

THE VESUVIUS POMICI DI AVELLINO PLINIAN ERUPTION AND RELATED PHENOMENA: EFFECTS ON THE BRONZE AGE LANDSCAPE OF CAMPANIA REGION (SOUTHERN ITALY)

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ABSTRACT: The Vesuvian Pomici di Avellino eruption affected an area densely inhabited by Early Bronze Age human communities and resulted in the long term abandonment of an extensive zone surrounding the volcano. The study of geological and archaeological sequences have yielded an understanding of the eruption local effects and of their duration. The territory was rapidly abandoned during the eruption. Only few settlements were found of phases 1 and 2 of the Middle Bronze Age in most of the area affected by the eruption. We interpret this as due to diffuse phenomena of remobilization of the erupted pyroclastics, generating long lasting alluvial processes. A significant resettlement of the territory occurred only hundreds of years after the eruption, during phase 3 of the Middle Bronze Age.

KEYWORDS: Plinian eruption, volcanoclastic mass flow, Vesuvius, bronze age, eruption impact

1. INTRODUCTION

Plinian eruptions are among the most dangerous natural phenomena for human life and the environment, characterized by very energetic and sustained explosive phases generating convective plumes and whose instability and collapse can generate pyroclastic density currents. They also produce secondary phenomena, not directly connected to the eruption itself, like, volcanoclastic mass flows (lahars) generated by the remobilization of pyroclastic deposits that can occur in areas very far from the vent and even centuries after an eruption.

The Pomici di Avellino eruption (hereafter PdA, $3,945 \pm 10$ cal yr BP) is one of the four Plinian eruptions of Vesuvius, considered one of the most explosive Holocene events in the Mediterranean area. The eruption and related phenomena affected a wide and densely inhabited area in the Early Bronze Age (hereafter EBA) (Di Vito et al., 2018 and references therein).

In this paper we present the results of volcanological and archaeological investigations concerning the impact of the PdA eruption and related volcanoclastic mass flows, in order to reconstruct the human abandonment and resettlement dynamics of the Campania region, during the Early and Middle Bronze Age.

2. MATERIAL AND METHODS

Combined volcanological and archaeological studies has permitted to understand the relationship between human settlements and natural hazards (Di Vito et al., 2009; Di Lorenzo et al., 2013; de Vita et al., 2013; Romano et al., 2013; Vingiani et al., 2017; Di Vito et al., 2018).

The integration of volcanological and archaeological data from literature and the analysis of sequences in

recent excavations permitted the creation of a dataset with information on more than 300 sites in the Campanian Plain and in the surrounding Apennine valleys. Particular attention has been paid to the emplacement mechanisms of volcanic and volcanoclastic deposits, in order to analyse the effects of the eruption and of the secondary environmental processes on the Palma Campania culture settlements pre-existing to the PdA eruption. The integration of stratigraphic and archaeological investigations also permitted to evaluate the time of reoccupation of the territory.

3. RESULTS

The Campanian Plain, and especially the lowlands surrounding Vesuvius, was densely inhabited by communities of farmers and pastoralists belonging to the EBA Palma Campania culture. All of the most important remains of this culture have come from the numerous villages buried by variable deposits of the PdA eruption (Fig. 1). Some of these settlements were of considerable extent.

In some places there are evidence of attempts of resettlement soon after eruption (green dots in fig. 1).

The PdA eruption occurred during the EBA and in particular between the end of the twentieth and the beginning of the nineteenth century BC (Passariello et al., 2009, 2010; Sevink et al., 2011). According to Di Vito et al. (2009), the eruption can be divided into five eruption units (EUs) emplaced during three phases: opening, Plinian and phreatomagmatic.

The opening phase was characterized by a low eruption column that emplaced thin ash layers (EU1) distributed toward the East of the vent; the Plinian phase generated a 23-to-31 km high eruption column, that emplaced widely distributed pumice fallouts deposits (EU2,

