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Eruptions of the last 2200 years at Vulcano and Vulcanello (Aeolian Islands, Italy) dated by high-accuracy archeomagnetism

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Abstract

The recent eruptive history of the Vulcano island (Southern Italy) was investigated through the high-accuracy "large sample" archeomagnetic method (Tanguy, J.C., Le Goff, M., Principe, C., Arrighi, S., Chillemi, V., Paiotti, A., La Delfa, S., Patanè, G., 2003. Archeomagnetic dating of Mediterranean volcanics of the last 2100 years: validity and limits. Earth Planet. Sci. Lett. 211, 111–124; Tanguy, J.C., Principe, C., Arrighi, S., 2005. Comment on "Historical measurements of the Earth's magnetic field compared with remanence directions from lava flows in Italy over the last four centuries" by R. Lanza, A. Meloni, and E. Tema. Phys. Earth Planet. Interiors 152, 116–120; Arrighi, S., 2004. The large sample archeomagnetic method applied to Neapolitan volcanoes and Aeolian Islands. PhD Thesis. University of Pisa, Italy, pp. 1–186). Age determination is based upon directional geomagnetic variation reconstructed from historically dated lavas in Southern Italy, and from archeological sites in Western Europe (Gallet, Y., Genevey, A., Le Goff, M., 2002. Three millennia of directional variation of the Earth's magnetic field in Western Europe as revealed by archeological artefacts. Phys. Earth Planet. Interiors 131, 81–89) relocated to Sicily. Results in the present paper were obtained on 12 sites including 185 samples weighing 0.5–1 kg, distributed over the Vulcanello platform lavas and pyroclastic cones, and on the lava flows from the Fossa cone. It is shown that the Vulcanello platform was built by nearly continuous activity between AD 1000 and 1250, which is more than a millennium younger than believed until now from questionable interpretation of imprecise historical accounts. Most of the lavas from the Fossa cone, whose ages were rather hypothetical or known with a large uncertainty, have erupted within the same period. However, the last "Pietre Cotte" obsidian flow is confirmed to date from 1720 ± 30, in agreement with historical data (1739).

Keywords: Volcanic eruptions; Archeomagnetic dating; Magmatic evolution; Volcanic risk; Vulcano

1. Introduction

Vulcano is the southernmost and the third largest of the seven major islands of the Aeolian arc in the Southern Tyrrhenian sea, with an area of 22 km^2 (Fig. 1). The main island developed during the Pleistocene and Holocene and underwent various stages of stratocone building and caldera collapse (Keller, 1980; De Astis et al., 1997, 2003). It is connected northward through a flat isthmus to the smaller island of Vulcanello, which is composed of a lava platform and three small pyroclastic cones. Both the platform and cones are popularly believed to have emerged in the last 2200 years.

