

The shape of Vesuvius before the 79 A.D. eruption according to a new finding from a Pompei fresco and Vesuvius central cone history in the last 2000 years

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Abstract

The history of Vesuvius and its central cone or Great Cone (*Gran Cono*) is important because it enables us to improve our understanding of the structural evolution of Somma-Vesuvius. Apart from geological and stratigraphic studies, investigations of the literary and artistic testimonies can also help to clarify some unresolved problems. Recently a detailed study of the consequences of the 1631 eruption on the volcano morphology as well as that of the following volcanic activity has shown that the present central cone was formed in the last few centuries after that eruption. With regard to the history of the central cone prior to the 1631 eruption, rare writings and iconographic records help clarify this question. In this short communication we announce the discovery of a new image representing Vesuvius before the 79 A.D. eruption identified in a fresco from Pompei excavations. This fresco could confirm the interpretation of a well-known Strabo quotation according to which there already existed a large caldera prior to the 79 A.D. eruption.

Key words *Vesuvius paleomorphology – Vesuvius 79 A.D. shape – Pompei archaeology – history of geology*

1. Introduction

Bearing in mind that the morphology of a volcano is closely related to the type and energy of its eruptive processes, it is possible to follow this relationship for a very long time with regard to Vesuvius, owing both to detailed stratigraphic and structural studies and the large historical records describing its activity. The investigation of these chronicles, in particular over the last

three centuries, has been done to supplement the stratigraphic surveys on Vesuvius deposits and today some detailed eruptive histories of the Neapolitan volcano exist (Arnò *et al.*, 1987; Nazzaro, 1985, 1997; Scandone *et al.*, 1993). As for the history of the Vesuvius central cone in the past centuries, the study of consequences of the 1631 subplinian eruption on the morphology of the volcano and the following shape evolution shows that the volcanic activity can both destroy and rebuild a central cone in the Somma caldera during the time span of about three centuries. Consequently in a very short time, from a geological point of view, the volcano can be affected by large, both shape and volume changes. Therefore it cannot be supposed that the present central cone (Great Cone), except for minor modifications, existed prior to the 79 A.D. eruption (Stothers *et al.*, 1983), or was formed during the same eruption, as sup-

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porters of the Elevation Crater theory have claimed (Von Buch, 1836).

The history of Vesuvius central cone is clearly important for its obvious relation with the history of Somma caldera and can be of great help to understand the morphological and structural evolution of the volcano. Volcanologists put the beginning of Somma caldera formation at the *Pomici di Base* Plinian eruption (Delibrias *et al.*, 1979; Bertagnini *et al.*, 1998), but we must consider that Mercato (8000 year BP) and Avellino (3760 years BP) Plinian eruptions could have caused the largest collapses (Rolandi *et al.*, 1993a,b). Moreover we are led to believe that the strong explosive activity forming the pumice and scoria deposits lying between Avellino and Pompei products (Rolandi *et al.*, 1998) could have contributed to the hollowing out and abate of the Somma caldera. Consequently we maintain that in 79 A.D. a very sunken and low-lying caldera existed and that there was no central cone in Somma-Vesuvius volcano. This shape, which could also explain the unusual southward distribution of the pumice fallout from the 79 A.D. eruption, has recently been supported by the discovery of a very believable, from a volcanological point of view, image of Vesuvius from the Pompei excavations.

2. The Somma caldera and Vesuvius central cone

The Somma-Vesuvius volcanic complex has today two summits. The northern summit (*Punta del Nasone* or *Ciglio*, 1113 m) is the highest part of the ancient volcanic structure, called Somma, a composite volcano characterised by a caldera with a diameter of 4 km whose formation began about 18 500 BP (Bertagnini *et al.*, 1998). The southern summit, a central cone called Vesuvius Great Cone (*Gran Cono*, 1281 m), is situated inside the Somma caldera and, from a structural point of view, it can also be classified as a composite volcano. As regards the history of this central cone and concerning in particular the shape of Vesuvius before 79 A.D. we think that at this time the volcano was represented by the northern Somma Mount with a large caldera and no central cone. Despite the adverse opinion of some authors (Stothers *et al.*, 1983), volcanologists have long thought, beginning with Von Buch (1836) (fig. 1), that a central cone did not exist before the 79 A.D. plinian eruption, according to both geological considerations and a description made by the Greek geographer Strabo who described the volcano without a central cone and with a flat top in-

