

Origins of Vulcanello based on the re-examination of historical sources (Vulcano, Aeolian Islands)

Marco Manni^{*,1}, Mauro Rosi²

⁽¹⁾ Istituto Nazionale Geofisica e Vulcanologia Sezione di Catania, Osservatorio Geofisico di Lipari, Lipari, Italy

⁽²⁾ Università degli Studi di Pisa, Dipartimento di Scienze della Terra; Pisa, Italy

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Abstract

The lava platform and the three pyroclastic cones of Vulcanello constitute the northernmost volcanic structure of the island of Vulcano (Aeolian Islands). The sandy isthmus connecting the platform to the main island was definitively formed in the first half of the 1500s; before then, Vulcano and Vulcanello were two close but separate islands. For a long time, the interpretation of the sources of the II-I century BC, had considered the islet as built up about 2200 years ago. This belief, which proliferated among naturalists from the 17th century, is not confirmed in the ancient texts or even in the geographical documents of the time, which do not indicate the presence of Vulcanello as a new and stable island near Vulcano. The islet would only be mentioned at the dawn of the second millennium, and named in Arabic “Gabal’ al Burkān”, meaning Mount of Vulcano; shortly thereafter the toponym changed to the Latin “Insulam Vulcanelli” and then, towards the 15th century, finally to Vulcanello.

Since the creation of a volcanic island certainly occurred in the Aeolian Islands in the classical era, but traces of it were quickly lost, the most plausible hypothesis is that it was formed in the area of the current Vulcanello, to be subsequently erased by the sea. The shallow, flat seabed, likely remaining as a result of sea abrasion, might have represented the morphological element on which the circular lava platform we know today was formed sometime between 950 and 1000 AD.

Keywords: Volcanic risk; Volcanic eruptions; General or miscellaneous.

1. Introduction

From a geological point of view, Vulcanello represents the youngest volcanic structure emerging from the sea in the Aeolian archipelago (Figure 1). With an area of about 1 km², until the first decade of the 16th century it maintained the characteristics of an islet, so much so that, together with Basiluzzo (in front of Panarea) and the seven main islands, it was considered the ninth emerged land of the Aeolian Islands. The number of the Aeolian Islands was uncertain in antiquity, indeed Homer referred to them as “wandering” and Dionysus as “roving”, since they vanished and reappeared again on the horizon.

Most of the authors (Callia, Diodorus, Pliny the Second, Strabo, Solinio, Marziano Cappella, etc.) counted seven islands: Strongyle (Stromboli), Euonymos (Panarea), Hierà (Vulcano), Meligunìs (Lipari), Didyme (Salina), Phoinicides (Filicudi) and Ericodes (Alicudi). They were considered more numerous when the Basiluzzo rock or the island of Ustica were included. Ptolemy (100-178 AD) in book III of the work *Geographike Hyphegesis*, includes Aeolia in the western waters beyond the archipelago, in the Ustica area; while in the easternmost group *Icesia*, together with Stromboli and Panarea, which according to the proposed coordinates would correspond to Basiluzzo (Figure 2). *Heraclea* and *Heraclotes* mentioned in *Itinerarium maritimum* (515.3-517.4) north of Sicily, and *Hercul'* cited in *Tabula Peutingeriana*, are uncertain toponyms [Libertini, 1921]. According to a more recent hypothesis, Heraclea could correspond to the ancient volcanic structure east of Panarea, now fragmented into small islets [Giustolisi, 2007]. None of the ancient and contemporary authors have related these (or other uncertain toponyms) with an islet located near Vulcano.

To complicate the toponymic picture further, some maps, printed in Venice in the second half of the 16th century (maps by Gastaldi and deriving thereof), depict in the same site east of Panarea, an island called *Vulcaneto* (in other versions *Vulcanello*), a term that in reality would recall a site of important hydrothermal activity. The inaccuracies concerning the composition of the archipelago were caused by the limited geographical and cartographic capacities of the time.

The purpose of this work is to discuss the epoch of formation of the sub-aerial portion of Vulcanello by means of a critical analysis of previously known historical information, cartographic documents and some new unpublished documents. The fascinating picture that emerges profoundly revises what has been believed to date on the origin and evolution of volcanic phenomena in the northern sector of the island of Vulcano. It also sheds new light on the time relationships between the volcanic activity at La Fossa and Vulcanello.



Figure 1. Vulcanello seen from the south. Photo from the 1950s.

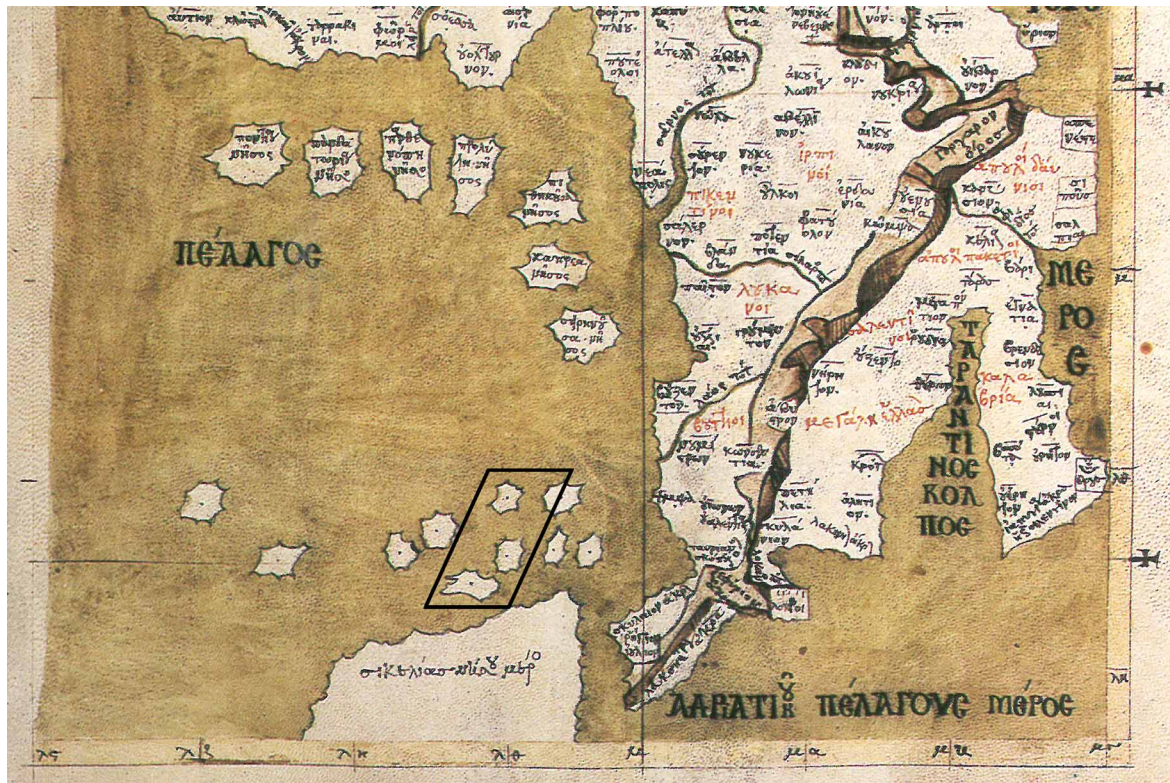


Figure 2. Handwritten paper annexed to the cod. Greek VIND.HIST preserved at the Österreichische Nationalbibliothek in Vienna, from which derive the tables annexed to the Latin codices that inspired the first printed maps [Borri, 2004]. In the central group of the Aeolian Islands, inside the black trapezoid, note the absence of Vulcanello. On the left, Ustica and the presumed Eolia.

