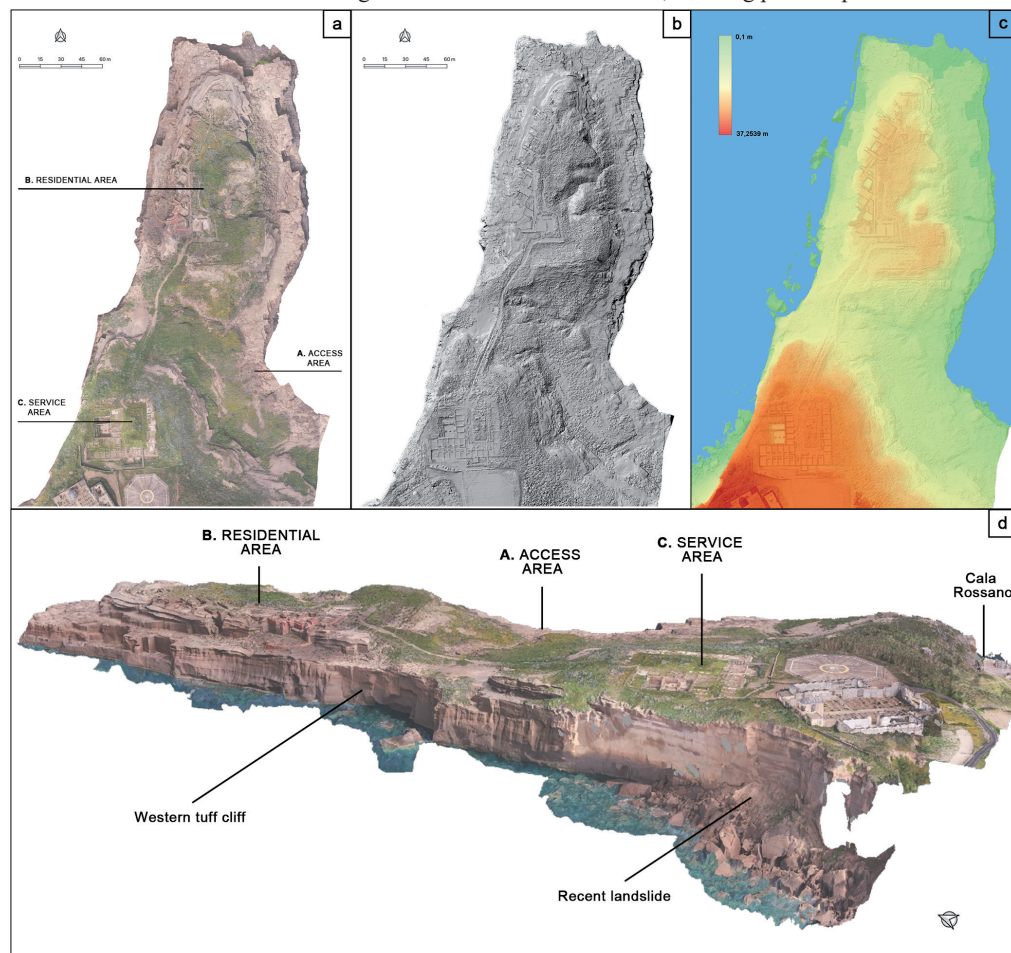


Fig. 2 - Punta Eolo. a) Orthophoto mosaic; b) DSM hillshade; c) DSM elevation model; d) Southwest view of the 3D model

THE GEOLOGICAL AND GEOMORPHOLOGICAL ASSETS (SM-GG)

Together with Ponza, Palmarola and Zannone, Ventotene and Santo Stefano belong to the Pontine Archipelago, a group of small islands located about 50 km off the Gaeta coast. Approximately 2800 m long and a maximum of 800 m wide, the island of Ventotene has an area of 1.54 km² and it is distinguished by orography that gently slopes northwards from its highest point of Mt. Arco (139 m a.s.l.).

Ventotene and S. Stefano islands represent the summit of a large stratovolcano built during the last 800k years, located on the southern edge of the Ventotene basin (PERROTTA *et alii*, 1996), which had to reach a maximum height of 800 m.

The Ventotene island is composed by basaltic to trachytic lavas (0.80–0.48 Myrs; METRICH *et alii*, 1988) unconformably covered by pyroclastic products erupted during the last 0.2 Myrs (METRICH *et alii*, 1988) that nowadays form a tuff plateau slightly dipping toward NE. The youngest member is represented by the so-called “Parata Grande Tuff” (PGT) and it predominantly crops out in the northernmost sector of the island where the Villa Giulia archaeological site is located. Because of the stratigraphic setting, the island’s coastal profile is irregular and dominated by vertical cliffs locally interrupted by pocket beaches like Cala Rossano and Cala Nave.

FELIZIANI *et alii* (2024) conceptualized an engineering-geological model of the Punta Eolo promontory and recognizing five engineering-geological units:

- Lavas Unit (LU). It is the basal unit above which all the stratigraphic succession is placed.
- Tuffs Unit (TU). It is the dominant unit cropping out in the study area.
- Eolian Unit (EU). Composed by sands alternating with salt-encrusted horizons.
- Eluvial-Colluvial Unit (ECU). This member is represented by weathered material and by detrital deposits mainly transported by running waters and rill channels.
- Anthropic Unit (AU), constituted both by the archaeological remains of the Villa Giulia complex and by the waste deposits of the different archaeological excavations carried out in the area.