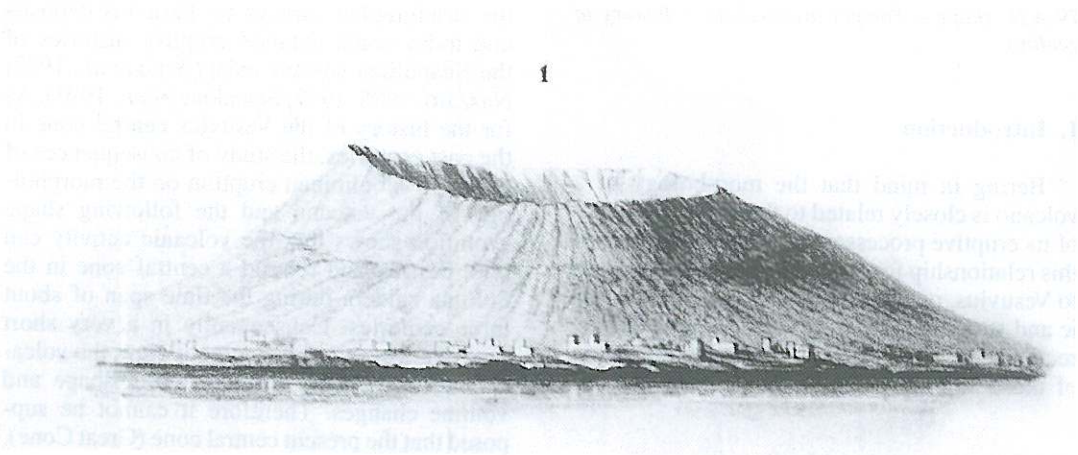


Fig. 1. Vesuvius in 79 A.D. drawn by Von Buch (1836), Palmieri (1880) and Mercalli (1883) following Strabo's description. Note the resemblance with fig. 5c.



Fig. 2a. Vesuvius before 1631 eruption. *Spinacorona* limestone water fountain in Naples, representing the Somma-Vesuvius probably in XII century (Alfano, 1924; Nazzaro, 1997).



Fig. 2b. Vesuvius before 1631 eruption. Painting in the S. Maria delle Grazie a Caponapoli cloister, today *Incurabili* Hospital. The Vesuvius Great central cone is visible in the background of picture (Nazzaro, 1989).