2. Historical sources

Over 40 sources (consisting of over 20 manuscripts, and as many maps and drawings), dealing with the emergence of a new island and related phenomena, starting from II BC, were examined. All the historical sources cited in the text are organized in chronological order and shown in extended form in the appendix. We referred to the Italian translations of the original texts (in Greek, Latin, Arabic, German, Spanish) and specified the translators except when they were done by the authors of this work. The English translations were made from these Italian versions. Not taking the existence of a stable islet to the north of Vulcano as an unequivocal given, has allowed us to grasp new elements not only on what is expressed in the sources, but also on what has been ‘unsaid’, because evidently not directly observed by the various authors in the course of the following centuries on this islet, whose history is replete with misunderstandings and contradictions.

The objective confirmation of a new island north of Vulcano was confirmed only after the 10th century AD, as reported by several Arabic and Latin sources. Among the writings examined, of particular note is a document of the “Historical Archive of Sannio” dated to the 13th century, in which the island of Vulcanelli, renowned for its abundance of wild rabbits, appears for the first time among the possessions of the Church of Lipari-Patti. In the analysis of historical cartographies, care was taken to distinguish the ancient concepts of Ptolemaic derivation, persisting for centuries up to the Renaissance, from more modern maps based on the experience of navigators of the maritime republics having more accurate cartographic methods. This is the case of the so-called Pisan Charter, a document dating back to the 13th century which was the first to identify Vulcanello as an autonomous island.

Only from the 16th century would the islet be depicted ever more precisely in its correct position. Some drawings made by naturalists of the 18th century were finally examined for their references to the state of activity of the islet and also to assess the extent of the morphological changes produced by the erosive phenomena occurring in recent centuries.

3. Volcanological data

From a structural viewpoint, Vulcanello occupies a position of dubious significance. On one hand, the eruptive centres lie along the main active tectonic and magmatic structure, with a NS trend, connecting Vulcano to Lipari [Ruch et al., 2016]. On the other, the eruptive vents also lie along the extrapolation of the northern structural edge of the La Fossa caldera, implicitly suggesting that the structure might also be part of the same caldera system [Casalbore et al., 2019].

The Vulcanello structure consists of a sub-circular basaltic lava platform about 1400 m across, minor trachyte lava flows and three partially juxtaposed scoria and ash cones whose maximum elevation is 123m asl. The basaltic lava platform is made up of several stacked pahoehoe lava tongues, of metric to plurimetric thickness. On the east side of the platform, at the foot of cone 1, some small aa-type flows are also present. These flows likely originated from the rheomorphic flow of final spatter deposits of cone 1.

Cone 1, the largest of the three in size and height, superbly cut by marine abrasion, is formed by the superimposition of at least four lithologically distinct pyroclastic units, corresponding to as many eruptions probably separated by short eruption pauses [Fusillo et al., 2015]. Since there is evidence that the cone was built up in several phases, it is not clear whether the lava platform was also produced as a result of separate effusive phases or if the various flows stacked on top of each other without interruption. The general slope of the lava structure converges towards a relative maximum of about 60m asl located SW of cone 1, suggesting that the main effusive vent was located at this point. The formation of the first cone was followed by a significant time break at the end of which the new vent migrated slightly to the SW producing the structure of cinder cone 2. According to Fusillo et al. [2015], on the basis of compositional arguments, the explosive activity of Vulcanello 2 would have been accompanied by the intrusion of a dike that cuts the products of cone 1 and which would in turn have fed the emplacement of an offshore lava field of pillow lava [Gamberi, 2001; Romagnoli et al., 2013]. Again according to Fusillo et al. [2015] the eruptive activity leading to the formation of cone 3 and two lava flows (Figure 3). A first explosive phase was followed by the emission of the trachytic lava flow of Punta del Roveto; a second explosive phase, separated in time, led to the emission of the flow of the Valle dei Mostri. The modest pahoehoe and aa lava fan of the lava flow of Punta del Roveto; and of the blocky flow of the Valle dei Mostri are both directed towards N-NE. The flow of the Valle dei Mostri is also superimposed on that of Punta del Roveto. Unlike cones 1 and 2, which were formed only by scoriae and spatter, cone 3 is mainly made up of lapilli and fine ash deposits.

The age of formation of Vulcanello has been discussed in various geological papers. Keller [1980], on the basis of historical evidence from the Roman age, attributes an age of about 2.2 ka to Vulcanello while, according to the same author, the north-western cone (Vulcanello III), was built up between the 6th and 16th century AD. The latter interpretation was based on the recognition of a tephra ash bed with a rhyolitic composition underlying the lava flow of Punta del Roveto and attributed to the eruption of Monte Pilato of Lipari [Pistolesi et al., 2021]. It was also determined on the basis of a ¹⁴C dating age performed by the same author on charcoal residues subjected to a deposit of tephra from cone 3 and which gave a value of 0.397 ± 0.097 ka, equivalent to a calibrated age of 1553 ± 97 AD. Voltaggio et al. [1995] based on Ra266/Th230 radiometric data, dated the formation of Vulcanello 1 to 1.9 ± 0.2 ka and this same chronological attribution was taken up and confirmed in the new geological map of the Vulcano Island by De Astis et al. [2013]. According to Arrighi et al. [2006] and Malaguti et al. [2021], the formation of Vulcanello would instead be ascribed to eruptions that took place starting from around 1000 AD and cones 1 and 2 would have completed their construction by 1100. Fusillo et al. [2015] confirm Arrighi's thesis by also suggesting a different correlation of the rhyolitic tephra emplaced underneath the Lava of Punta del Roveto, with the eruption of Rocche Rosse (late 1200 - early 1300 AD) rather than the eruption of Monte Pilato (776 AD). Such a correlation and age was also recently confirmed by Pistolesi et al. [2021]. The same authors also consider that cone 3 was formed as a result of various eruptions that led to the deposition of 4 distinct units of tephra named 3A, 3B, 3C and 3D, attributing the Keller age of 397 ± 0.097 ka as subjected to unit 3A. However, Keller himself (personal communication to MR) specified that he had taken the charcoal material on the western side of cone 3, therefore on the top of the lava flow of Punta del Roveto, thus probably dating a younger eruptive phase of cone 3 [tephra unit 3B of Fusillo et al. 2015] and possibly connected to the placement of the flow of the Valle dei Mostri. A new work in press on the chronology of the recent volcanic history of Vulcano and Vulcanello [Malaguti et al., 2021] provided further strength to the reconstruction presented in Arrighi et al. [2006], placing the emersion of Vulcanello between the late 900 and the early 1000 AD. The geophysical monitoring data indicate that the Vulcanello area has a low seismic activity