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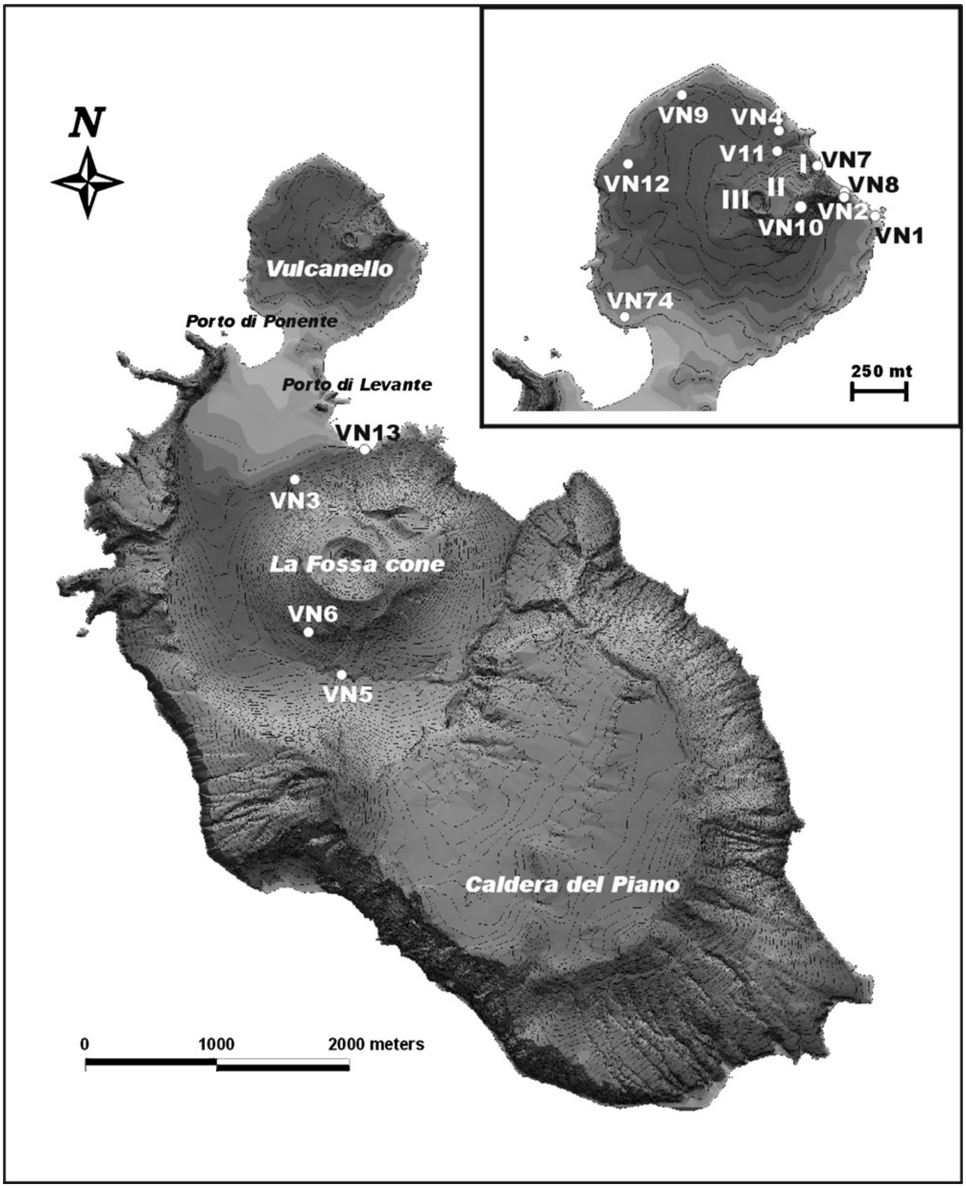

Fig. 1. Schematic map of the Vulcano island with indication of the various sites (VN) sampled for archeomagnetic study (see text for explanation).

In fact, although Vulcano is close to Sicily, it remained uninhabited for most of the historical times (Bernabo Brea and Cavalier, 1991), probably because the only possible harbour was located just below the violently explosive crater of La Fossa. During the Greek epoch (7th–3rd cent. BC), the island was called "Hiera Hephestou", i.e. the Holy place dedicated to Hephestos, the God of Fire, and therefore inaccessible to human beings. From descriptions by ancient authors collected in recent literature (e.g. De Fiore, 1922; Frazzetta et al., 1984), it would appear that eruptions until the medieval times were more frequent and violent than today. Details of these events, however, are largely lacking, so that not only the products from a given eruption cannot be identified, but in some cases it is not even sure whether activity occurred at Vulcano or at the neighbouring island of Lipari (Keller, personal communication). On the other hand, for reconstructing the volcanological evolution of the last two millennia, traditional radiometric methods such as K/Ar dating are too imprecise, and ^{14}C dating is subordined to the finding of carbonized wood which is rarely available. Here we propose a full reexamination of the last eruptions of Vulcano and Vulcanello by using the high-accuracy archeomagnetic dating which was shown to reach an average precision of ±40 years for the last 1200 years, and about ±100 to 200 years from then until 150 BC (Tanguy et al., 2003; Principe et al., 2004).

2. Geological setting

The presently active center of Vulcano is locally called “La Fossa” or “Gran Cratere” (Fig. 1). It is composed of a broad cone with steep flanks nested within a half-submerged caldera and showing a funnel-shaped crater whose eastern rim reaches 391 m elevation. Although its activity is known since the Greek epoch, only the last eruptive period of 1888–1890 is reported in detail (Mercalli and Silvestri, 1891; Clocchiatti et al., 1994). From 1890 to the time of writing, La Fossa remained in a fumarolic stage despite transient periods of unrest (Montalto, 1996).