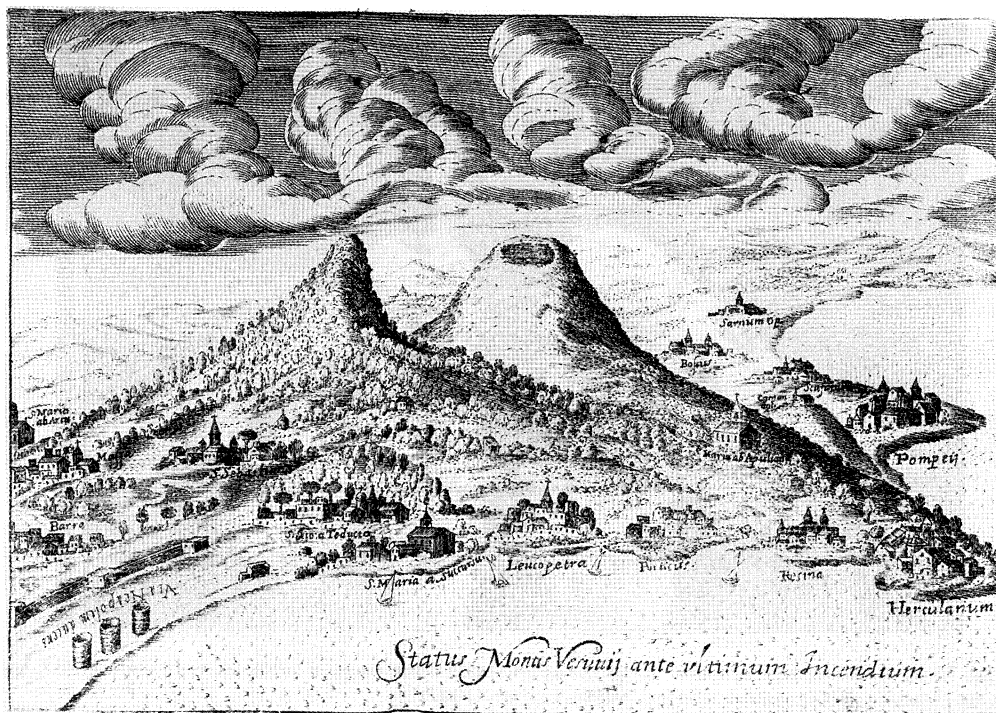


Fig. 2c. Vesuvius before 1631 eruption. The volcano immediately before the eruption is seen from west, at left appears Mt. Somma and at right Vesuvius Great central cone (Masculo, 1633).

terpretable as a large caldera (Palmieri, 1880; Mercalli, 1883; Alfano, 1924).

«(...) Mt. Vesuvio, which, with the exception of his summit, has dwellings all round, on farm-lands that are absolutely beautiful. As for the summit, a considerable part of it is flat, but all of it is unfruitful, and looks an ash colour, and it shows pore-like cavities in masses of rock that are soot-coloured on the surface, these masses of rock looking as though they had been eaten out by fire; and hence one might infer that in earlier times this district was on fire and had craters of fire and then, because the fuel gave out, was quenched.» (Strabo, *Geography*, V, 4, 8).

Recent research (Nazzaro 1997, 1998; Rolandi *et al.*, 1998) also agrees with the assumption that in 79 A.D. the central cone did not exist inside the Somma caldera due to the Avellino plinian eruption and the subplinian events pre-

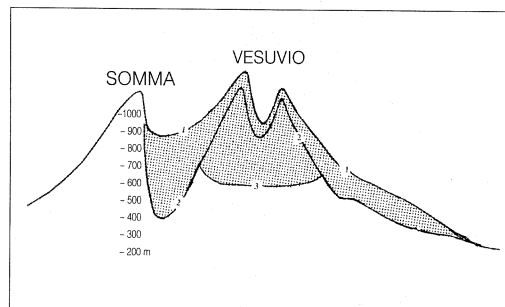


Fig. 3. Somma-Vesuvius as seen from north to south. 1 = Modern Vesuvius profile; 2 = Vesuvius profile before the 16 December 1631; 3 = crater rim after 1631 eruption. The dotted area indicated the volume of erupted rocks from 1631 until 1944 into the Somma caldera, corresponding about to 5 km³ (Nazzaro, 1989, 1997).

ceding the 79 A.D. Pompei eruption. On the other hand, we can observe that Strabo's report of a flat summit and even the path followed by Spartacus within the volcano to escape the Roman siege, can be explained much better by a low flat caldera than a crater bottom (Florus, 1967). Moreover, we here note that during the Roman period the volcano was known only as *Vesuvius*; and the terminological differentiation between *Vesuvius* and *Somma* started after the year 1000 (Bulifon, 1701; Nazzaro, 1998). For this reason we also consider that the Vesuvius central cone (Great Cone) existing before the 1631 eruption (figs. 2a-c) was developed in the middle ages due to the volcanic activity following the strong 472 A.D. eruption. To corroborate our assertions, we can make reference to the morphodynamic effects of the strong explosive eruptions such as the one in 1631. This eruption in fact lowered the volcano by more than 450 m, almost completely destroying the pre-existing central cone (Nazzaro, 1985, 1989). The subsequent activity, from 1631 until the last eruption

