



The Casal de' Pazzi site in the light of new geological and geomorphological data

Carlo Rosa ^{1,2,*}

¹ Società Italiana di Geologia Ambientale (SIGEA) - APS, Lazio

² Istituto Italiano di Paleontologia Umana (IsIPU)

* Corresponding author: carlorosa62@gmail.com

ABSTRACT - The article discusses the Pleistocene deposit of Casal de' Pazzi in Rome, which was discovered during the construction of a new neighborhood of Rebibbia in 1981. The excavation, spanning from 1981 to 1985, unveiled fluvial gravelly deposits of volcanoclastic composition containing abundant fauna remains and lithic industry. These deposits, originally assigned to the Aniene river, are placed on a pyroclastic unit attributed to the Lionato Tuff. Subsequently, it was assigned to the Pozzolanelle pyroclastic unit based on a subsequent excavation campaign conducted in 2013. Both the pyroclastic units were deposited during the Villa Senni eruption back approximately 357,000 years B.P. This article provides details about the depositional behavior of these deposits and their relationship with the eruptive event. It also discusses on the morphological and geological setting of the Casal de' Pazzi site, in the light of new data derived from the 2013 excavation campaign. Finally, the article explores stratigraphic data collected in the area by Massimo Ruffo during the first excavation program from 1981 to 1985, emphasizing the importance of his meticulous documentation in reconstructing the stratigraphy and gaining a deeper understanding of the Casal de' Pazzi site.

Keywords: Casal de' Pazzi; Quaternary; Middle Pleistocene; Geoarchaeology; Villa Senni Eruption.

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1. INTRODUCTION

The Casal de' Pazzi deposit is located in the lower Aniene valley, an area hosting numerous paleontological sites (Fig. 1) that has attracted Italian and foreign scholars interested

in Rome's geology and paleontology since the 19th century. The dating of the site's fluvial sediments, which are found above an erosive surface on a pyroclastic flow deposit attributed to the Villa Senni Eruption (Rosa et al., 1993; Rosa, 1995; Freda et al., 1997; Watkins et al., 2002), was



Fig. 1 - The archeo-paleontological sites of the lower Aniene valley (imagine from Google Earth).

initially estimated by Prof. A.G. Segre. In the absence of direct dating of the pyroclastic unit deposit, which Segre himself referred to as “Tufo litoide lionato” (Anzidei et al., 1982, p. 132-133), the dating was approximated to be between 300,000 and 200,000 years BP. This estimate was based on a K-Ar dating of 366,000 years, which was available at the time for a tephra layer (LS-2), located immediately below the Tufo Lionato at Fontana Ranuccio (Anagni) (Biddittu et al., 1979). The dating leaned more towards the lower end, at around 200,000 years.

The Pleistocene deposit of Casal de' Pazzi was uncovered in 1981 during the construction of a neighborhood of Rome called Rebibbia. A subsequent excavation campaign, led by Anna Paola Anzidei and involving collaboration with Massimo Ruffo and the consultancy by Prof. A.G. Segre (Anzidei et al., 1982), yielded highly significant results. These findings resulted in the initial preservation of the site through a variant of the Regulatory Plan, that included a fast-flowing road above the just discovered site. Researchers participating in the excavation attributed the gravel-rich volcanoclastic deposits with fauna and lithic industry to a fluvial episode of the ancient Aniene River.

A second excavation campaign, conducted during the garden arrangement works of the Museum between May 30 and July 27, 2013 (Gioia et al., 2014), led to the reattribution of the pyroclastic unit, occurring at the base of the deposit, to the Pozzolanelle unit instead of the Tufo Lionato, as previously identified, both belonging to the Villa Senni Eruption. In addition, a preliminary sedimentological analysis of the site's deposits by Prof. S. Milli allowed for a better definition of the paleocurrents pattern. Locally, this pattern indicated a flow direction

from NNW to SSE, which was contrary to the one deduced by Massimo Ruffo and Prof. A.G. Segre, who instead indicated a flow from SSE to NNW. These new data, although local and preliminary, have been partially confirmed by more recent investigations (S. Milli personal communication) and constitute a crucial point to be integrated with the various stratigraphic sections originally produced by Massimo Ruffo.

2. THE VILLA SENNI ERUPTIVE UNIT

The Villa Senni Eruptive Unit, which was dated using the $^{40}\text{Ar}/^{39}\text{Ar}$ method on a single crystal, has an age of about 357,000 years BP (Karner et al., 2001). It represents the most recent major paroxysmal explosive eruption of the “Volcano Laziale” which is part of the Colli Albani Volcanic District, located 30 km southeast of Rome.

This eruption resulted in the emplacement of two pyroclastic flow deposits named Tufo Lionato and Pozzolanelle, (lower and upper flow units respectively) (Figs. 2 and 3) that followed one another within a few hours, with no evidence of erosion at the contact between them (Fig. 4):

- The lower unit (Tufo Lionato, Fig. 5), ranges in colour from light yellow to orange and contains abundant leucite crystals, which are often analcimized as well as centimeter-sized yellow or orange scoriae within a cineritic matrix with zeolitic cement. Additionally, this unit contains lavic xenoliths, holocrystalline leucite, and pyroxene.
- The upper unit (Pozzolanelle, Fig. 6), emitted following the caldera collapse, is gray or reddish in colour. It contains abundant leucite crystals, often analcimized,