Although Keller (1980) considers all the geologically recent trachytic flows from La Fossa in identical stratigraphic position, further investigations led Frazzetta et al. (1983, 1984), and Frazzetta and La Volpe (1991), to distinguish various eruptive cycles showing a similar pattern of activity, i.e.: (1) quiescent stage, (2) ash surge eruptions, (3) vulcanian explosions, and (4) lava flow effusion. Erosional unconformities suggest periods of rest between the various cycles. Conversely, there are neither erosional surfaces nor paleosoils between deposits from a single cycle, so that each eruptive period is assumed to have had a relatively short duration.

The Punte Nere deposits are considered by Frazzetta et al. as the oldest of the recent cycles of activity. They include dry surge beds overlain by a thick fall sequence. A trachytic lava flow ended the cycle, which represents today a prominent part of the northern flank of the cone near the Porto di Levante (VN 13, Fig. 1). The age of this flow was determined to 5500 ± 1300 years BP by K/Ar dating (Frazzetta et al., 1984).

The Palizzi cycle is considered by the same authors as distinct from the preceding one. It is mainly characterized by a well-developed trachytic lava flow that nearly reached the southern foot of the Fossa cone (VN 5). The Palizzi flow was dated to 1600 ± 1000 years BP (K/Ar, Frazzetta et al., 1984), and to 1500 ± 200 years BP (Ra/Th, Voltaggio et al., 1995).

Similarly, the Commenda cycle is thought to have ended with extrusion of an obsidian lava flow (VN 6) outcropping on the SSW flank between 125 and 250 m elevation, near the Western border of the Palizzi flow. Although Frazzetta and La Volpe (1991) stated that the Commenda flow was historically dated to AD 785 by refering to Frazzetta et al. (1984), there is no allusion to such an information in this particular publication.

The Pietre Cotte obsidian flow (VN 3, made of rhyolite) is today a striking feature on the NNW side of the Fossa cone. Its front is tongue-shaped and morphologically very fresh. According to Mercalli and Silvestri (1891), it could have been emitted in 1771, whereas De Fiore points out that it was already mentioned by De Luc in 1757 (De Fiore, 1922). Following this latter author, both Keller (1970) and Frazzetta et al. (1984) suggest that the Pietre Cotte flow was erupted at the end of the 1731–1739 period of activity.

The Vulcanello peninsula appears implicitly considered as a separate eruptive system. Its “birth” is traditionally dated to 183 or 126 BC (Strabo and Plinius writing quoted by De Fiore, 1922), although interpretation of the historical accounts is actually quite subject to caution. For instance Strabo’s writing describing a submarine eruption (“mud was seen spurting up from the sea, accompanied in many places by jets of flame. Then it solidified and formed rock”, see full translation in Scarth and Tanguy, 2001) can hardly been regarded as indicating the birth of a true island. A small islet emerged (νησιδίω in the text), on which sacrifice was offered to the gods by a Roman committee, but there is no evidence that this islet could have been similar to the platform as it appears today. According to Keller (1980), various stages of activity occurred in this area until about 1550 AD, although it is often difficult to distinguish whether activities took place at Vulcanello or La Fossa crater. From a stratigraphical standpoint, the earliest vent is the eastern one (Vulcanello I cone, Fig. 1), soon followed by the central cone (Vulcanello II). The building of the lava platform occurred later when at least eight distinct leucite tephrite flows were produced. An erosional unconformity indicates a significant gap in activity before the appearance of the western cone (Vulcanello III), which emitted the small trachytic flow of Punta Roveto. A ^{14}C dating on organic matter from the Vulcanello III tuff cone gave an age of 325 ± 100 years BP (Keller, 1970, 1980). Weak fumarolic activity was noticed within this crater until the end of the 19th century.

3. Archeomagnetic sampling, measurements and results

The high-accuracy “large sample” archeomagnetic method was already described in previous works (references in Tanguy et al., 2003). It involves collection of rocks weighing 0.5–1 kg each detached with hammer and cisel and sun-oriented through a plaster plane. These are then measured by means of an adapted rotating inductometer and an alternating field demagnetization device. Such a procedure allows a much better precision

Table 1
Sites sampled on Vulcano and Vulcanello (VN), and Lipari (LP) for archeomagnetic study