(less than twenty earthquakes in thirty years). The tectonic seismicity in the northern sector of Vulcano is limited to a few events/year, generally characterized by $1.0 \leq M_d \leq 2.6$ and 3–8 km of depth. The main seismic energy release occurred in 1998 [Alparone et al, 2019]. The geodetic network of Vulcano also identifies a maximum subsidence just south of the Vulcanello peninsula, in a position further inside the La Fossa caldera structure; the subsidence recorded in Vulcanello between the mid-90s and 2011 amounts to about 85 mm, [Alparone et al., 2019], corresponding to at least 3.5 mm / y. However, such a value could rise to more than 5 mm/y if we limit the analysis to the period of total quiescence i.e. removing periods of unrest.

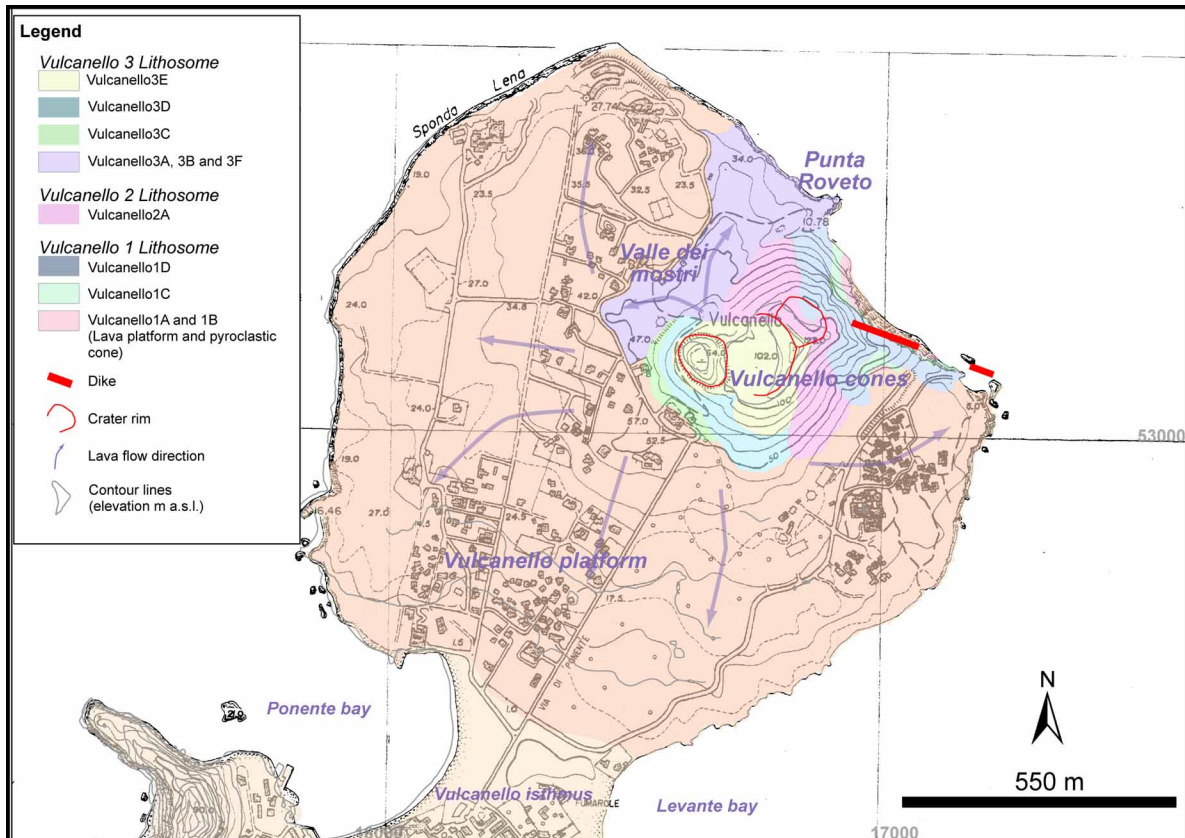


Figure 3. Geological map of Vulcanello peninsula redrawn from Fusillo et al. [2015].

4. Origins of the Vulcanello toponym and the ancient maps of the Aeolian Islands

The toponym Vulcanello was used, perhaps as early as the 6th century AD, to indicate the current locality of Piano Greca located in Lipari [Iacolino, 2008], where there was a widespread fumarolic field that is now reduced in size and level of activity. From the Late Middle Ages onwards, this basin was also called *Piana dei Greci* because it was previously inhabited by Greek-Sicilian monks [Iacolino 1996]. In modern times, the same locality was called the *Buontempo Valley* [Arena, 1991], given its location sheltered from the prevailing winds. There is no trace of Vulcanello islet (nor of any island between Vulcano and Lipari) in Ptolemy's planisphere, the oldest map of the world as it was then presumed to be and represented in the 2nd century AD by Western civilization. Neither was it in the handwritten papers inspired by this map, handed down by the Byzantines after the loss of the original work of the Alexandrian geographer, annexed to the Greek and Latin codices (Figure 2).

The Greek manuscript codes were traced to the Far East where they had been compiled and transcribed starting from the year 1000 (Urbinate Greco, Laurentiano, Marciano, Vindobonensis Hist.); they remained unknown to the Latin world which had not copied them until then [Borri, 2004]. In 1396, Ptolemy's "Geography" reached Italy, having been found in Constantinople, and was translated into Latin in the following years. Thus, the first geographical maps of Italy printed from the 15th century (the first Italian print is from 1477), received the information contained in the original work dating back more than a thousand years earlier. In the derived cartography (Figures 4), the archipelago is still depicted according to old patterns (Figures 2), not adhering to the modern conformation, and with uncertain names.