Environmental seismic noise measurements processed with the spectral ratio technique proposed by Nakamura (1989) were carried out in the area of the archaeological site of Villa Giulia in order to constrain the thicknesses of the aforementioned geological units (FELIZIANI *et alii*, 2024). The results detail the lava-tuffs’ contact at a depth of approximately 60 m from the ground level, and reveal cover deposit (*i.e.*, ECU and AU) thicknesses between 4 and 9 m.

While the presence of cover deposits protects the archaeological remains (not yet excavated or merely covered to protect them from the weather), it also favours the development

of a marked drainage network. Actually, the development of rills and gullies is encouraged by the overlap of these erodible units above the bedrock (TU), which channels the runoff waters and exposes the ancient remains to erosive processes.

Many landslides struck the boundaries of the island, depicting a predominant process in terms of coastal retreat and geological risk in general. The local litho-technical structure determines the frequency and intensity of the current coastal erosion phenomena. The southern sector of the island experiences a lower rate of retreat due to the lavas that comprise the basal portion of the cliffs being less erodible, whereas the northern quadrant, where the coastal cliffs are composed of pyroclastic products, experiences a much higher rate of retreat. The kinematic compatibility for toppling, planar sliding and rock wedge sliding (HUNGR *et alii*, 2014) is admitted by the presence of primary joints (generated by the genetic cooling of the pyroclastic products) and secondary joints, mostly controlled by parietal detensioning phenomena of coastal cills. Sea storms are one of the various conditioning factors that prepare landslides by promoting the formation of overhangs that prime the system for larger-scale gravity collapses.

These gravitational phenomena, in many cases, represent an important geohazard source as they can expose to danger elements on the island, including the population, the historical-cultural and archaeological heritage, and related tourist activities. The conservation of Roman cultural heritage, including the ancient port and Villa Giulia, which are currently protected by the SABAP FR-LT, has been undermined by landslides in recent times. Given the archaeological site’s architectural layout, in fact, the Villa Giulia must have been larger, particularly in the residential area. According to DE ROSSI (2019), the imperial building’s water supply was filled via underground aqueduct constructions, and the entrance and service roadways were most likely situated on the west side of the complex. None of these buildings remain today, indicating that the section of shoreline where they were built collapsed. Several landslides occurred in recent times along the western flank of the promontory, such as the one of the Cimitero, that compromised the accessibility of the monumental island’s cemetery (Fig. 3). Other landslides undermined the accessibility and safety of beaches like Cala Rossano or Parata Grande, or even buildings for private use, as occurred in the Cala Nave area (RUBERTI *et alii.*, 2020).

THE ARCHEOLOGICAL SETTING OF THE ISLAND AND OF THE IMPERIAL VILLA

Between the 1980s and 2006, the island of Ventotene was the focus of extensive archaeological investigations and research. These efforts led to the discovery, analysis, and documentation of numerous archaeological remains, both on land and underwater. Carried out under the supervision of the current SABAP FR-LT, much of this work was directed by Giovanni Maria De Rossi,

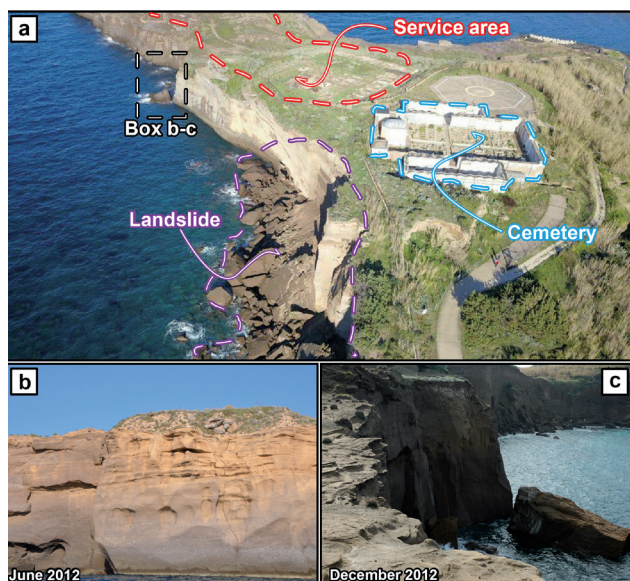


Fig. 3 - Most important landslides occurred on the western flank of the Punta Eolo promontory: a) Cimitero landslide; rock toppling before (b) and after (c) the activation

professor of Ancient Italian Topography at the University of Salerno. De Rossi, who passed away in 2019, devoted a significant part of his academic career (DE ROSSI 1980; 1984; 1986; 1999; 2000; 2006; 2019; DE ROSSI & MEDAGLIA 2018) to studying the archaeological heritage of the island and the Pontine Archipelago. His contributions left a profound impact on both the academic community and the local population.