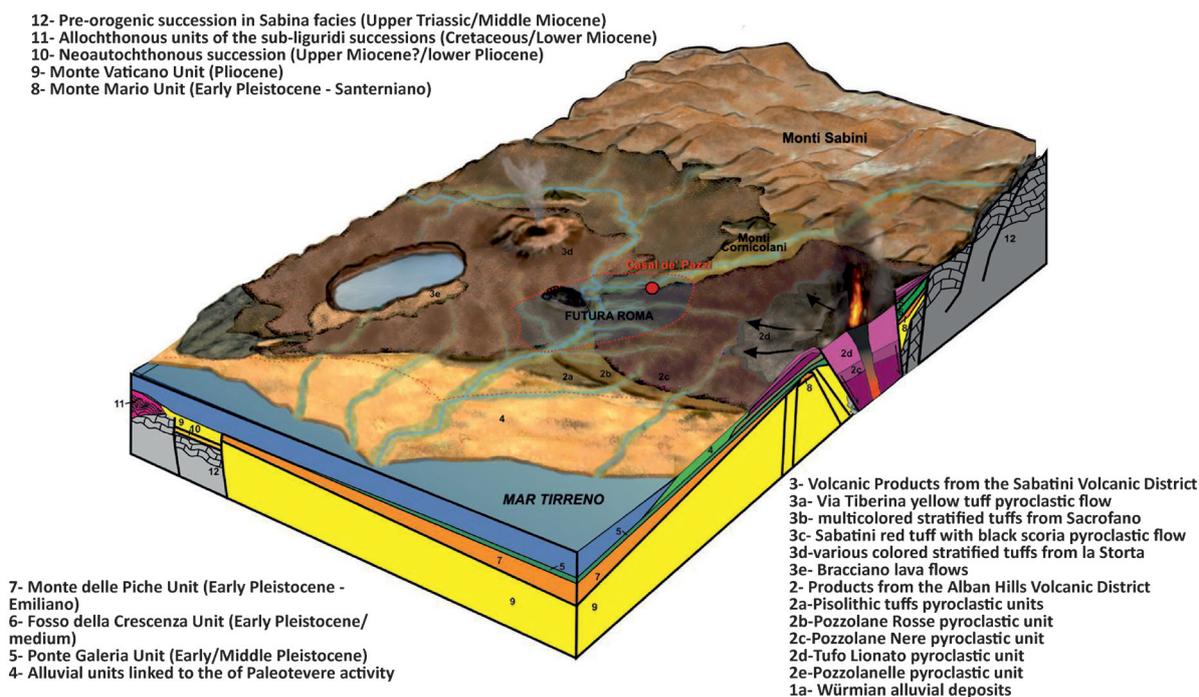


Fig. 2 - Villa Senni Eruption: emission of the Tufo Lionato pyroclastic flow unit. Image from Rosa in Gioia (2020).

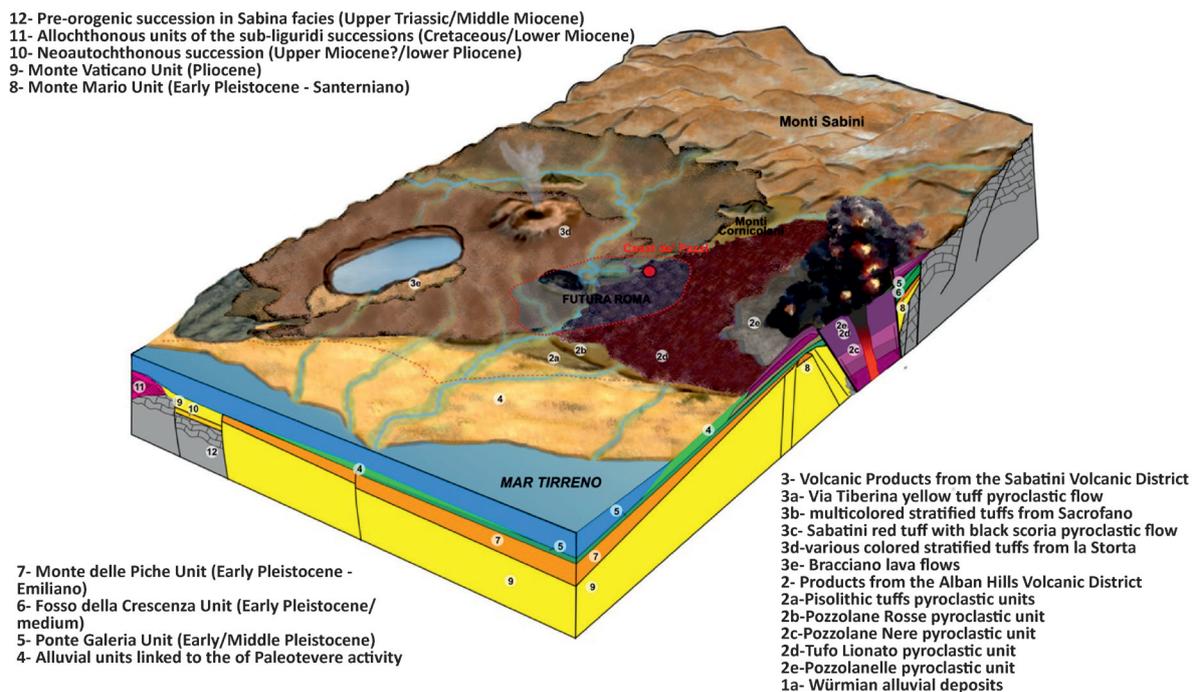


Fig. 3 - Villa Senni Eruption: calderic collapse and contemporary emission of the Pozzolanelle pyroclastic flow unit. Image from Rosa in Gioia (2020).



Fig. 4 - Outcrop of the pyroclastic flow deposits related to the Villa Senni Eruption showing the superimposition of the two pyroclastic units (Tufo Lionato below and Pozzolanelle above) near Via di Fioranello. On the left, close up showing the sharp contact between the two flow deposits.

along with reddish or blackish scoriae. These scoriae range in size from centimetric to decimetric and are embedded in a coarse lapillous matrix. The latter is rarely cemented and contains lavic xenoliths, holocrystalline leucite, and pyroxene.

The Tufo Lionato unit displays depositional characteristics typical of a dense flow, whose deposition was significantly influenced by landscape morphology. In more distal areas, far from the eruptive center, it fills paleo-depressions that existed at the time of its emplacement, restricting its areal extent. In contrast, the depositional characteristics of the Pozzolanelle suggest an emplacement through a less dense and more expansive pyroclastic flow that reached sectors higher in altitude than the Tufo Lionato. This allowed its superimposition on the Tufo Lionato as can be observed in the area around the Casal de' Pazzi Museum (Fig. 7).