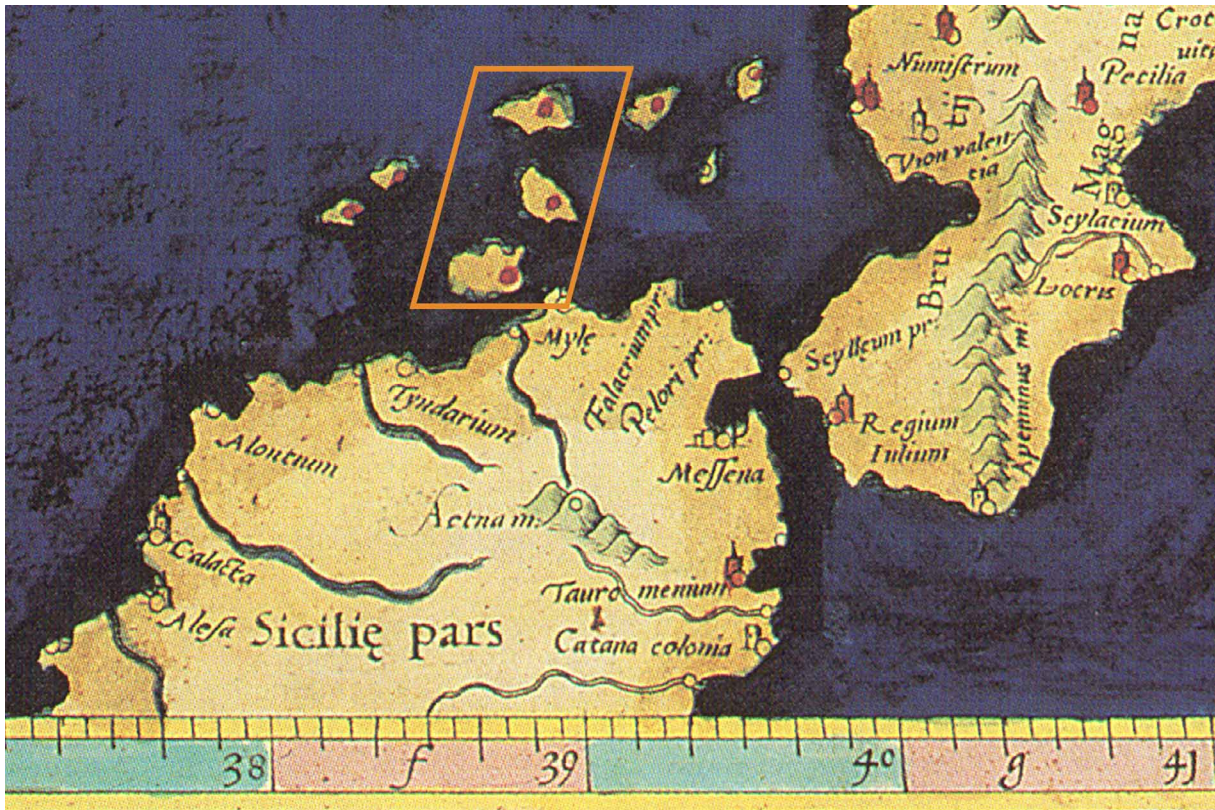


Figure 4. Ptolemaic map by Gerardo Mercatore from 1578 depicting the Aeolian archipelago [Borri, 2004]. Inside the orange trapezoid, it is possible to discern Salina, Lipari and Vulcano, but near the latter there is no Vulcanello.

An example of this is yet another island that Ptolemy intended to arbitrarily place in the waters of Ustica, christening it with the Homeric name *Eolia* (Figures 2), perhaps on the basis of the ancient sources that had handed down the creation of a mud platform in the waters of *Evonima* in the II BC, as detailed in the next paragraph. The Late Middle Ages presents rare examples of naval maps drawn up with information deriving from the direct experiences of expert sailors. The oldest among those reaching us is the so-called "Pisan Charter", datable to around 1275, by an unknown author, and so called because it was found in an archive in Pisa. It represents the first and only cartographic document of the period that can document the real presence of the islet that had arisen in the meantime north of Vulcano (Figure 5).

Pisan sailors boasted direct knowledge of the archipelago since the early 11th century, when they acquired almost total control of the Tyrrhenian Sea. In 1035, the republic of Pisa conquered the city of Lipari, establishing a strategic outpost [La Greca, 2009, a]. "Serra dei Pisani" and "Grotta dei Pisani" are toponyms of the island of Vulcano that could date back to that period.

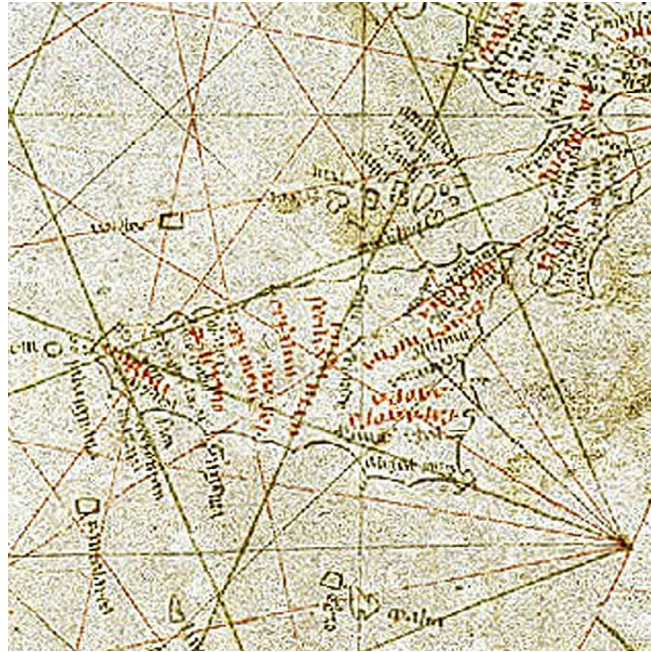


Figure 5a The “Pisan Charter” drawn by an anonymous person in the 13th century.

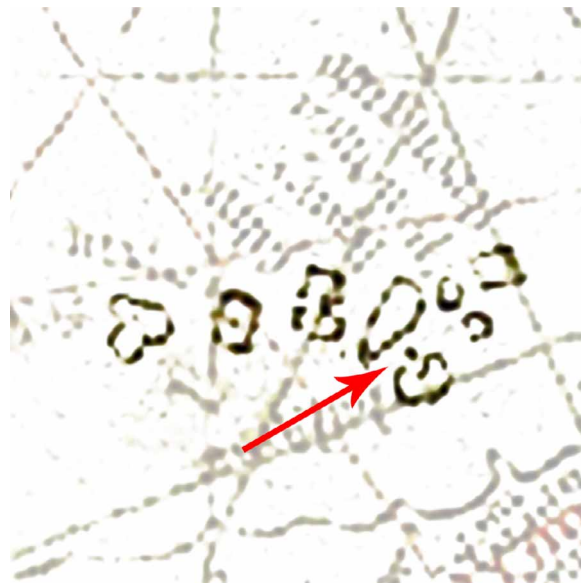


Figure 5b Enlargement of the Aeolian archipelago. Vulcanello can be recognized as a small separate island located between the major islands of Vulcano and Lipari (indicated by the arrow).