The imperial villa of Punta Eolo is considered the focal point of ancient Ventotene. Surrounding this complex are additional archaeological features, including residential pavilions, a sophisticated water management system, natural and artificial harbours with docks, fishponds, nymphaea, cult areas, tombs, and possibly a lighthouse (Fig. 1). This residence, infamously associated with the exile and deaths of prominent women from the Julio-Claudian and Flavian dynasties, is most famously linked to Julia, the eldest daughter of Augustus. Julia was exiled here for five years starting in 2 BCE, a connection that inspired the site's current name, *Villa 'di Giulia'*.

The complex exemplifies the *villa a padiglioni* architectural asset (LAFON, 2001), characterised by pavilion-like structures harmoniously integrated into the landscape while maintaining a luxury and prestige environment. Spanning over four hectares, the complex influenced the anthropized parts of the island, excluding the southern third. Its layout comprises three main sections (Fig. 4): the Access Area (A) near Cala Rossano, the Residential Area (B), and the Service Area (C), interconnected by ramps and terraces in a configuration reminiscent of other grand maritime villas along the Campanian-Latinal coast.

The Residential Area (B), located on the northern edge of a tuff

plateau overlooking the sea, was centred around a north-south axis. Access was likely through an elongated space, possibly a xystus (II), adjacent to a series of richly decorated rectangular rooms likely used for receptions (DE VOS & MAURINA, 2023: 22-131). The central area (III) opened into a large peristyle or *viridarium* (IV), surrounded by colonnaded porticoes and featuring an apse at the northern end. This led through a transitional area (V) to a semicircular *belvedere* (VI) with dramatic sea views, possibly used as a banquet hall (*triclinium*).

To the west of the central block, two additional sectors, rotated 35° from the main axis, were connected by stepped pathways, possibly providing access to the sea or a mid-slope path between 12-16 m a.s.l. However, Bourbon-era quarrying activities, which gave the promontory its terraced appearance, have obscured the precise layout and extent of these features.

The southwestern corner housed an elegant *balneum* (VII), with a large residential apartment (VIII) to its north.

This area may have accommodated some of the villa's inhabitants, including women sentenced to *relegatio ad insulam*. On the contrary, the understanding of the eastern part of the complex is uncertain, due to significant damage from quarrying and ongoing hydrogeological challenges.

In the southern part of the promontory, the Service Area (C) of the villa was located comprising a secondary rectangular structure. Originally comprising 42 rooms arranged around an open courtyard, with two cisterns to the west, this building's simplicity in design – white plaster walls, fictile-based concrete pavements floors – and its parallels with other coastal villas suggest it functioned as an *ergastulum* or housing for the residence staff. Supporting this interpretation, nearly 4,000 vessels and transport amphorae were discovered in the abandonment layers dating to the late 1st century CE (FERRANDES *et alii*, 2023). The cisterns within the Service Area formed part of a sophisticated rainwater collection and distribution network that served the entire island. This system, including the large '*Carcerati*' and '*Villa Stefania*' cisterns, supplied the imperial residence and associated facilities, such as the harbours at Cala Rossano, Cala Nave, and the artificial port with its docks (DE ROSSI, 2019).

Following a phase of analysis, surveying, and study during the 1980s, formal excavations at Punta Eolo began in 1990, focusing on the Residential Area. Funded by the Regione Lazio, these efforts were followed between 1992 and 1996 by restoration work in the southwestern sector, particularly the *balneum*, as part of plans to establish an Archaeological Park. The most recent systematic archaeological campaign took place between 2001 and 2006 (with a break in 2003), focusing on the Service Area and the southern area of the Residential one. All these previous works yielded valuable but incomplete insights into the villa's architectural structure and evolution.