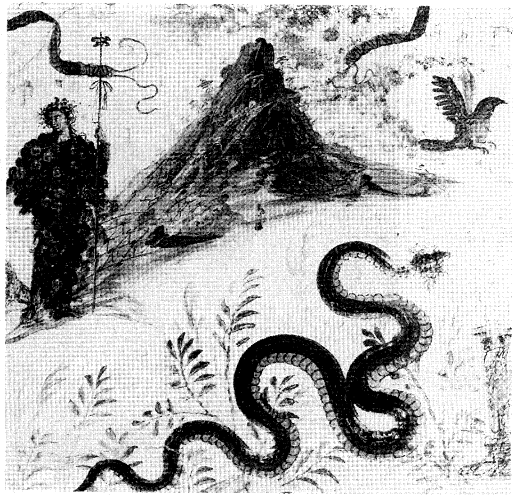


Fig. 4. Fresco from the *House of Centenario* (1.4 × 1.0 m) in Pompei. Archaeologic Museum, Naples. It is generally known as the image of Vesuvius before 79 A.D.

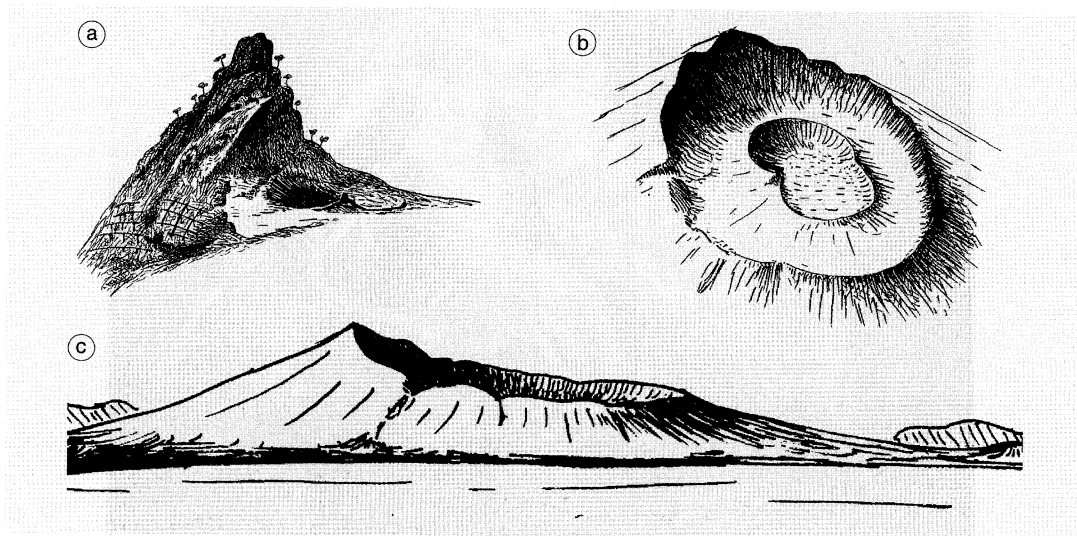


Fig. 5a-c. Images of Vesuvius before 79 A.D. by Scherillo (1982) based on the fresco of fig. 4. Scherillo believes that this fresco does not represent faithfully the volcano at that time and that it does not point out its calderic structure. He thinks instead that the fresco of the *House of Centenario* represents Mt. Somma and the volcano northern summit (a) while (b) and (c) should show respectively the upper and western outlook of the volcano. Figure 5c is practically identical to fig. 1 and fits very well the Vesuvius image in the *House of Citarista* fresco (fig. 6).