5. Discussion

For a long time, it was believed that Vulcanello, as it appears today, was the same structure, according to Posidonio, that emerged between Euonimos (Panarea) and Iera (Vulcano) in 183 BC, which Pliny generically indicated “in the middle of the Aeolian sea”. This date, questioned by some historians, is actually supported by the fact that at the time of the event Tito Flaminio (229-174 BC) was governor of Sicily, according to Strabo.

However, this reconstruction is only partially acceptable since, following this event, no island was to find a stable place in the archipelago, throughout the first Christian millennium. Traces of the mud platform that emerged near

Vulcano were quickly lost. In fact, we find confirmation of the absence of land emerged in the stretch of sea between Lipari and Sicily, with the exception of Vulcano, as Strabo (63 BC-23 AD) tells us, quoting Polybius (206-120 BC approximately), who reports that the activity of the craters of Vulcano was considerable and that the ejected materials were filling the stretch of sea between Lipari and Vulcano island. Even before Polybius, during the 2nd century BC, there is testimony to the fact that, north of Vulcano, there was nothing but a shallow seabed.

The sources at the turn of the 2nd - 1st century BC highlight two cycles of submarine events in the waters of Lipari and Vulcano. A description of Ossequente referring to 126 BC, and that of Pliny to 91-88 BC, which report submarine eruptions in the waters of Lipari and Vulcano, do not reveal the pre-existence of any islet, nor the creation of a new land that emerged following of the phenomena reported.

Likewise, Virgil, at the end of the 1st century BC, indicating the location of Vulcano between the Sicilian coast and Lipari, does not mention the islet among them.

The rapid regression of sea cliffs of the newly emerged volcanic cones, with the formation of wide submerged shelves, is a phenomenon of which there are numerous and well-documented recent examples: Capelinhos, 1957-58 (Faial, Azores), Surtsey, 1963-67 (Iceland) and the Ferdinanda Island emerging in the Sicilian channel in 1831. Bathymetric surveys carried out just 3 years later found, where Ferdinanda Island had first arisen, a vast shallow seabed, from which two rock pinnacles rose up to -2.7 and -3.3 m, which were then reduced with explosives to about -8 m to ensure the safety of navigation [Falzone et al., 2009]. The current situation of the shoal of the Ferdinanda volcano is shown in Figure 6. The same erosional process might have occurred to the detriment of the tephra platform, at the time of Polybius and Strabo leaving a circular shoal in the area of the present-day Vulcanello.

The formation of a volcanic structure in the 2nd century BC needs at least two requirements: the proximity to an active volcanic system and the existence of a shallow seabed that acts as a “support” to allow the emergence of a new island following an eruption. These conditions were certainly present north of Vulcano, and in no other Aeolian site. This coincidence is not found for example in the stretch of sea indicated by Posidonio between Panarea and Vulcano or between Ustica and Alicudi, and the only candidate area to host the ancient platform therefore proves to be the one located north of Vulcano, now occupied by Vulcanello.

The news of the emergence of a new island in 183 BC created quite a stir in the Roman world (the Aeolian Islands were under the dominion of Rome from 251 BC), so much so that for many centuries recollection of such news was taken up and passed on by various authors. There were several Latin writers of the imperial age (Eutropio, Orosio, Cassiodorus) who seemed to recognize this island as Vulcano. No little misunderstanding, but which can be explained by the absence of the islet in the first Christian millennium.

In the early Middle Ages, the silence of the sources prevailed in conjunction with a drastic reduction of inhabitants and visitors to the archipelago. The existence of Vulcanello in the first millennium is once again placed in strong doubt by the omission of any clue referable to the islet in the description on Vulcano and Lipari, and once again by its lack of mention in contemporary geography.

The most recent document listing the islands making up the Aeolian archipelago, except Vulcanello, compiled by an anonymous man from Ravenna in the 7th century AD, includes: Erculis, Lipparis, Stroile, Pagnarea, Vulcana, Didimi, Enicodes, Basilidin, Erigodes (Erculis, Lipari, Stromboli, Panarea, Vulcano, Salina, Filicudi, Basiluzzo, Alicudi). [Bernabò Brea, 1988; Pagliara, 1995]. Regarding Erculis, mention was made in the introduction of this work; as can be noted, it includes the rock of Basiluzzo.

The Enkomion of San Teodoro Studita (758-826 AD) tells of the legendary arrival in Lipari of the remains of San Bartolomeo at the end of the 3rd century AD, and of the consequent removal of Mount Vulcano from Lipari. In a passage describing Vulcano in the early Middle Ages as a lonely mountain, the absence of Vulcanello is not overlooked.

Al-Mas-ūdī (900-956), one of the first Arab geographers to report news from this part of the Mediterranean, describes the activity of the volcanoes of Sicily in his works entitled “Gold meadows and gem mines” and in “Tanbīh...”

In the writings, received incomplete, the toponym ‘Gabal’ al Burkān (Mount of the volcano) and the generic term gazirat (island), both refer to Vulcano and not to Vulcanello.

The second phase of Vulcanello, which probably occurred at the end of the early Middle Ages, resulted in the construction of the current lava platform and pyroclastic cones 1 and 2 (cinder and spatter-cone). The characteristic sub-circular shape of the lava platform (Figure 7) was probably determined by the presence of a previous shallow circular seabed. Medieval Vulcanello therefore developed, most likely, on the submarine vestiges of the ancient Roman volcano, presumably using the same magma feeding system.