In 2021, the DSA and SABAP signed an agreement to analyse

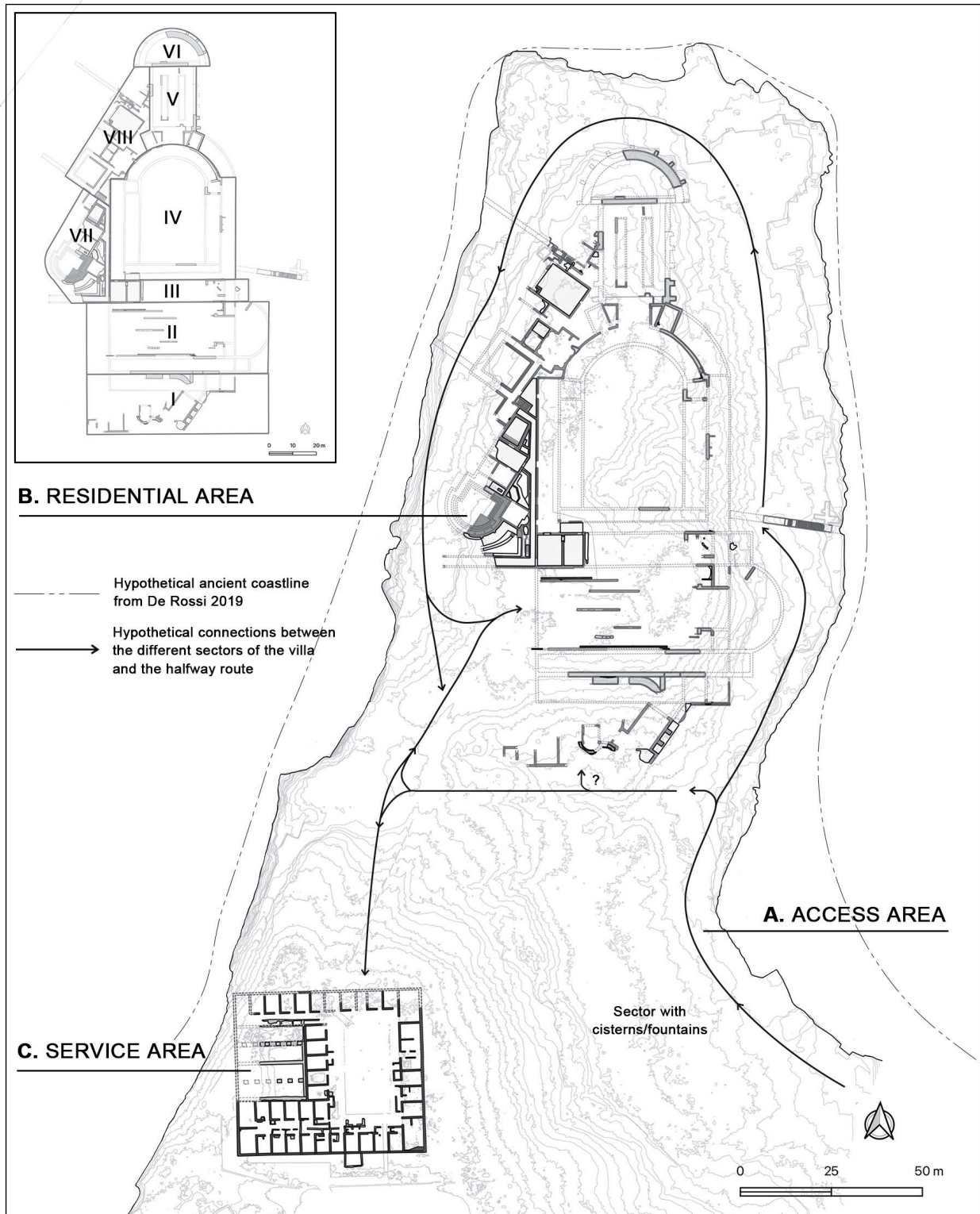


Fig. 4 - Punta Eolo, Villa of Giulia. Location and layout of the areas of the complex identified on the promontory. At the top right, a detailed view of the Residential Area of the villa with its division into sectors (I-VIII)

and publish findings from earlier investigations on Ventotene. This research has re-examined stratigraphy, structures, and decorations, leading to a revised understanding of the Punta Eolo villa's development. At least five main building phases, some with sub-phases based on decorative analysis, have been identified, reflecting the site's prominence from the late 1st century BCE to its abandonment in the late 1st century CE.

In 2023 the advent of the TRIQUETRA Project marked a significant advancement in the research on the Punta Eolo promontory, with further and interdisciplinary investigations poised to deepen understanding of this remarkable site.

ARCHAEOLOGICAL INVESTIGATIONS FOR THE TRIQUETRA PROJECT

As part of the project, archaeological investigations on the promontory have primarily focused on analysing the complex and its components. Beyond enhancing the understanding of the monument's structural complexity, the main goal was to provide a scientific basis for developing conservation strategies compatible with the nature of the archaeological evidence and the area's current hydro-geological dynamics.

The review of the available archaeological documentation, mainly composed of published elements (DE ROSSI & MEDAGLIA, 2018; DE ROSSI, 2019; VOS & MAURINA, 2023) with occasional archival sources, revealed a lack of detailed documentation concerning the villa's archaeological features. Furthermore, the surface cleaning operations conducted in 2023-24 revealed the partial incompleteness of the previously executed planimetric survey.

All these elements enhanced the need for a renewed examination of the villa's architectural layout through structural reassessment and the identification of previously undocumented architectural elements. The creation of an updated site plan has therefore been a fundamental step for developing the conservation strategies targeted by the TRIQUETRA Project. An updated documentation of the conservation status of the structures and wall coverings has been produced through high resolution photogrammetric surveys and field investigations. The collected data were recorded in a GIS environment, allowing for the generation of specific thematic maps.

In relation to this activity, the mapping of structures and in situ wall coverings is underway (Fig. 5). The villa of Punta Eolo, which underwent multiple construction phases between the late Republican period and the end of the 1st century CE, features a complex stratification reflected in the alternation of different masonry techniques (tuff ashlar, *opus reticulatum*, *testaceum* and *mixtum*) and materials (brown and yellow tuff, broken tiles, and white aeolian stones in some foundations). According to De Rossi's interpretation, the *opus reticulatum* structures with regular brown tuff *cubilia* belong to the original early Augustan phase (DE ROSSI, 1999: 31), although the presence of an earlier complex is suggested by fresco fragments found in

post depositional layers and dated to the late Republican/proto-Augustan period (DE VOS & MAURINA, 2023: 410).