Site number	Deposit typology	Presumed age	References for ages
VN 1 a and b	Vulcanello platform (leucite tephrite) to the East of cone I	183 or 126 BC	De Fiore (1922), Keller (1970, 1980) (from Plinius and Strabo writing)
VN 2	Upper leucite tephrite flow from Vulcanello cone I	183 or 126 BC	Same as V 1
VN 3	Pietre Cotte rhyolitic flow on North side of the Fossa cone	1739 AD	De Fiore (1922), Keller (1970)
VN 4, VN 11	Trachytic flow overlying the Vulcanello platform	1625 AD (±100)	^{14}C dating (Keller, 1970)
VN 5	Palizzi trachytic flow on Southern side of the Fossa cone	1600 BP (±1000)	K/Ar dating (Frazzetta et al., 1984)
VN 6	Commenda rhyolitic flow on SSW side of the Fossa cone	785 AD (?)	Frazzetta and La Volpe (1991) (see text)
VN 7	Leucite tephrite flow at the base of Vulcanello cone I	183 or 126 BC	Same as V 1
VN 8	Lower leucite tephrite flow from Vulcanello cone I	183 or 126 BC	same as V 1
VN 9	Superficial lava from Vulcanello platform, NW side	91 BC	Same as V 1
VN 10	Loose scoriae from Vulcanello cone II	91 BC	Same as V 1
VN 12	Upper part of Vulcanello platform, W side	91 BC	Same as V 1
VN 13	Punte Nere trachytic flow at NE base of the Fossa cone	5400 BP (±1300)	K/Ar dating (Frazzetta et al., 1984)
VN 74	Vulcanello platform, SW side at sea level (Porto di Ponente)	183 or 126 BC	Same as V 1
LP 1	Lipari Rocche Rosse obsidian (rhyolitic) flow	776 AD (±100)(?)	By assuming this flow is contemporaneous of a pumice fall ^{14}C dated by Keller (2002) (see text)

See Fig. 1 for location (VN 74 are unpublished data from Tanguy, 1974).

than the classical core-drilling method currently used in paleomagnetism. Moreover it makes impossible any parasitic drilling induced remanent magnetization and guarantees a large homogeneity of the primary thermoremanent magnetization (details in Arrighi et al., 2005; Tanguy et al., 2005).

In the present study a total of 185 large samples were collected on 15 sites from Vulcano Fossa and Vulcanello (Fig. 1 and Table 1, details of sampling in Arrighi, 2004). Samples of 8–23 were taken on each site, distributed over a broad area of several meters or tens of meters in order to avoid possible local disturbances owing to the strong magnetization of the lavas (Tanguy et al., 2005).

Another imperative constraint implies, of course, that materials were emplaced at high temperature (above the Curie point) and not displaced later. The best guarantee with this respect is provided by availability of large quarries or trenches of road which deeply penetrate into the internal parts of lava flows. This is unfortunately not the case at Vulcano, where only one quarry can be found near the front of the Palizzi flow (VN 5, Fig. 1). Thus, good sampling was only possible there and along natural cliffs at the seashore (VN 1, VN 2, VN 7, VN 8, VN 12, VN 13, see results on Table 2). Elsewhere we were constrained to use superficial lava, so that in some cases an unusually large number of samples were

Table 2
Archeomagnetic results (see Table 1 for site numbers)

Site	*N*/*n*	α95 (°)	*k*	*I* (°)	*D* (°)	Magnetic age (years AD)
VN 1 a and b	18/18	1.13	851	50.8	16.6	1180 ± 30
VN 2	11/12	2.06	410	57.8	20.8	1050 ± 70
VN 3	12/23	1.85	480	64.1	−10.6	1720 ± 30
VN 5	13/16	0.94	1693	47.3	17.0	1230 ± 20
VN 6	15/16	5.1	51	46.3	15.8	1250 ± 100 (?)
VN 7	10/10	1.60	767	55.9	21.4	1080 ± 50
VN 8	8/8	1.90	678	58.4	17.3	1000 ± 60
VN 9	12/14	3.0	186	50.7	16.9	1180 ± 70
VN 12	8/11	1.40	1256	47.3	14.6	1230 ± 30
VN 13	15/15	0.92	1543	51.4	15.5	1170 ± 20 or prehistoric
VN 74	7/10	1.78	885	55.3	16.0	1100 ± 60
LP 1 (four sites)	17/26	1.88	327	47.9	15.9	1230 ± 40

N: number of samples selected for calculation of the magnetic direction; *n*: total number of samples; α95: semi-angle of error on magnetic direction at 95% confidence level, *k*: precision parameter (see Tanguy et al., 2003); *I*: magnetic Inclination; *D*: declination (negative value westward). All directions are relocated to the Etna coordinates: 37.75° N, 15° E of Greenwich. Note that the inferred magnetic ages do not take into account uncertainty on the reference curve. See text for VN 6, VN 13, and LP 1.