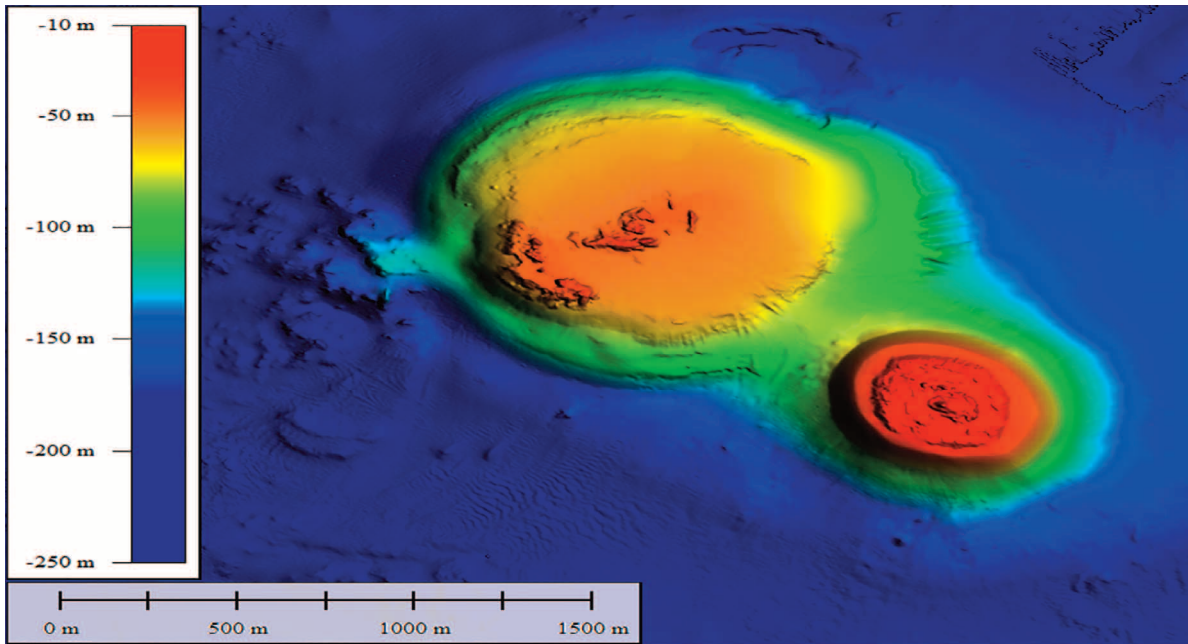


Figure 6. High-resolution shaded relief image of young and shallow volcanic banks in the Sicily Channel after Cavallaro and Coltelli [2019]. The smaller structure on the right – bottom of the figure is the Graham bank formed after the Ferdinandea eruption of 1831. Both structures prove how newly volcanic islands tend to be quickly abraded by the wave action leaving shallow, sub-horizontal, seabed structures with a circular plan.

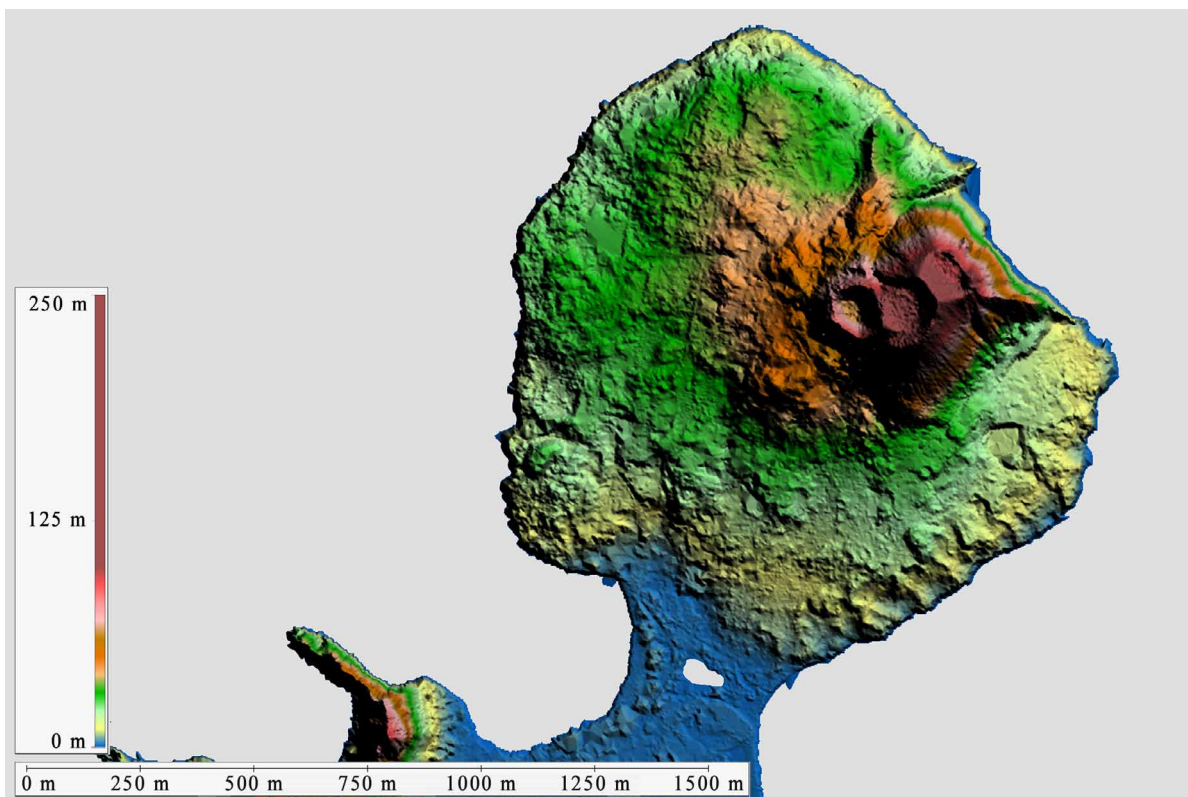


Figure 7. Digital Terrestrial Model of Vulcanello [Anzidei, 2021]. The formation of an almost perfect circular lava platform about 1.5 km diameter required the presence of a flat, horizontal and shallow seabed before the lava emission. Such a seabed structure most probably formed by the abrasion of a previous volcanic structure likely formed in the same place in Roman time.

According to the archaeo-magnetic dating of Arrighi et al. [2006], the eruption of the lavas that make up the current platform began around 1050. The historical sources do not offer explicit references to the eruptive phase that led to the definitive emergence of Vulcanello. The first clues derive from the work of Al-Bakri (1014 or 28 - 1094), an Arab- Hispanic geographer and historian. His work, a geographical dictionary called *Kitāb al-Masālik wa al-Mamālik* (book of roads and kingdoms), brought to light in 1064-67, is based on the travel reports of merchants and sailors of the past or their contemporaries, given the author himself did not leave the Iberian Peninsula. He draws a great deal from another Iberian geographer, Al-Udri or El Odrí (1003-1085); in describing “the great volcano - in two islands to the north of Sicily”, the author highlights to some extent the close relationship between Vulcano and Vulcanello. This testimony suggests a period of just prior to 1050 for the emergence of the platform and therefore in good agreement with the claims of Arrighi et al. [2006]. Al Masudi in the first half of 10th century, is therefore the last known author to give detailed attention to phenomena that occurred on the island of Vulcano, without however detecting the adjacent island. In consideration of all these last testimonies, we could hypothesize that the emergence of Vulcanello took place between the first and second millennium.