Significant remodelling is evident in the *balneum* (VII) and in numerous wall closures, suggesting changes in the internal circulation of the villa and its rooms, alongside stylistic variations in the coverings revealed by a recent monographic publication (DE VOS & MAURINA, 2023). The study of archaeological structures conducted within the Triquetra Project enables the dating of the construction of the *balneum* to the Tiberian Age, as well as the reshaping of the cisterns located in the western part of the complex within the Service Area.

Regarding wall coverings, the remaining in situ plasters and frescoes have been mapped (Fig. 5) and the recording of their conservation state is undergoing, with graphical documentation where possible to allow long-term condition monitoring. Comparisons with photographic records from previous investigations have revealed significant plaster deterioration over the past two decades (Fig. 7d).

Concerning the flooring, three main types have been identified (Fig. 6): fictile-based concrete pavements, sometimes covered with a coloured layer (often ochre) and occasionally with lithic inserts; small- and medium-*tessera* mosaics; and *opus sectile*. Additionally, the sub-flooring of heated rooms belonging to the baths consists of broken tiles and *bipedales*. Notably, in several villa sectors the presence of at least two pavement decorative phases has been observed. The mapping of these floor covering types, in terms of both conservation status and distribution across the sectors, will aid in understanding the possible spatial hierarchy and variations over time. Additionally, the specific coatings required for the conservation of each pavement type depend on their unique composition, including both the materials and techniques used.

Beyond structural surveys, various tests on the materials used for masonry and coverings are being conducted. The CERI team is performing mechanical, physical, and chemical analyses of local tuff varieties. In this regard, it is important to stress that, being the same tuff used in the villa's construction, the results of these tests contribute to the understanding of the building materials for developing conservation strategies. Thermometric surveys have also been conducted on selected walls with coverings to monitor their response to current climatic conditions, including humidity and temperature fluctuations. Finally, the collection of wall-covering and construction material samples across the villa has been coordinated by SABAP FR-LT for laboratory testing aimed at developing compatible conservation products specifically designed to address the site's vulnerabilities. These tests include assessing weather resistance, interaction with salt deposits, and mitigation capacity against hydro-geological degradation, crucial factors for long-term site conservation.