3. MORPHOLOGICAL AND GEOLOGICAL CONTEXT OF THE CASAL DE' PAZZI SITE

The area surrounding the Casal de' Pazzi site is located at elevations ranging from 25 and 38 meters above sea level (Figs. 8 and 9). Morphologically, it can be described as a terrace above the Aniene River with the highest point reaching approximately 35-37 meters above sea level.

According to Geological Map of the City of Rome (Funicello et al., 2008; Funicello and Giordano, 2008) and the Geological Map of the Colli Albani Volcano (Giordano et al., 2010) the deposits of the Casal de' Pazzi area have been attributed to the Saccopastone Unit (Fig. 10). The sediments at the Casal de' Pazzi site are correlated with those of the Saccopastone site based on their morphology and absolute deposit elevations

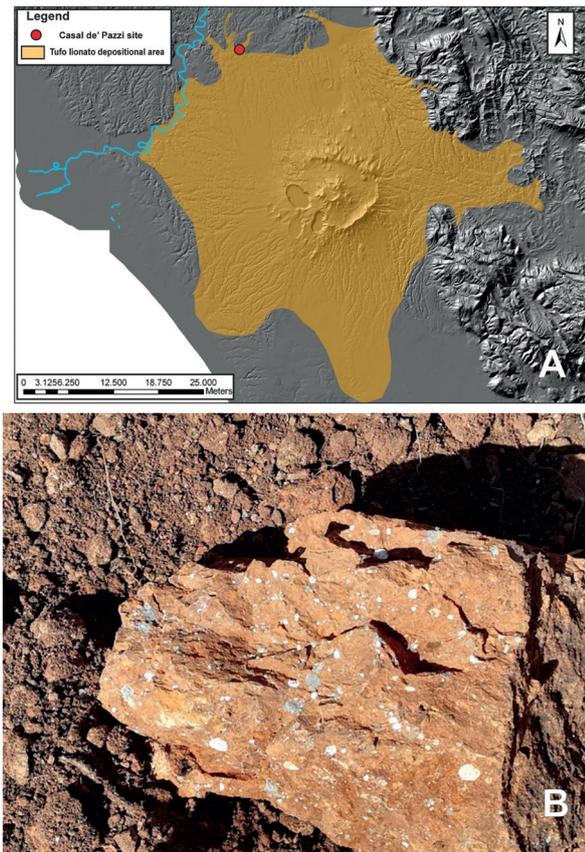


Fig. 5 - A) areal distribution of Tufo Lionato pyroclastic flow on a shaded relief image of the Colli Albani Volcanic District; B) sample of Tufo Lionato unit showing the macroscopic aspect of the deposit.

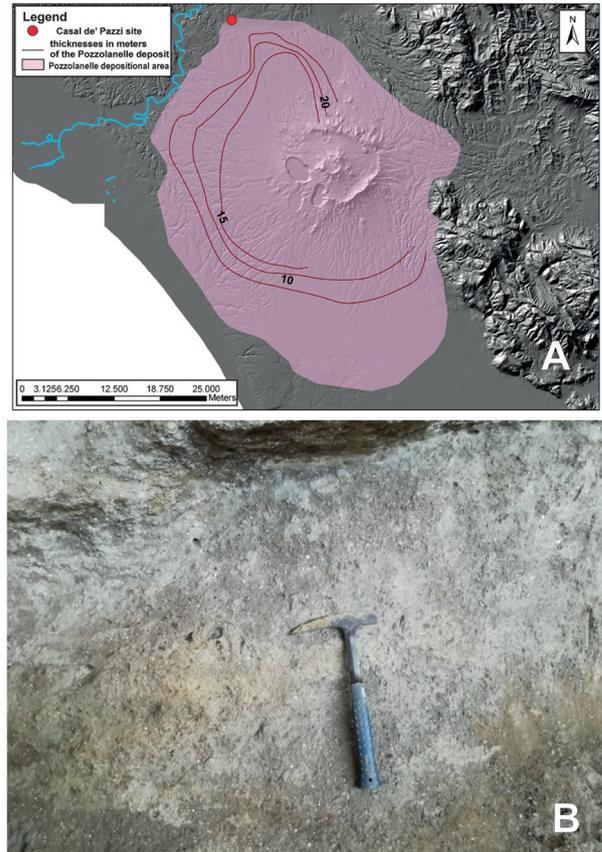


Fig. 6 - A) areal distribution and thicknesses (in meters) of Pozzolanelle pyroclastic flow on a shaded relief image of the Colli Albani Volcanic District; B) outcrop of Pozzolanelle unit in the Casal de' Pazzi Museum.

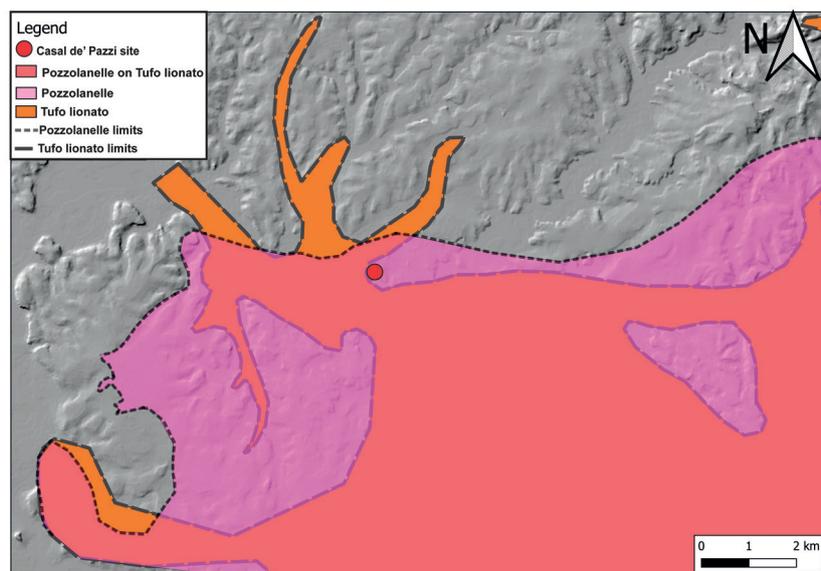


Fig. 7 - Areal distribution of the Tufo Lionato (in orange) and Pozzolanelle (in purple) around the Casal de' Pazzi site.