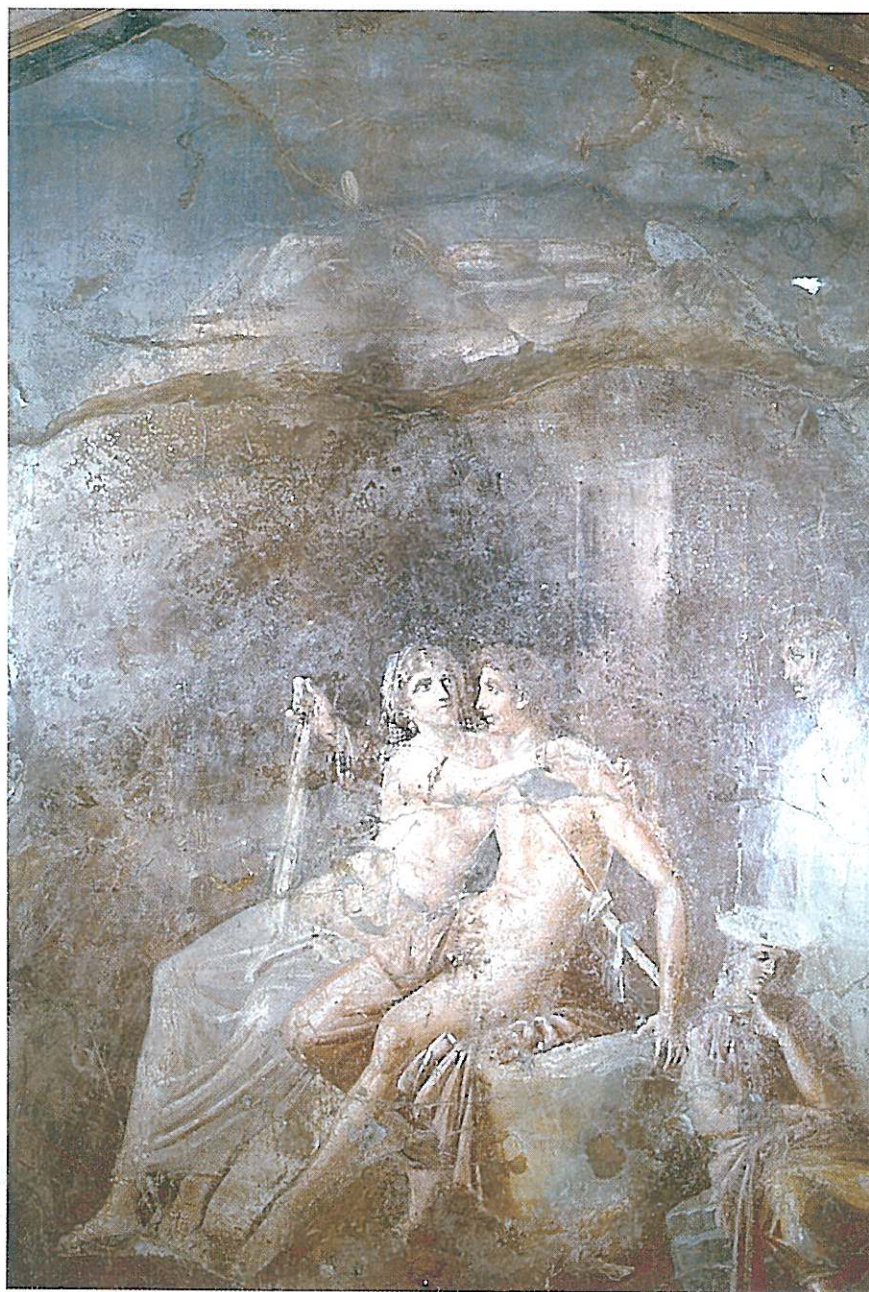


Fig. 6. *Loves of Ares and Aphrodite*, fresco (2.5 × 1.5 m) from *House of Citarista* in Pompei. Archaeologic Museum, Naples. Vesuvius before 79 A.D. as seen from Pompei, *i.e.* from the south, appears in the upper part of the fresco.