All ongoing investigations described above - aligned with

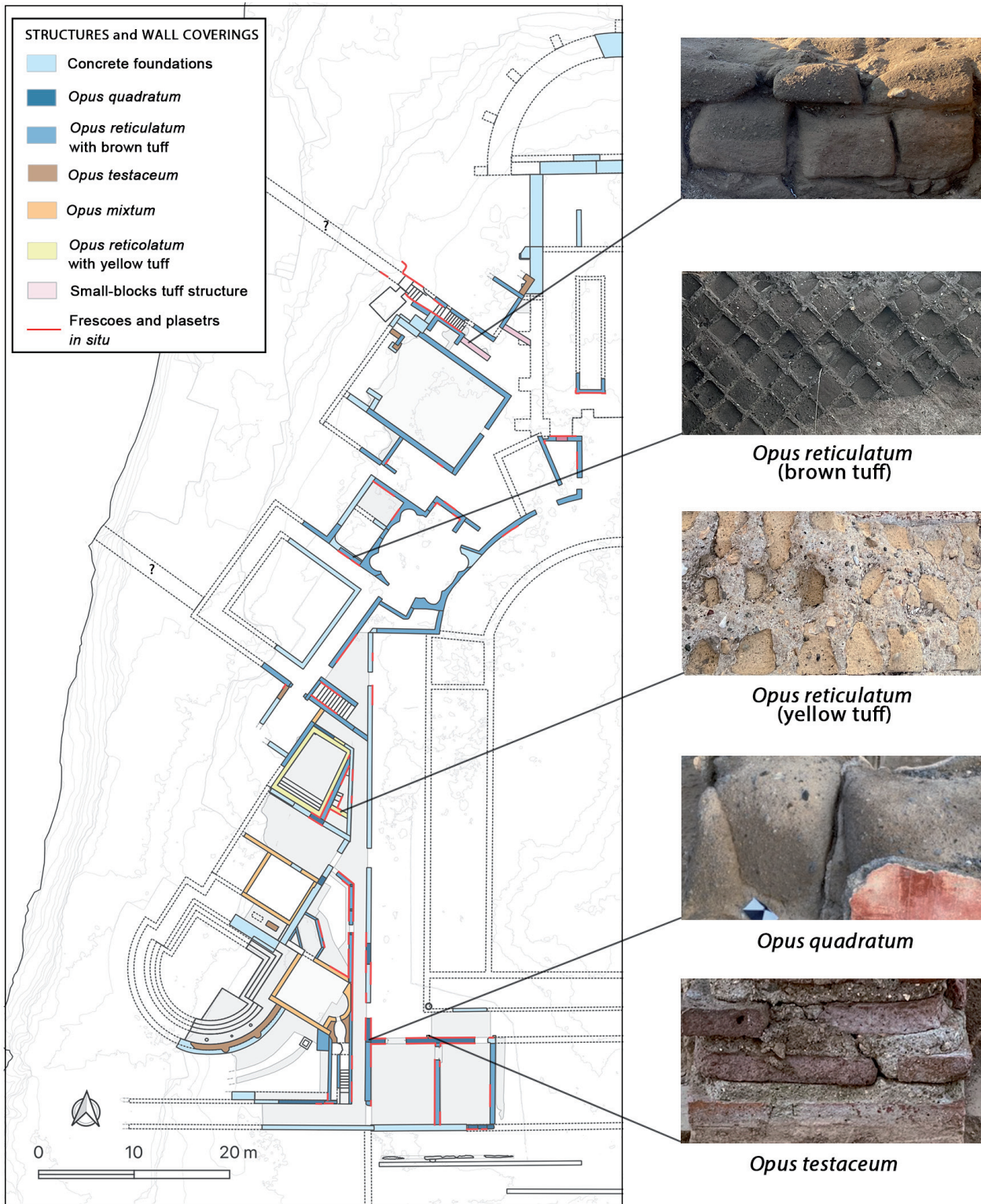


Fig. 5 - Punta Eolo, Villa of Giulia. Thematic plan of the structures with the location of *in situ* wall coverings in the western portion of the Residential Area (B, III, VII-VIII)

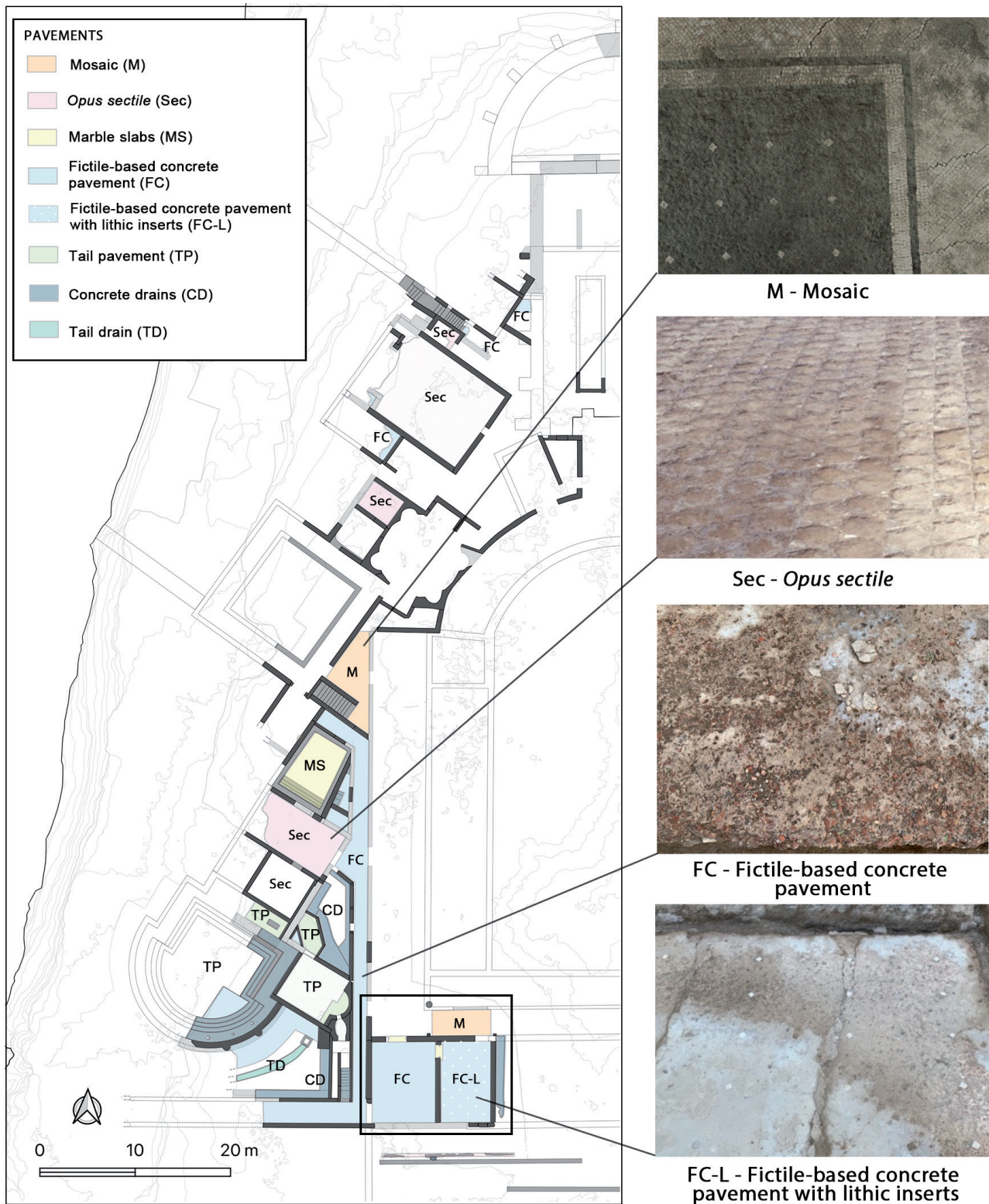


Fig. 6 - Punta Eolo, Villa of Giulia. Thematic plan of the pavement coverings in the western part of the Residential Area (B. III, VII-VIII)

the project's objectives - aim to produce updated documentation of the villa, in which the conservation state of the structures and coverings is analysed in relation to the environmental factors influencing their decay. A significant example is the evident cracking observed in the floors of rooms AB and