as described in Funciello and Giordano (2008). The last authors emphasize the nature of the deposit as a “river terrace deposit with a roof surface at elevations

of about 30 meters above sea level”. Initially, this deposit was attributed to the MIS5 interglacial by Bruner and Manzi (2006), Caloi and Palombo (1986, 1994a, 1994b),

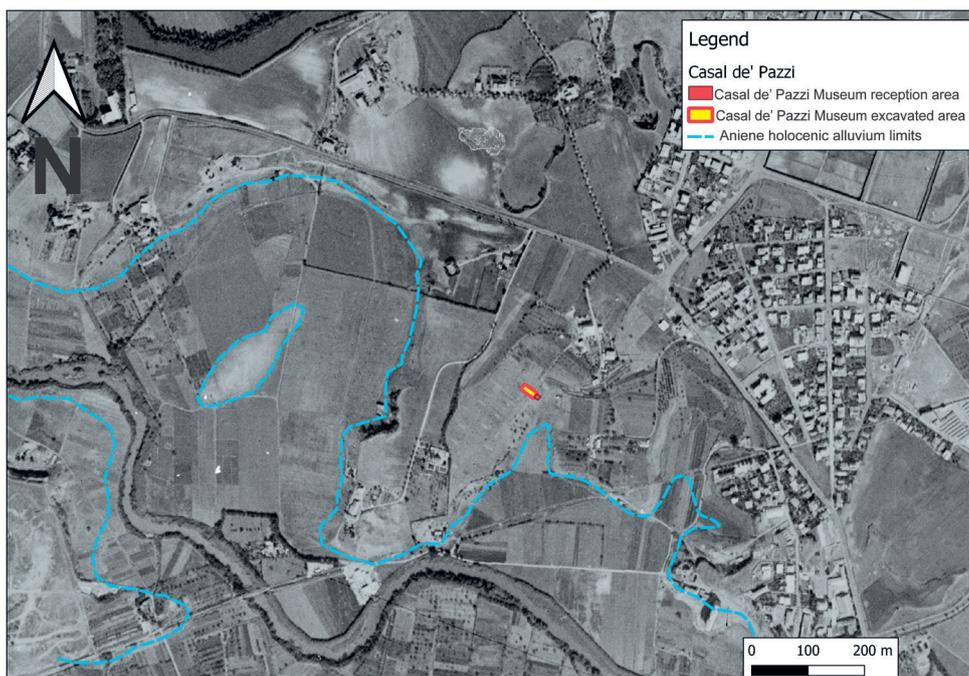


Fig. 8 - 1954 aerial photo detail of the Casal de' Pazzi site from the Istituto Geografico Militare. The cyan dashed line represents the borders of the Aniene alluvial deposits. The actual Museum building position is indicated in red and yellow.

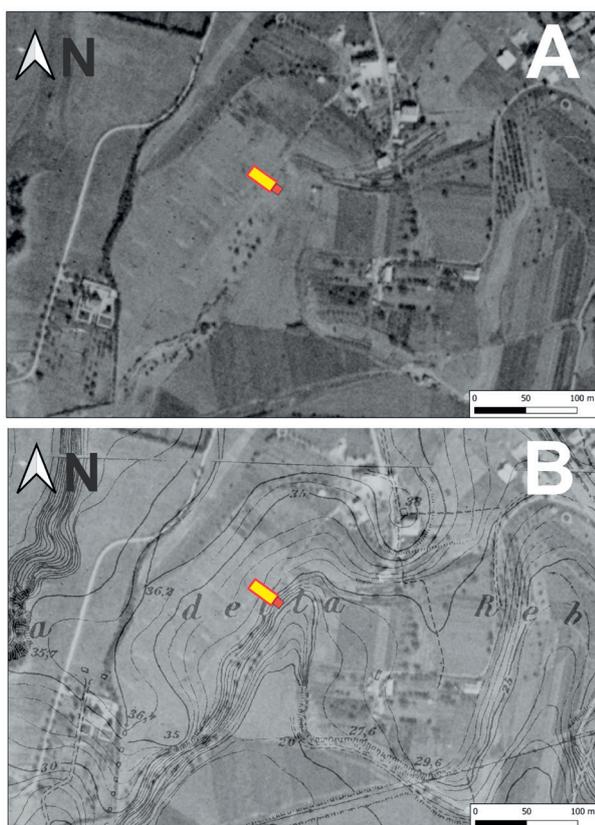


Fig. 9 - A) 1954 aerial photo detail of the Casal de' Pazzi site from the Istituto Geografico Militare; B) 1954 aerial photo detail of the Casal de' Pazzi site from the Istituto Geografico Militare which has been overlaid with a 1924 Istituto Geografico Militare Map of the Campagna Romana 1:5,000 scale using QGIS. Altitude isolines are marked every meter, providing insight into the complex morphology of the area.

Caloi et al. (1989), Manzi et al. (2001) and Palombo (2004). However, more recently, Marra et al. (2015) have attributed it as belonging to the MIS7 interglacial.