Fig. 7. Details of fig. 6. The upper drawing emphasizes the volcano profile. The V-shaped line on the southern side, corresponding to a discontinuity of the volcano structure, is to be noted.

in 1944 formed the central cone as we see it today (the so called *Great Cone*). Consequently, during these three centuries the Somma caldera has been filled up to several hundred meters, and we can infer that, in this time span, the total volume of about 5 km³ of volcanic rocks erupted inside the caldera, corresponding to an average effusion rate of 1.68×10^7 m³/year (fig. 3) (Nazzaro 1997, 1998).

3. Two Pompei frescoes on the Vesuvius shape before 79 A.D.

Getting back to the shape of Vesuvius before the 79 A.D. eruption, in the last century some frescoes from Pompei excavations were thought to represent the volcano as it was at that time (Preusse, 1931), and in particular a fresco from the so-called Centenario House (*Casa del Centenario*) which represents Bacchus near a isolated mountain covered by grape vines (fig. 4). Even though this fresco is still today believed to represent Vesuvius, we have to say that generally only archaeologists and philologists are of this opinion (Sogliano, 1899; Cocchia, 1900-1901; Gigante, 1995). Recently, the Centenario House fresco was accurately analysed from a volcanological point of view and it is believed that it may represent only Mt. Somma (Scherillo, 1982) (fig. 5a-c). This interpretation is now supported by a recent discovery of an image of another Pompei fresco, which has brought to light important new evidence of the volcano's real shape in 79 A.D. It concerns a fresco called Loves of Ares and Aphrodite and comes from the Citarista House (*Casa del Citarista*) in Pompei. In the upper part of this fresco a truncated cone-shaped mountain, which could be Vesuvius before 79 A.D. can be seen very clearly (fig. 6). A volcano calderic morphology with a clear opening 'hollow' is perfectly visible, probably toward Pompei, *i.e.* southwards (fig. 7). This hollow is nowadays not visible as it has been filled up by more recent volcanic materials starting from debris flow deposits within the southern area belonging to the 79 A.D. eruption (Sigurdsson *et al.*, 1985). By the way, a manifest southern angular unconformity between the

oldest volcanic products of Somma and the latest ones of Vesuvius, *i.e.* before and after 79 A.D. Plinian eruption, in *Vallone del Fico* (Nazzaro, 1997), can indicate this break in the caldera structural rim which has finally been supported by recent seismic tomographic study, with regard to an attenuation of the seismic wave velocities down to 500 m below ground level within the southern area of the volcano caldera (Zollo *et al.*, 1996). The concordance between the fresco of Citarista House, the figure deduced by Scherillo (1982) (fig. 5c) and the interpretation of Von Buch and subsequent volcanologists of Strabo's description (fig. 1) is very surprising and provides further evidence that the image from Citarista House reproduces in a very realistic way the shape of the volcano before 79 A.D. The fresco has been in the National Archaeological Museum of Naples for a long time, but nobody until now has noticed its fascinating hidden secret.

4. The anomaly of the 79 A.D. Plinian eruption isopaches

The ancient Vesuvius shape, that we have discussed so far could also explain a well-known anomaly concerning the distribution of pumice fallout from the 79 A.D. Plinian eruption. In fact, we know that the dispersion axis of the fallout products from all of the Somma-Vesuvius eruptions was eastward, with the exception of the 79 A.D. eruption who's products were dispersed towards the south (Lirer *et al.*, 1973). A possible explanation of this anomaly could be found if we accept that the morphology of the volcano and in particular the shape, dimension and the height a.s.l. of the eruptive vent represent an important initial condition which could have influenced the phenomenology and characteristics of the 79 A.D. eruption. We think in particular that the pumice column of this eruption could have been thrown out in the lower atmosphere, rather than in a stratospheric region controlled by eastward winds, due to the particular shape of the volcano as discussed above, *i.e.* characterised by an eruptive vent in a low collapsed caldera.

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