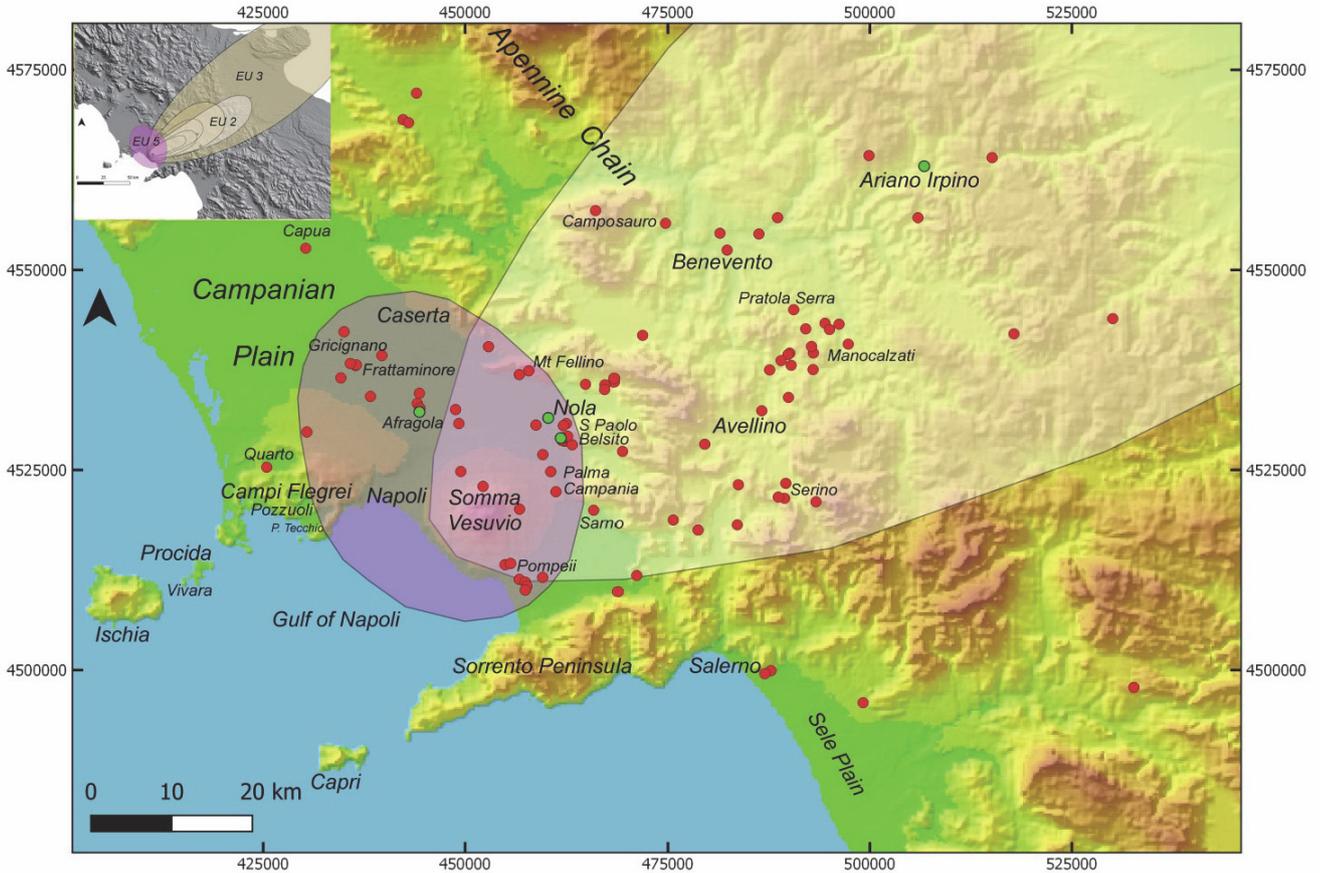


Fig. 1 - Early Bronze Age settlements. Red dots indicate the sites existing before the Pomici di Avellino eruption; green dots indicate those sites in which there are also evidences of resettlement soon after the eruption. The total distribution of the Pomici di Avellino deposits is reported for reference: PDC deposits in purple; fallout deposits in white. In the inset the total distribution of the Pomici di Avellino deposits. (modified after Di Vito et al., 2018).

EU3 and EU4 – Fig. 1), and ended with a caldera collapse. The last phreatomagmatic phase was dominated by pulsating phreatomagmatic explosions that produced both pyroclastic density currents and minor fallout deposits (EU5 – Fig. 1). These deposits can be divided in four subunits (EU5a-d), that correspond to at least four explosive episodes, separated by short pauses during the eruption. Human and animal footprints and hoofprints have been found at different heights in EU5 unit and testify to some migration episodes during the final phases of the eruption (Di Vito et al., 2009).

The eruption caused also a general hydrogeological destabilization of the territory, which generated lahars, debris flows and alluvial processes in a wide area. In archaeological excavations and in natural exposures, the presence of soils or unconformities between the primary and secondary deposits, or within the secondary deposit has been used to distinguish among syn-eruptive (according to the definition of Sulpizio et al., 2006) and inter-eruptive lahars, debris flows and alluvial deposits. In fig. 2 we report only the sites containing syn-eruptive debris flow deposits. They are composed almost exclusively of fragments from PdA eruption.

4. DISCUSSION AND CONCLUSIONS

The analysis carried out in an area of about 3.000 km2 and on at least 300 investigated sites shows that before the PdA eruption Campanian Plain was more or less occupied by Palma Campania facies settlements. The first effect of the eruption is that the following facies, that is the Proto Apennine facies (Middle Bronze Age 1 and 2), is almost completely missing in the area, covered by primary and secondary deposits; instead there are evidence of a continuity of human presence, with the two archaeological facies, in few sites far from the areas interested by the main deposition of the PdA primary and secondary products (Fig. 2) or along the coastal area of the Gulf of Naples, where an increase in the settled sites is seen.