4. GEOLOGICAL DATA COLLECTED DURING THE 2013 EXCAVATION CAMPAIGN

The pyroclastic deposits exposed at the Casal de' Pazzi site during the 2013 excavation campaign (Gioia et al., 2014), constitute the remnants of the upper unit (Pozzolanelle) from the Villa Senni eruption. These deposits exhibit cemented facies with all the typical characteristics of this type of material: a pozzolanitic texture, a greyish colour, an abundance of blackish and occasionally reddish scoriae, and a high content of analcimized leucite crystals. Notably, there is a complete absence of yellow and orange scoriae scattered within the matrix, as well as zeolitic cement. At the base of the Pozzolanelle, which is visible in the Museum near the direct entrance to the excavation, a pedogenized brown pyroclastic sediment occurred, that constituted the top of the morphological surface at the time of deposition of Villa Senni eruption (Fig. 11). The Tufo Lionato is represented within the Museum area only as rare decimetric blocks and decimetric pebbles (see Fig. 12), likely probably originating from the erosion of this portion of tuff upstream of the Museum area, at higher elevations than the local ones. Numerous other blocks of pluridecimetric dimensions are found within the fossiliferous volcanoclastic gravel deposit (Fig. 13). These blocks consist of laminated clayey silts that belong to the Aurelia Formation (MIS9), a stratigraphic unit deposited subsequently to the deposition of Tufo Lionato and Pozzolanelle. It is here suggested that part of this

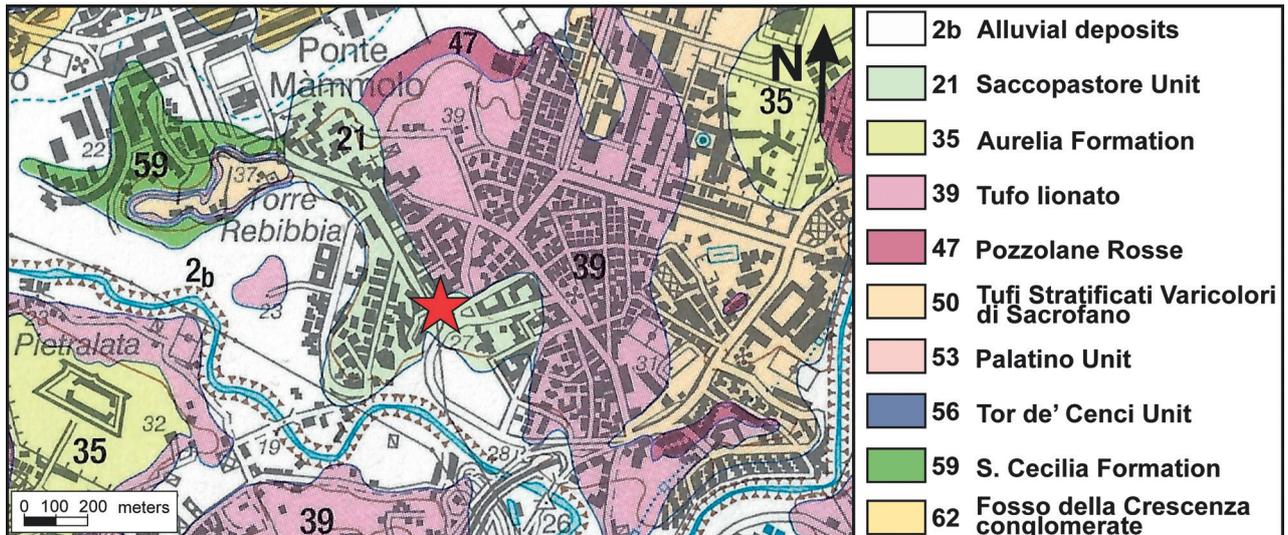


Fig. 10 - Excerpt from a geological map of the Colli Albani Volcano with the location of the Casal de' Pazzi site (slightly modified from Giordano et al., 2010).

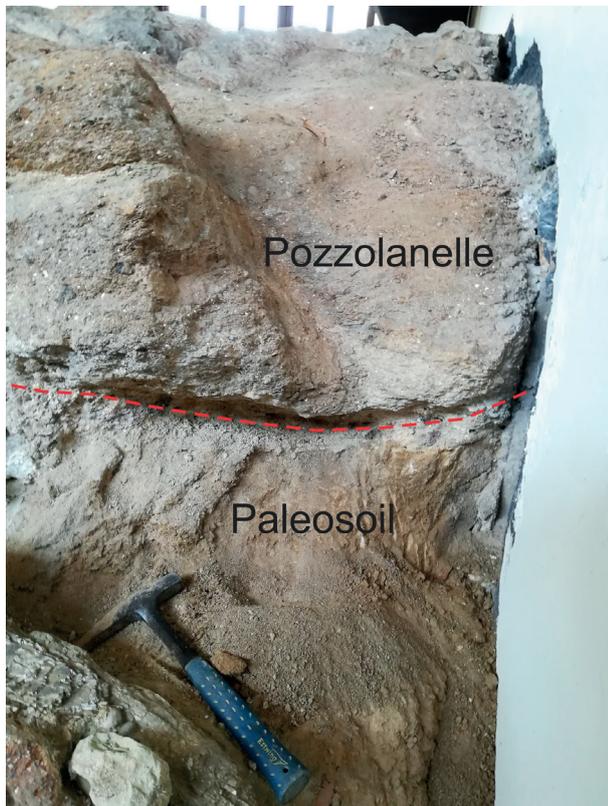


Fig. 11 - Pozzolanelle - paleosoil contact in the Casal de' Pazzi Museum. The photo was taken by Carlo Rosa (courtesy of the Casal de' Pazzi Museum).

stratigraphic unit was eroded together to Tufo Lionato and Pozzolanelle, whose several fragments were subsequently transported by a local stream. The presence of Tufo Lionato fragments suggests a source of the deposits and water flow from the east, where Tufo Lionato deposits crop out at elevations significantly greater than 32 meters above sea level.

Outside the museum, on the northwest side of the Casal



Fig. 12 - Tufo Lionato cobble occurring in the volcanoclastic deposits of the Casal de' Pazzi site. The photo was taken by Carlo Rosa (courtesy of the Casal de' Pazzi Museum).



Fig. 13 - Mud pebbles and cobbles derived from deposits attributed to the Aurelia formation associated with elephantine defenses found in the volcanoclastic deposits of the Casal de' Pazzi site. The photo was taken by Carlo Rosa (courtesy of the Casal de' Pazzi Museum).