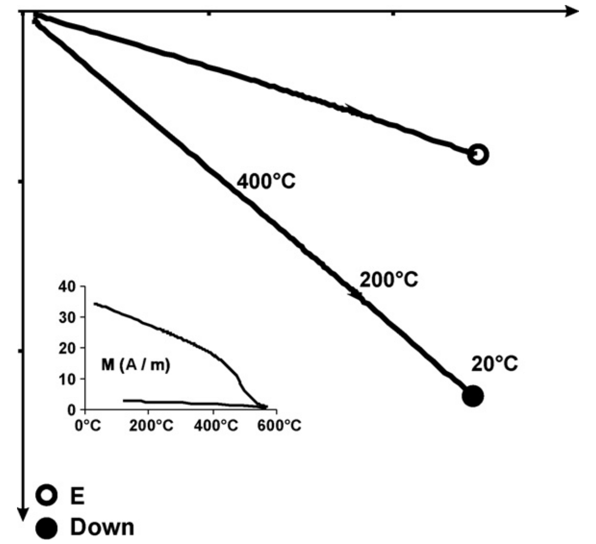

Fig. 2. Continuous thermal demagnetization (211 measurements, LeGoff and Gallet, 2004) of the VN6-232 sample, showing a single component of thermoremanence.

rejected because they appeared to have been displaced during or after cooling (VN 3), or the overall precision is unusually low (VN 6, VN 9). Post-cooling displacement on these sites is attested by the fact that stepwise demagnetization, either thermal or through alternating field, does not reveal any parasitic component (Fig. 2). For the same reason, attempts on pyroclasts from the unique outcrop of the Vulcanello II cone (VN 10), and on the superficial part of the Vulcanello III trachytic flow (VN 4, VN 11) were unsuccessful. This was actually not surprising because field observations showed probable post-cooling displacements (Arrighi, 2004).

As already reported all our samples were sun-oriented and measured by means of the St. Maur large sample inductometer. It was checked on pilot samples that AF demagnetization from NRM to 40 mT produced single component remanent vector going through the origin. The semi-angle of the average paleodirection at the 95% confidence level (α95) was then calculated for each of the sites listed in Table 1.

Despite limitations on the quality of sites as indicated above, the present work brings quite reliable results (Table 2 and Fig. 3). The statistical parameter of precision α95 is comprised between 0.9° and 2.1°, except for two cases (3° for VN 9 and 5.1° for VN 6). The error bars of the ages are obtained by projection of the 95% confidence circles on the reference curve, the accuracy of which is considered better than 20–30 years (Tanguy et al., 2003, 2005). It must be pointed out that for most of the results presented in Table 2, the reference curve is further constrained between the well-dated eruptions of Vesuvius in AD 1139 and Ischia in AD 1302. Similarly, Fig. 3 shows that the VN 3 result is constrained not only by our reference curve, but also by the instrumental measurements between AD 1700 and 1750. All things considered, an overall uncertainty of ±40 years, in average, seems reasonable for the present study. In the following paragraphs, this uncertainty will be expressed as “circa”.

4. Discussion

We will see below that several of our results are consistent with historical records, but all the data regarding Vulcanello were a major surprise because we found no trace of the islet mentioned by Strabo, the lowest outcrop in stratigraphical order being more than a millennium younger. This should indicate, therefore, that this former islet either did not survive for long, or was entirely buried by products of further activity.

4.1. Pietre cotte, Palizzi and Commenda flows

As expected from the literature (De Fiore, 1922; Keller, 1970; Frazzetta et al., 1984), the Pietre Cotte flow VN 3 gives an archeomagnetic age of AD 1720 circa (Table 2 and Fig. 3), which closely agrees with the 1731–1739 eruptive period.