The moment of the medieval emergence of Vulcanello evidently went unnoticed due to the lack of eyewitnesses in Lipari (and of social institutions in the archipelago that came to be established sometime later), able to report the event in writing. We know that at the beginning of the second millennium Lipari had only a few dozen inhabitants [Arena, 1991; Iacolino, 1996]; and that the island was stolen from Muslims by Pisans in 1035 [La Greca, 2009a]. To the absence of substantial written documents prior to 1000, was added the complete unavailability of cartography which, as we have seen, made its appearance in the West at the end of the Middle Ages. The Pisan Charter, presumably drawn up in the 13th century, is the first sailing directions manual to include the presence of the islet of Vulcanello, about two centuries after its emergence.

The islet did not originally take its current Latin name (a further detail refuting the alleged Roman origins), but the Arabic term ‘Gabal’ al Burkān, namely Mount of Vulcano, attributed by the geographer Edrisi towards the mid-twelfth century.

An inventory of 1247 drawn up by the Diocese of Lipari-Patti [Iacolino, 2001], in which mention is made of the new island in Latin, “*Insulam Vulcanelli*”, is also of notable importance for our purpose. The official document analytically lists the lands worked and which assets in each Aeolian island belonged to the Monastery of Lipari by virtue of the concessions of Count Roger, then reconfirmed by his son Roger II in 1134. In the original concessions, dating back to the previous century, no useful elements are collected for our purpose as the islets are not analytically listed, but generically indicated as “*appurtenances*” of the seven main islands. Among the possessions of the Church of Lipari-Patti spread over nine islands, the islet appears for the first time.

The use of the plural “*Vulcanelli*” implies the formation of cone n. 2 for some time, probably accompanied by a series of eruptions, which according to the dates lasted until about 1200 [Arrighi et al., 2006]. This activity appears supported by the testimonies of Ibn Gūbayr al-Kinani who in 1184 observed how fire and incandescent material came from openings on two islands, according to Amari [1880] the southernmost ones of the archipelago.

From the diocesan text, we can deduce a regular human presence motivated by the abundance of wild rabbits, indicating liveable conditions and ultimately the reaching of a volcanic stasis. Henry III’s ambassadors, while heading to Samarkand in 1403, observed that Stromboli, Vulcano and to a lesser extent Vulcanello, emitted fumes and made a great noise [López Estrada, 1943; Iacolino, 2007]. Fazello in 1500 attests that the respective eruptive centres were occasionally affected by a concomitance of explosive phenomena.

The formation and consolidation of the isthmus connecting Vulcano with Vulcanello would take place thanks to the sedimentary contributions linked to the eruptive activity of the crater de la Fossa after the year 1000.

Fazello confirms that in his time (namely at the beginning of 1500) the islet was still separate, while at the time of completing his work, in 1563, it was connected by the isthmus.

The Ignoto Berlingheriano map printed in Florence in 1482 (Figure 8) and others derived from it, including the Map of Sicily of sixteenth-century conception (Figure 9), in agreement with Fazello clearly reveal Vulcanello as detached from Vulcano. The parchment of 1513 by the Turkish admiral Piri Reis also shows the same situation [Cheshire, 2018].

The sandy isthmus was instead consolidated at the time of the siege of the Saracen pirate Ariadeno Barbarossa in 1544. The priest Maurando, a member of his crew, landed on Vulcanello on 2 July and then reached the Grand Crater across the modest strip of land. We can thus establish that the union of Vulcan and Vulcanello probably took place between about 1513 and 1544.

Orgins of the islet of Vulcanello

The writer therefore testifies that Vulcan and Vulcanello were initially divided, but that in his time they were one island because the abundant ash coming out of the mouth of the crater of Vulcano closed the passage blocking the stretch of the sea that divided them, through which the ships passed on the eastern side; thus a port was created. A sketch made by the same author shows an emission-free Vulcanello (unlike Vulcano and Stromboli).



Figure 8. Geographical map of 1482 entitled "Novella Carta", by Ignoto Berlingheriano (typ. N. Laurenti, known as Toderico-Florence). Enlargement of the south-eastern Tyrrhenian Sea.



Figure 9. Detail of the Map of Sicily, belonging to the series commissioned by Pope Gregory XIII between 1580-3, showing in the foreground Vulcano in activity and Vulcanello still detached from it. Photo © GOVERNATORATO SCV – DIREZIONE DEI MUSEI.

An anonymous representation, about 1565, was the first to show Vulcano and Vulcanello linked together (Figure 10).



Figure 10. Anonymous, about 1565 (woodcut by Lorenzo Zacchia, printed in Lucca).

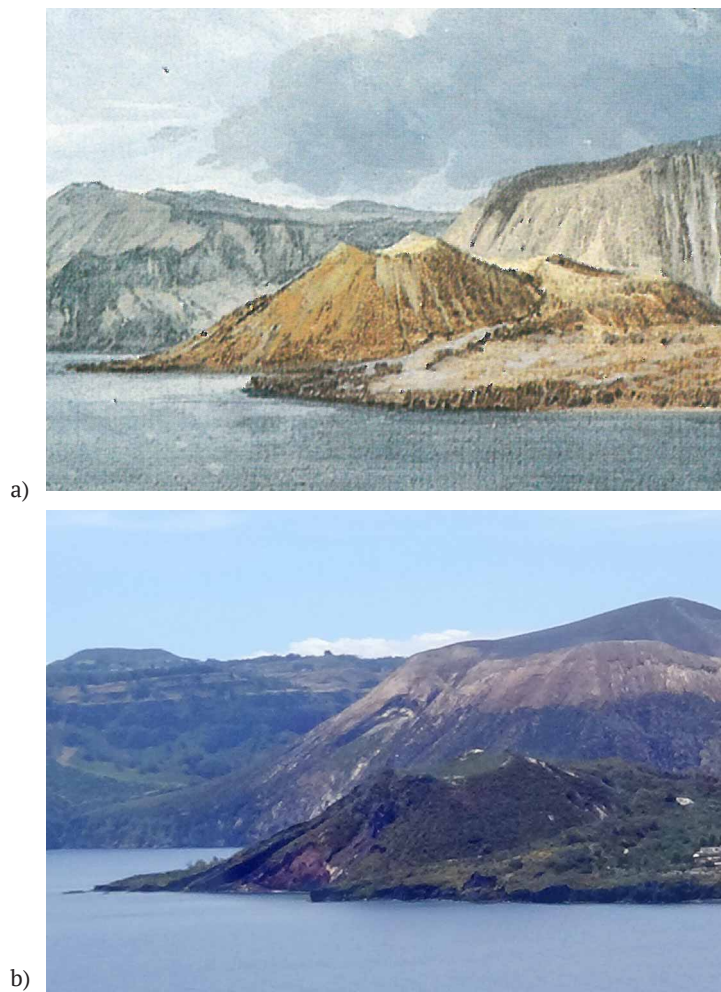


Figure 11. Comparison between Houel's painting of 1777-78 a) and a current photograph b). In Houel's drawing, the lavas of Punta del Roveto and Valle dei Mostri can be seen in the foreground, already affected by marine abrasion. In the current image, cone 1 appears significantly more eroded than in Houel's painting.