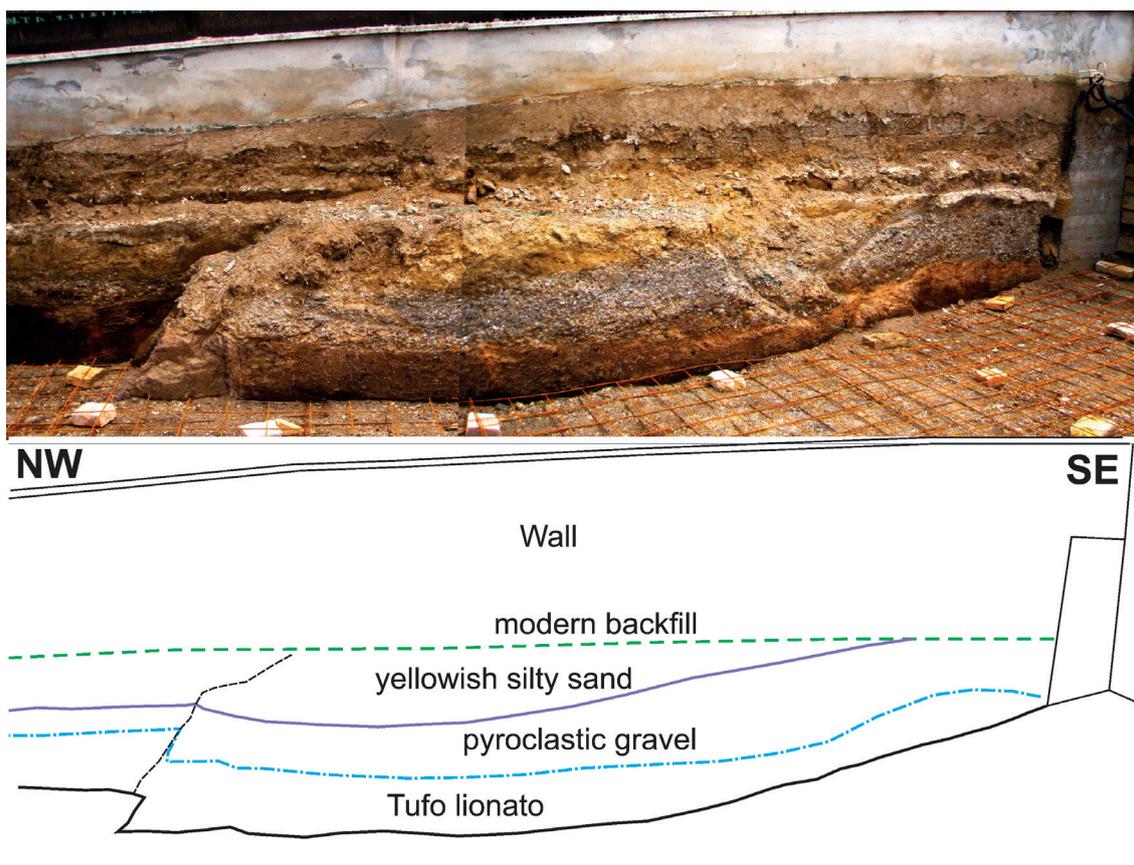


Fig. 14 - Outcrop of Tufo Lionato in the rest area 3 outside of the Casal de' Pazzi Museum. The photo was taken by Carlo Rosa (courtesy of the Casal de' Pazzi Museum).

de' Pazzi site (rest area 3), the top of the Tufo Lionato was encountered at an elevation of approximately 30.50 meters above sea level, about the same as that one found near the adjacent street, via Egidio Galbani (Fig. 14). Here the Tufo Lionato is orange in colour and contains small orange and yellowish scoriae as well as analcimized leucite crystals. In this area, it is covered by an erosional surface on which volcanoclastic gravel deposits rich in analcimized leucite crystals, reddish and yellowish scoriae, lavic xenoliths, holocrystalline xenoliths with leucite and pyroxene occur. These materials result from the erosion of the Pozzolanelle and the underlying Tufo Lionato.

During the excavation campaign in the garden to the north of the Museum, the eroded top of the Pozzolanelle emerged. On this surface, volcanoclastic deposits with cross-stratification were observed, suggesting transportation and deposition by a local fluvial current. These materials included small blackish scoriae and abundant analcimized leucite crystals at the base (Fig. 15). They transitionally pass upward to decimetric scoriae and decimetric blocks of Tufo Lionato, mixed with centimetric to decimetric fragments of laminated clayey silt, eroded by the nearby deposits of the Aurelia formation (Fig. 16) (see also the Geological Map of the City of Rome, Funicello et al., 2008 and the Geological Map of the Colli Albani Volcano, Giordano et al., 2010).

5. STRATIGRAPHIC DATA FROM EXCAVATION AND OUTCROPS FROM THE 1981-85 UTILITY TUNNELS AND SEWER NETWORK DOCUMENTATION REPORTS BY MASSIMO RUFFO

Invaluable for reconstructing the excavation stratigraphy and adjacent sectors is the extensive documentation



Fig. 15 - 2013 Excavation campaign. Detail of volcanoclastic gravel deposit on the Pozzolanelle unit. The photo was taken by Carlo Rosa (courtesy of the Casal de' Pazzi Museum).



Fig. 16 - 2013 Excavation campaign. NE-SW section with a boulder of Tufo Lionato inside the volcanoclastic gravel deposits resting on the Pozzolanelle unit. The photo was taken by Carlo Rosa (courtesy of the Casal de' Pazzi Museum).

collected and drawn by Massimo Ruffo.

The area originally affected by the 1981-85 excavation campaign, as depicted in figure 17, was significantly more extensive than what is currently preserved in the Museum. Nevertheless, it remains a notable accomplishment for its time. Figure 18 shows the numerous points analyzed by M. Ruffo, which included sections from utility tunnels and sewer networks, examined during the excavation to establish correlations with the deposit's stratigraphy.