AC, located in the entrance area (III) of the Residential Area (Fig. 7a-c). This phenomenon seems to be connected to the progressive eastward erosion of the soil linked to the adjacent central *viridarium* (IV), a process likely triggered by extensive extraction activities during the Bourbon period

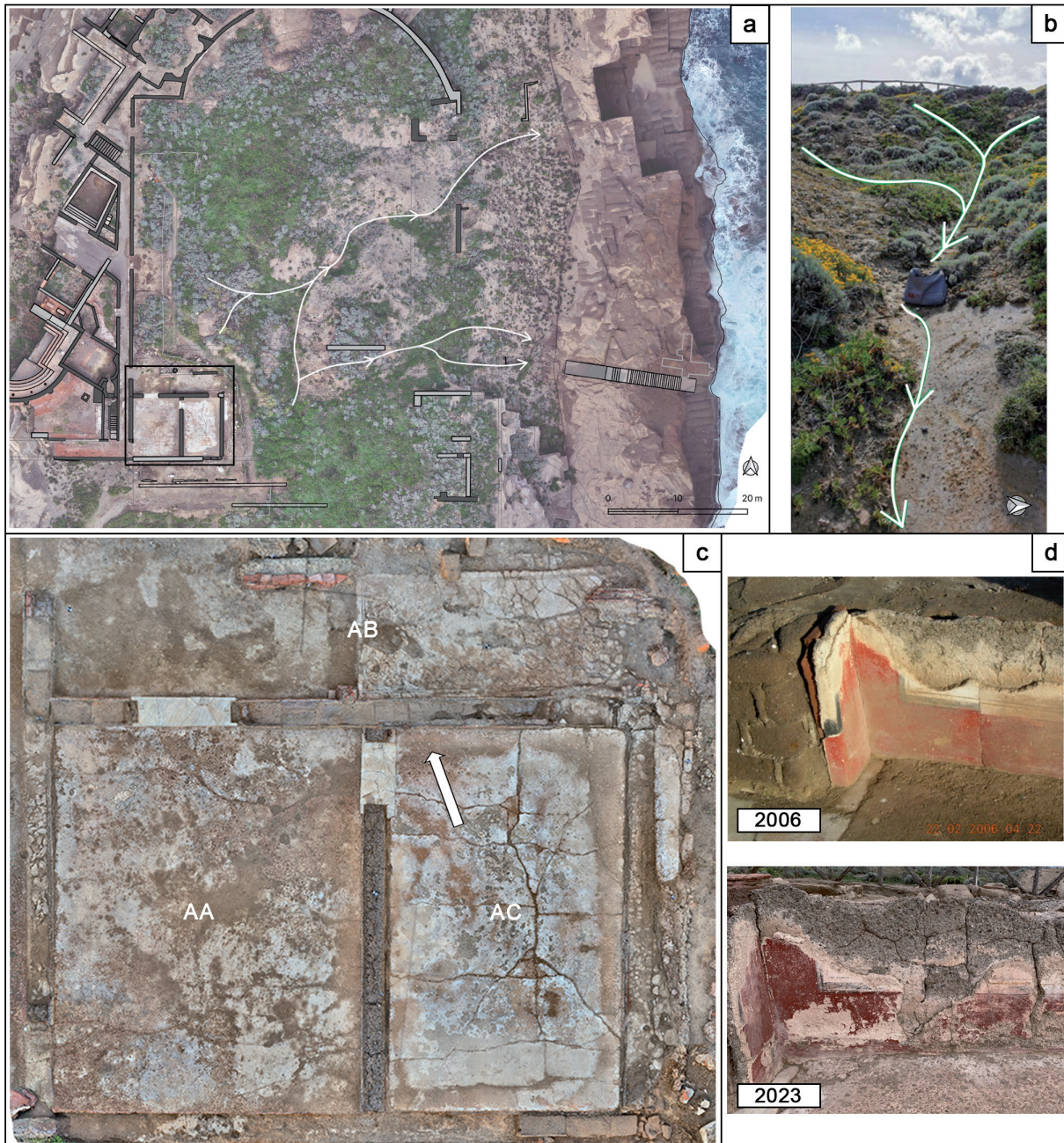


Fig. 7 - a) The sector of the large peristyle/viridarium (IV) in the Residential Area affected by soil erosion; b) an eastward view of the northern gully formed in the viridarium area; c) an orthophoto of rooms AA, AB, and AC taken after the thorough cleaning of the sector in the autumn of 2023; d) a detail of the plaster preserved at the base of the NW portion of the northern wall of room AC: on the right, an archival photograph by De Rossi taken in 2006 (from DE VOS - MAURINA, 2023, fig. 2.92); on the left, a photograph taken in the autumn of 2023

and exacerbated by the erosive action of rainwater runoff. The latter, through the formation of deep channels, is significantly compromising the structural stability of the areas facing this sector, reflected in the cracking of the floor coverings in rooms AC (a fictile based *caementicium* pavement with inserts of mosaic tiles,) and AB (a white mosaic pavements with black ties frame).