In the same manner, the archeomagnetic age of the VN 5 Palizzi flow (AD 1230 circa) can be considered as consistent with the K/Ar age (Frazzetta et al., 1984) because of the large uncertainty of the latter (between AD 1400 and 600 BC). Conversely, the same VN 5 value disagrees with respect to results obtained through a rather original method based on $^{230}Th/^{226}Ra$ disequilibria (Voltaggio et al., 1995), giving an age of 1500 BP ± 200 years (AD 300–700). However this error bar (at only 1σ level) could be considerably larger, all the more so since the method is based on the assumption that no initial ^{226}Ra is present in the Th-rich accessory mineral dissolved during the leaching procedure. If some Ra was initially present, then the age would be younger, so that this method should be considered as giving only maximum ages (Condomines, personal communication).

The Commenda flow VN 6 (on the Western border of VN 5), was considered to belong to another eruptive cycle, but its magnetic direction is statistically undistinguishable from that of the Palizzi flow, and it could be questioned whether the two flows were emitted during the same eruptive event. We have to consider, however, that the magnetic direction of the Commenda flow is here poorly constrained with an α95 of 5.1° (Table 2), for the

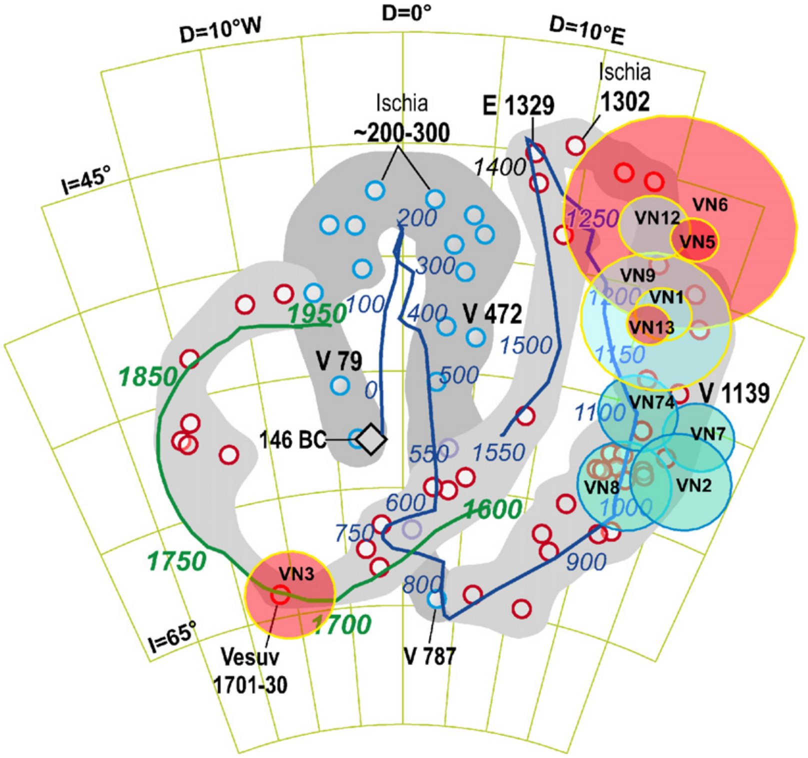

Fig. 3. Stereographic projection of the directional secular variation of the geomagnetic field for the last 2200 years, as reconstructed from Italian lavas (V = Vesuvius, E = Etna, see Tanguy et al., 2003). All directions are relocated to Etna coordinates. Red dots indicate lavas from AD 1950 to 800, blue dots are those from AD 800 to 200 BC, the shaded band represents uncertainty on the curve. Some "benchmarks" coming from well-dated lavas of Etna, Vesuvius, and nearby Ischia, are indicated in bold characters (146 BC is the archeological site of Carthage from Thellier, 1981). The green line indicates instrumental measurements of the geomagnetic direction from AD 1950 to 1600 the blue line is the French archeomagnetic curve (the westward shift of this curve for the period 1100–1400 results from the lack of well-dated archeological sites, data from Gallet et al., 2002). On the diagram are reported as VN the 95% confidence circles of the various sites from Vulcano Fossa (red) and Vulcanello (blue). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of the article.)

reason already emphasized that this flow presents only superficial lava accessible to sampling. The Commenda flow thus deserves further study if forthcoming events, such as landslides, make available a more suitable outcrop.