The original summarized stratigraphic column of the Casal de' Pazzi site, produced by Massimo Ruffo at the time and supervised by Professor A.G. Segre, is depicted

in figure 19, with adjustments made by myself using 2013 data. The section in figure 19 and the stratigraphy in the vicinity of the Casal de' Pazzi site derive from Marco Ruffo's report titled: "Indagini geologiche sulla composizione del sottosuolo nell'area di Rebibbia-Casal de' Pazzi. Raccolta dei dati durante gli scavi per la costruzione di tunnel di servizio e reti fognarie (P.Z. 12 Rebibbia)". The stratigraphic column of the area has been reconstructed using direct excavation data related to the fossiliferous deposit. The upper portion of this column is based on excavations carried out in the northwest-southeast direction on the western side of the ISVEUR Building (Fig. 20), which were conducted as part of the sewer network construction (point 7 in Fig. 18). The lower portion of the stratigraphic column in figure 20 is derived from trench data collected along the south boundary collector of PZ12, in proximity to the excavation site (see Ruffo's report, table 29 on page 54 for further details).

6. CONCLUSIONS

Despite the numerous research efforts conducted on the Casal de'Pazzi site, the study of this site is not yet complete, and new research activities are still ongoing. The acquisition of new sedimentological data, combined with the geological investigations currently being carried out, will provide a more detailed understanding, both from an environmental and a chronostratigraphic perspective, of the area where the site developed. This, along with the archeological investigations, will enable a more detailed reconstruction of the entire area and a

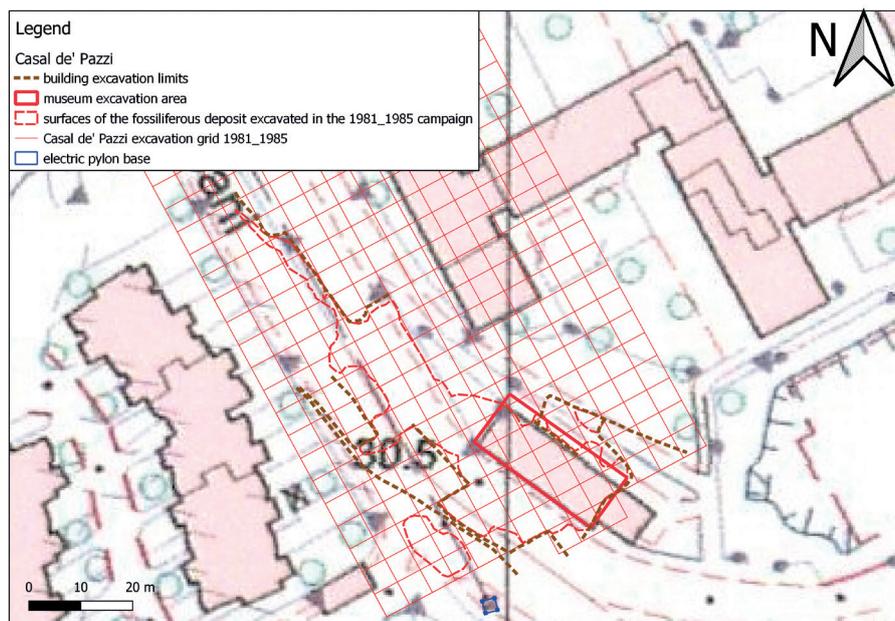


Fig. 17 - 5 m x 5 m grid represented in red, corresponds to the area excavated during the 1981-85 campaign. The paleontological deposit's real extension limits are marked with a red dashed line. The Museum area (Red rectangle) and limits of the building excavations during that period are shown with brown dashed lines. The blue square is the base of the electrical pylon, which served as an altimetric benchmark at the time.

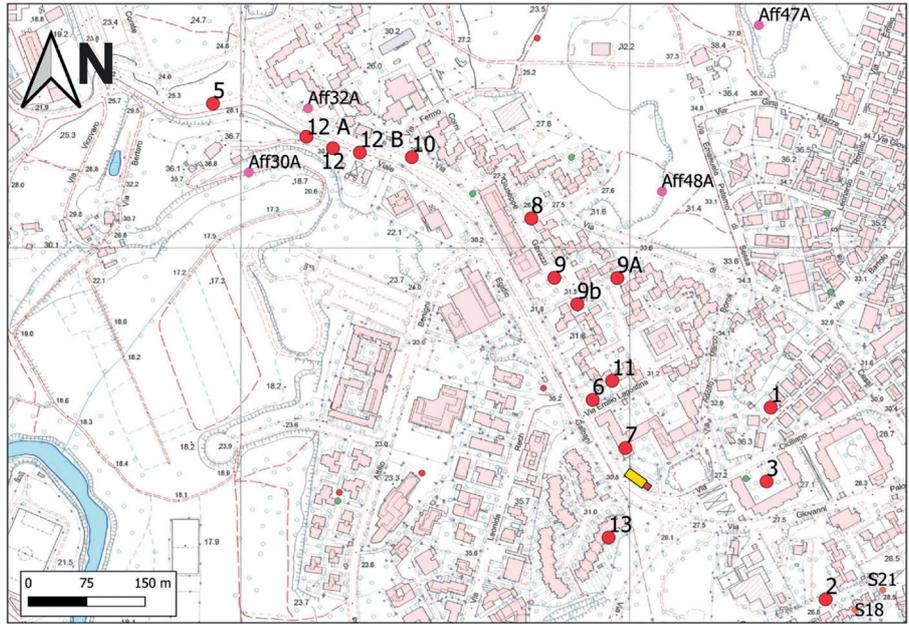


Fig. 18 - Red Dots: Locations of the stratigraphic sections measured by M. Ruffo in 1981-85; other smaller colored dots: Core drillings with stratigraphical data and outcrops currently available; yellow rectangle: Casal de Pazzi Museum excavated area; red square: Casal de Pazzi Museum reception area.