FINAL REMARKS

The engineering-geological modelling of the Punta Eolo site and the related geological cross-sections (FELIZIANI *et alii* 2024) to reconstruct the near surface geology have become a fundamental tool for the interpretation of the archaeological structures of the imperial villa, both in reference to the new investigations performed and to the re-interpretation of the excavations carried out in the past. Furthermore, the identification

of geohazard sources in the area of the Punta Eolo promontory represents an essential prerequisite for the conscious planning of protection strategies that are both effective and sustainable for the archaeological remains. The hope is that these strategies will increase the tourist usability of the archaeological site and bring it to ever greater visibility, also in the dissemination field.

History has alternately characterized this archaeological site, first seeing it as a sumptuous expression of the Roman Empire and then as a forgotten place left exposed to bad weather and looting which overall contributed to its destruction and damage.

Thanks to the recent study and research activities reported here, the Villa 'di Giulia' has become present and visible to Europe in a new guise, as a pilot site for advanced and challenging preservative methodologies. Like a paradox, the damage caused by environmental stressors over time and the spoliation caused by humans have thus become the reason for its "rediscovery".

REFERENCES

- DE ROSSI G.M. (1980) - *Lazio meridionale*. Roma: 331-342.
- DE ROSSI G.M. (1984) - *Ventotene romana: dal porto alla "villa di Giulia" a Punta Eolo*. In: AA.VV. *Ventotene*. Roma: 17-32.
- DE ROSSI G.M. (ED.) (1986) - *Le Isole Pontine attraverso i Tempi*. Roma, Guido Guidotti Editore.
- DE ROSSI G.M. (1999) - *Ventotene e S. Stefano*. Roma, Guido Guidotti Editore.
- DE ROSSI G.M. (2000) - *L'esilio di Giulia a Ventotene: alcune considerazioni di storia e topografia*. In: *Studi di Storia e Geostoria Antica*. Quaderni del Dipartimento di scienze dell'antichità, **24**: 167-184.
- DE ROSSI G.M. (2006) - *Ventotene. Il parco archeologico*. Ventotene.
- DE ROSSI G.M. (2019) - *La raccolta e la distribuzione dell'acqua a Ventotene in età romana: ricerche archeologiche nell'isola di Ventotene 2*. Archaeopress, Oxford.
- DE ROSSI G.M. & MEDAGLIA S. (2018) - *Introduzione Alle Antichità Di Ventotene: Ricerche Archeologiche Nell'isola Di Ventotene 1*. Archaeopress, Oxford.
- DE VOS R. & MAURINA B. (2023) - *La villa imperiale di Punta Eolo: rivestimenti pavimentali e parietali del settore residenziale*. Ricerche archeologiche nell'isola di Ventotene 3. Archaeopress, Oxford.
- FELIZIANI F., MARMONI G.M., GIANNI V., FERRANDES A.F., PEGURRI A., GRECHI G., FELLI G., CIAMPI P., BOZZANO F., DELPINO C., ARRIGHI C. & MARTINO S. (2024) - *Engineering-geological modelling as a tool for archaeological site preservation strategies*. Italian Journal of Engineering Geology and Environment, 2024, Special Issue **1**: 115-126. <https://doi.org/10.4408/IJEGE.2024-01.S-13>
- FERRANDES A.F., FORTUNATO M., LAMBICCHI F., PARISI F. & PEGURRI A. (2023) - *L'ultimo esilio. Nuovi dati sull'occupazione della villa 'di Giulia' a Ventotene (LT) e sulla cultura materiale centro-italica alla fine del I secolo d.C.* Journal on Hellenistic and Roman Material Culture, **12**: 53-137.
- HUNGR O., LEROUÉIL S. & PICARELLI L. (2014) - *The Varnes classification of landslide types, an update*. Landslides, **11**: 167-194.
- LAFON X. (2001) - *Villa maritima. Recherches sur les villas littorales de l'Italie romaine*. Roma, École française de Rome.
- METRICH N., SANTACROCE R. & SAVELLI C. (1988) - *Ventotene a Quaternary potassic volcano in central Tyrrhenian Sea*. Rendiconti della Società Italiana di Mineralogia e Petrologia, **43**: 1195-1213.
- NAKAMURA, Y. (1989). - *A method for dynamic characteristics estimation of subsurface using microtremor on the ground surface*. Railway Technical Research Institute, Quarterly Reports, **30**(1).
- PERROTTA A., SCARPATI C., GIACOMELLI L. & CAPOZZI A.R. (1996) - *Proximal depositional facies from a caldera-forming eruption: the Parata Grande Tuff at Ventotene Island (Italy)*. Journal of volcanology and geothermal research, **71**(2-4): 207-228.
- RUBERTI D., MARINO E., PIGNALOSA A., ROMANO P. & VIGLIOTTI M. (2020) - *Assessment of tuff sea cliff stability integrating geological surveys and remote sensing. Case history from Ventotene Island (Southern Italy)*. Remote Sensing, **12**(12): 1-19.

Received February 2025 - Accepted June 2025