Therefore, from the period immediately following the PdA eruption and for at least a couple of centuries, the population declined in almost the entire area affected by the eruption and related phenomena. This seems to have occurred regardless of the distance from the vent and the local impact of the eruption phenomena on the environment and human settlements. This population decline might have also been caused by adverse

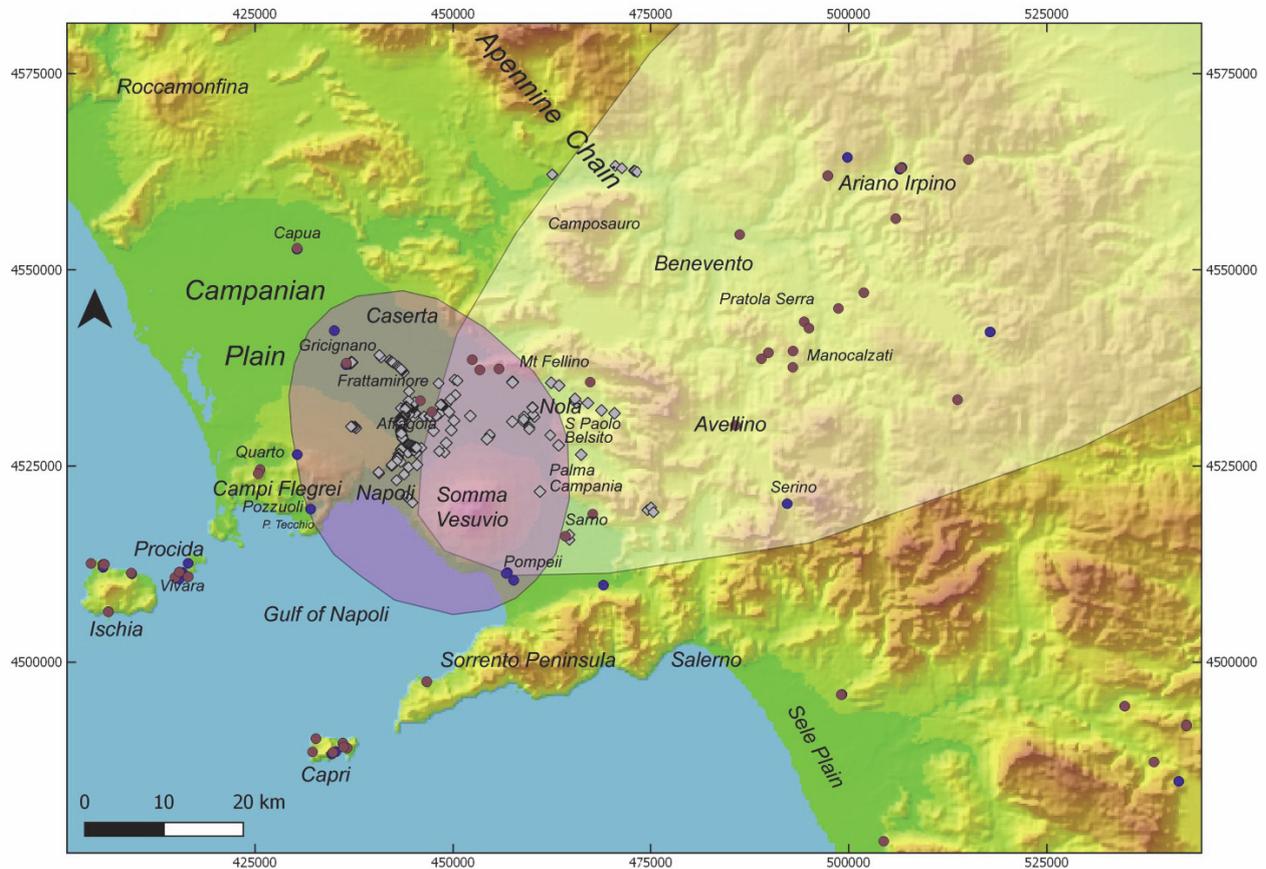


Fig. 2 - Location of the Middle Bronze Age 1, 2 (ProtoApennine 1 and 2 facies, blue dots) and 3 sites (Apennine facies, red dots). The total distribution of the Pomici di Avellino deposits is reported for reference, as in Fig. 1. Grey diamonds indicate the sites at which the syneruptive volcanoclastic mass flow deposits have been recognized. The total distribution of the Pomici di Avellino deposits is reported for reference, as in Fig. 1 (modified after Di Vito et al., 2018)

climatic conditions, which soon after the eruption increased the area's hydrogeological instability, with generation of huge, frequent and widely distributed lahars (Fig. 2, see distribution of grey diamonds). This period was followed by a climate deterioration that would not have favored agriculture in the zone (Zanchetta et al., submitted).

Furthermore, all along the coastal area, even though the crisis triggered deep changes, it did not lead to a total de-structuring of the territory and, after a short period, a new equilibrium seems to have been reached.

A significant resettlement of the territory occurred only hundreds of years after the PdA eruption, during phase 3 of the Middle Bronze Age (Apennine facies), during a period of favourable environmental conditions.

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