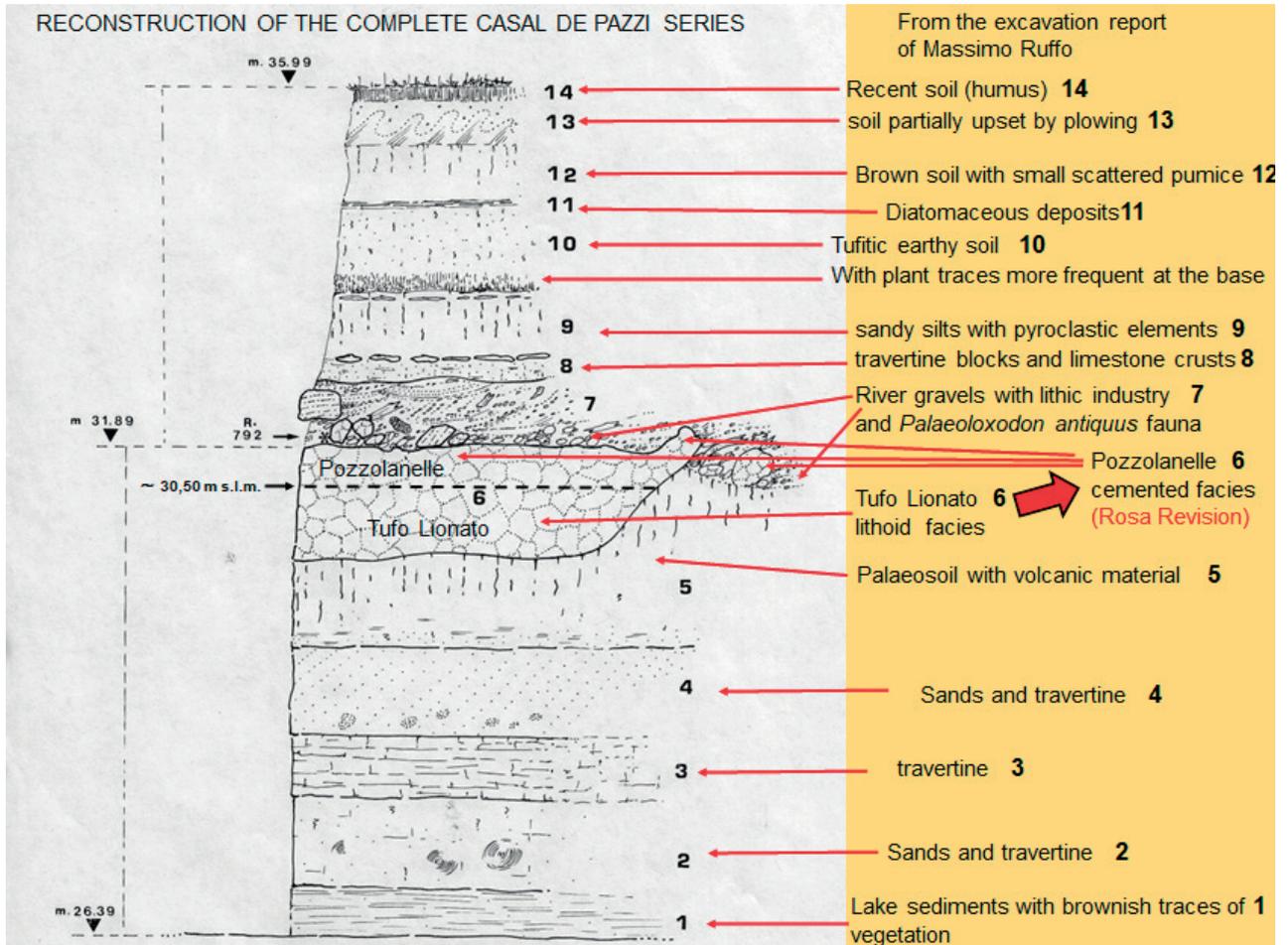


Fig. 19 - Stratigraphic column of the Casal de Pazzi site as reconstructed by M. Ruffo.

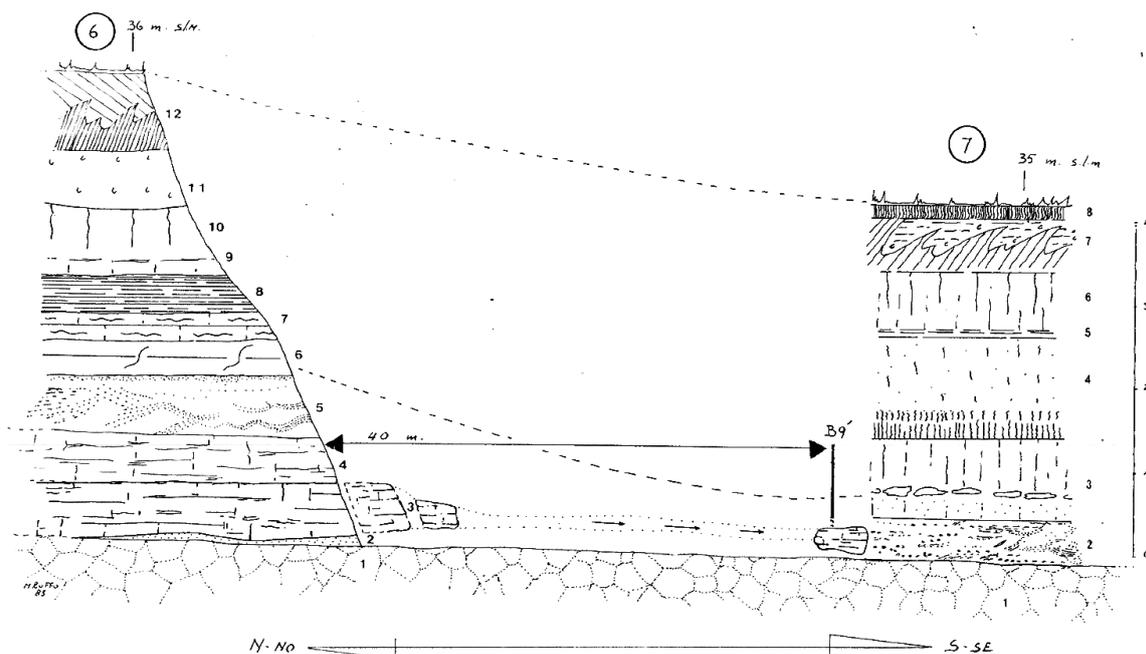


Fig. 20 - NO-SE stratigraphic cross-section between two outcrops in the Casal de' Pazzi site excavation area. From the original drawing by M. Ruffo.

comparison with other archeological and paleontological sites in the Lazio region.

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