4.2. Punta delle pietre nere flow

Although the Punte Nere flow (VN 13) presents a magnetic direction similar to those of the preceding lavas, both its much more ancient K/Ar age and its somewhat weathered morphology suggest that it is prehistorical. In fact the geomagnetic field, when going back further into the past, presents increasing cases of ambiguity where its direction can virtually be the same (e.g. Thellier, 1981). Thus, a geomagnetic direction relatively close to that of the VN 13 outcrop seems to have occurred around 1000 BC (Gallet et al., 2002). However, VN 13 remains significantly different from this direction at the 95% confidence level, and no other comparable direction of the geomagnetic field is known for the last 5000 years.

4.3. Vulcanello peninsula

The Vulcanello results are by far the most unexpected of the present study. As shown in Fig. 3, none of the sites investigated could have erupted at the presumed dates of 126 nor 183 BC, their magnetic directions differing by 20° or more from that of the geomagnetic field at the beginning of the Roman epoch (e.g. $I = 58°$ and $D = 3°$ West at Carthage, close to Sicily, in 146 BC, Thellier, 1981, see also Gallet et al., 2002; Evans and Hoye, 2005). According to the magnetic directions presented in Fig. 3 and Table 2, the Vulcanello I cone and its spatter-fed flows (VN 2, 7, 8) were erupted between AD 1000 and 1100. The whole lava platform mostly developed between AD 1100 and 1250 circa (VN 1, 9, 12, see also Fig. 1). The entire building of Vulcanello, therefore, took place more than a millennium later than it was until now believed.

It must be pointed out, also, that these magnetic results are consistent with the stratigraphic succession described in Section 2, showing that the cone I preceded the development of the lava platform, which was mainly produced by the crater II. Thus, the "birth" of Vulcanello was not a single event, but rather a succession of several eruptions, or a long-lived eruptive period. Although magnetic data are not available for the tuff cone III and its trachytic lava (because displaced after cooling, see above), these are obviously much more recent as a quiescence of several centuries was necessary for obtaining a paleosoil at their base. This is further consistent with the scheme of a small magma pocket firstly feeding the leucite tephrite platform and then undergoing differentiation into trachyte at upper level. The previous ^{14}C result leading to the view that the cone III eruption took place around the 1600s (325 ± 100 year BP, Keller, 1970) is thus entirely confirmed.

Besides our results are in full agreement with what is found by sound geological investigations, they are even substantiated by a classical core-drilling paleomagnetic study (Zanella, 1995), although this latter method is much less precise and did not allow to assign a proper age, also because no reference curve was at the author's disposal. When reported on our own reference curve, the two Zanella's results on Vulcano Fossa (Punte Nere and Palizzi flows, $I = 51.1°$ and $44.6°$, respectively, and $D = 17.9°$ and $16.4°$) are in agreement with ours (compare with our Fig. 3 and Table 2, VN 13 and VN 5). Similarly, her four results on Vulcanello ($I = 51–59.7°$, $D = 11.7–37.5°$) support our interpretation, although they do not allow to discriminate between AD 900–1250 and 1400–1550, given their larger uncertainties. Anyway, and despite 95% confidence circles going from 4° to 20°, none of Zanella's results is consistent with the "historical age" of 126–183 BC.

4.4. Further constraints for the medieval age of vulcanello

Because a medieval epoch for the age of Vulcanello seemed at first unlikely, and because the direction of the geomagnetic field is virtually the same in 1000 BC and in AD 1000, it was believed on the basis of a preliminary archeomagnetic sampling (Tanguy, unpublished) that at least a part of Vulcanello was even older than 126–183 BC and close to 1000 BC. If this was the case, then further sampling towards more recent products (upper levels of the stratigraphic succession) should had led to increasing magnetic inclinations as shown by Gallet et al. (2002) for the period from 1000 to 700 BC. On the contrary, the present work demonstrates that magnetic inclination decreases from 58° to 47° when going from the Vulcanello I cone to the upper levels of the lava platform (VN 8–VN 12, Table 2 and Fig. 3). This is by far beyond the admissible error on magnetic measurements and provides further evidence for the medieval age of the entire Vulcanello island.