It was Fazello who explained how the obstruction of the canal was due to the enormous mass of ashes and stones emanating from the furnaces of Vulcano, which presupposes the occurrence of eruptions on Vulcano between 1444 and 1544, the year in which the existence of the isthmus is ascertained. The hypothesis of an eruption occurring around 1550 according to Dolomieu [1781], later cited by Spallanzani [1788] (giving an indication of when the eruption occurred that determined the union of Vulcanello with Vulcano) is refuted by these new considerations. Documentation prior to 1544 is objectively lacking due to the destruction of Lipari wrought by the Saracen pirate Ariadeno Barbarossa who, in deporting a large part of the population, devastated the territory, administrative offices and archives, irreparably severing the local historical memory. This event, which represents the last serious cultural break to strike the archipelago, is known as the “Ruina di Lipari” (the ruin of Lipari).

Father Kircher testifies that in the 17th century it was common to identify Vulcanello with the mud platform that emerged in the second century BC. This is probably the first documented testimony that attributes a Roman genesis to the islet, a concept that would be upheld and reaffirmed to this day.

This interpretation was later proposed by Dolomieu [1781] and by Spallanzani [1785], who were among the first to describe the volcanism of the Aeolian Islands in a modern key. This hypothesis, on the other hand, had not been examined in these terms by Fazello, who just two centuries earlier, speaking of the history of Vulcano (not of Vulcanello), declared equivocally that this island was not formed like the others at the beginning of the world, but it was created, and came about in an instant, from the fire exciting by the wind as Eusebius writes, out of the water, at the time that Spu. Postumius Albinus and Quintus Fabio Labeone were Consuls in Rome, five hundred and fifty years after its construction.

It is not known whether the formation of the sandy isthmus preceded or followed the effusion of the Roveto and Valle dei Mostri flows. Henry Michelot's 1699 map depicts the two active islands, while J. Houel's 1777-8 painting shows the lava fronts of Punta Roveto and Valle dei Mostri cut off by an abrasion sea cliff (Figure 11). Friedrich Munter's brief description of February 1786 describes Vulcanello puffing out smoke, in the year (and more generally in the century) in which Vulcano was affected by an extraordinary sequence of paroxysms. This state seems to agree well with the hypothesis that Vulcanello had exhausted its eruptive activity by the first half of the eighteenth century.

At the end of the 19th century, Guy De Maupassant and Salvatore Luigi D'Austria describe the isthmus connecting Vulcano to Vulcanello, which had widened following the numerous eruptions of the Great Crater during the course of the 18th century.

6. Conclusions

This work presents a summary of historical data on Vulcanello that confirm its medieval age, showing how the analysis of its history has for a long time been distorted by misunderstandings and contradictions, reiterated to the present day. Several elements may have contributed to concealing the real medieval origins of Vulcanello: the interposition of Vulcano with respect to Sicily which limited the observation of eruptive phenomena from the main island; the historical-cultural caesuras between the 9th-10th centuries on occasion of the first Arab occupation of Lipari which coincided with its drastic depopulation, and in 1544 when the city of Lipari was besieged and destroyed by the Saracens, circumstances that led to deportation of archives and ultimately of historical memory. A fundamental element that arises from this reconstruction is the report that the volcanic structure emerged from the sea at the beginning of the second century BC. It disappeared in a short time, presumably leaving an area of shallow water. On the other hand, the legend of its emergence which has reached our time remained intact.

In summary, there are four main points arising from this work:

- a) It is confirmed that between the 1st and 2nd centuries BC, various eruptions occurred in the sea of the Aeolian archipelago which led to the formation of an emerged land. The eruptions occurred in 183 BC and gave rise to a new island; shortly after, however, the island was eroded while other eruptions occurred on the same site or a nearby site, in 126 and between 91 and 88 BC. Late Roman documents do not contain references to the formation of a stable island. Regarding the location of the eruptive phenomena of the Roman era, several elements suggest that they occurred at the same place where Vulcanello is today.
- b) The definitive emergence of the current Vulcanello, although not directly observed and described, appears, from indirect historical information, to have occurred around 1000 AD. In fact, only starting from this period did an islet with an autonomous name begin to be present in the documents of Arab geographers of the first

two centuries of the second millennium. In these documents, Vulcanello is indicated with the name of “mount of Vulcano” to distinguish it from the active volcano of La Fossa, indicated instead with the name of “Vulcano island”. The Latinization of the name first in Vulcanelli, due to the presence of more cones, and then in Vulcanello, happened from 13th century. The young age of the structure is in harmony with its excellent state of conservation despite its cliffs showing a rapid and continuous retreat.

- c) The present study highlights the probable repetition, in the same area, of a significant eruptive activity in Roman times that occurred in several phases (183, 126 and between 91 and 88 BC), around the year 1000 AD (construction of the scoria cones 1 and 2) and again around 1450-1500 AD. The repetition in the same site of volcanic activity indicates that the Vulcanello eruptive centre was consolidating its role as a new eruptive centre. If we also consider that some historical references (citation of the Roman period of 88 BC, the ancient medieval one 1184), report the contemporaneity of the eruption between Vulcanello and the crater of La Fossa, it appears plausible that the two centres are fed by the same magmatic system and that Vulcanello constitutes a second subsidiary eruptive centre located within the same caldera of La Fossa.
- d) This new islet played a prominent role in favoring the creation of the flat area of Vulcano Porto and, in the first half of 1500, of a sandy isthmus that definitively connected the island of Vulcanello to the main island. Our findings double the temporal recurrence of eruptive phenomena of the northern sector of the Vulcano over the past 2000 yrs, significantly increasing the medium-long term volcanic hazard of the settled areas of Vulcanello, Porto di Ponente and Porto di Levante.

It is finally worth noticing how the historical arguments outlined in the present work are in excellent agreement with the chronological framework of Vulcanello's origin, already presented in Arrighi et al. [2006], and now confirmed by the most recent archaeomagnetic, radiocarbon and stratigraphic reconstruction presented by Malaguti et al. [2021].

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***CORRESPONDING AUTHOR: Marco MANNI,**

Istituto Nazionale di Geofisica, Catania Osservatorio Etneo, Catania, Italy,
and Monte Falcone, San Salvatore locality, 98055 Lipari (ME),
e-mail: marco.manni@ingv.it,

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