On the other hand, an age of AD 1200 circa for the Vulcanello platform raises an apparent contradiction, because in some parts of the platform (e.g. VN 9) was observed a fallout of white rhyolitic pumice attributed to an eruption in the neighbouring Lipari island (Keller, 1970). Here a rather strong explosive activity built the Monte Pilato pumice cone, whose deposits in Lipari gave a calibrated ^{14}C age of AD 776 (+110/−90, Keller, 2002). The Mt. Pilato is breached to the NE, where an obsidian lava flow (named Rocche Rosse) was emitted, probably at the end of the eruption (Cortese et al., 1986). If all this activity took place in AD 776, then the Mt. Pilato fallout found at Vulcanello must be below the VN 9 outcrop, and not above it, as it is observed in the field (Arrighi, 2004). However, the archeomagnetic age of the Rocche Rosse flow has been revised through archeomagnetism to AD 1230 ± 40 (Tanguy et al., 2003), suggesting that at Lipari also the recent eruptive activity was rather complex and consisted of several episodes. The new age for the Rocche Rosse obsidian flow is in agreement with a geological study by Dellino and La Volpe (1995), who observed in the inner wall of the Mt. Pilato crater an erosional contact beneath the 20 upper meters of the pumice deposits. Following these authors, the main Mt. Pilato pyroclastic cone, more than 150 m thick on the South wall of the crater, is overlain by a further 20 m thick sequence made of coarse-grained pumice and ash layers containing angular fragments of obsidian. These uppermost deposits could very well correspond to the final, low intensity explosive episode that accompanied the emission of the obsidian flow, and threw light pumice falling on the Vulcanello platform. Our detailed results on the Rocche Rosse flow (LP 1) are shown for comparison in Table 2.

The unexpectedly close grouping of eruptions at both Vulcano and Vulcanello between AD 1000 and 1250 is to be compared to an increased activity at Etna around this epoch, as revealed by archeomagnetic evidence of at least six large eruptions between 950 and 1160 (Tanguy et al., 2003). Similarly, the last event at Vulcanello during the 1600s appears contemporaneous with the period of large Etnean eruptions between 1603 and 1669. Recently, unusual disturbances at other Aeolian islands Panarea and Stromboli in 2002 occurred virtually at the same time as did the most violently explosive eruption displayed by Etna during the last 100 years. Thus, a more reliable chronology of volcanic activity in Southern Italy, such as it results from the present study, brings additional support to some kind of common mechanism for magma movement that could exist at the mantle level between Aeolian Islands and Sicily.

5. Conclusions

High-accuracy archeomagnetic results on recent lavas from Vulcano and Vulcanello give paleodirections of the geomagnetic field with α95 confidence cones usually ranging from 0.9° to 2.1° (two exceptions resulted in 3° and 5.1°). These paleodirections, put on the geomagnetic reference curve established from both archeological materials from Western Europe and volcanics from Southern Italy (Gallet et al., 2002; Tanguy et al., 2003), are consistent with archeomagnetic ages accurate within ±40 years, in average, for the last 1200 years.

At the Fossa cone from the Vulcano island, the last effusive eruption (Pietre Cotte obsidian flow) is found to have occurred in AD 1720 (±30), in agreement with the previous age of AD 1739 deduced from contemporary historical accounts (De Fiore, 1922; Keller, 1970, 1980). On the contrary, instead of what was until now admitted from rather imprecise radiometric dating, the older Palizzi and Commenda trachytic flows appear both contemporaneous around AD 1200, although results on the Commenda flow are poorly constrained and need further checking. The still older Punte Nere flow, despite a paleomagnetic direction close to the preceding ones, could be prehistorical and out of the archeomagnetic dating period of the last 2200 years.

The Vulcanello peninsula, made of three small cones and a tephritic lava platform, results more than a millennium younger than previously believed (126 or 183 BC from unclear greek and latin writing). Following our data which are in accordance with the stratigraphic succession, the pyroclastic cone I erupted around AD 1050 whereas most of the lava platform (and very probably the cone II) were built through continuous activity between 1100 and 1250. Although no archeomagnetic data could be obtained from the ash cone III and its small trachytic flow, the preceding results support a previously suggested eruption during the 1600s (Keller, 1970). An age of AD 1200 circa for the Vulcanello platform deserves comparison with the archeomagnetic dating of AD 1230 recently found for the last eruption in the neighbouring Lipari island (Rocche Rosse obsidian flow).

As already observed on other volcanoes such as Etna or Vesuvius (Tanguy et al., 2003; Principe et al., 2004), the present work casts serious doubts on the modern interpretation of ancient historical accounts, most of them being largely imprecise and unsuitable for identification of the eruptive products. A more reliable chronology based upon high-accuracy methods, such as archeomagnetism, is needed for allowing statistical analyses of eruptive events, magmatic evolution, effusion rates, and maps of volcanic risk.

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