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Estimation of deposition temperature of the Pomici di Avellino (Somma-Vesuvius, 3.8 ka BP) products at Afragola village (Naples, Early Bronze Age): understanding the anomalies of TRM carried by potsherds embedded in the PDC deposits

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Rescue archaeological excavations brought to light the remains of a Bronze Age village close to the town of Afragola (Naples, Italy), partially destroyed and buried by pyroclastic density currents (PDCs) of the Pomici di Avellino eruption (Somma-Vesuvius, 3.8 ka BP) and subsequently sealed by alluvial deposits.
A previous investigation of the PDCs which buried the Afragola village during the Pomici di Avellino eruption, comparing volcanological and archaeological stratigraphies, showed that the currents were not destructive in the Afragola area, but thermoremanent magnetization (TRM) data indicate they were still hot enough to cause death or severe injury to humans and animals. Although most of the deposition temperatures estimated throughout the village were between 260 and 320 °C, anomalous values were observed in some potsherds taken from Hut 1, Hut 12 and Hut 17.
In order to understand the heterogeneous magnetic behavior of potsherds in the excavated portion of the village a new set of samples embedded in the PDC deposits were taken. A total of 40 potsherds underwent petrographical, mineralogical, chemical and TRM analysis. In addition, a selection of 8 samples with strong differences in TRM, from various locations in the excavated area was analyzed with Mössbauer spectroscopy.
The potsherds were produced with non-calcareous clays relatively rich in iron ($Fe2O_3$tot = 7 – 9 wt.%, XRF). Three pottery fabrics were distinguished in thin section, characterized by the presence of grog (Fabric 1, 10 samples), few volcanic inclusions (Fabric 2, 29 samples) and fine quartz sand (Fabric 3, 1 sample). In Fabric 1 and Fabric 3 a prevalently oxidizing atmosphere occurred during firing, while a prevalently reducing atmosphere characterized the Fabric 2. Mössbauer spectroscopy showed that no macrocrystalline magnetic phases are present and iron nanophases account for the magnetic behavior of the potsherds. Moreover, oxidized sherds contain only Fe(III) in two different sites and the reduced ones include also variable amounts of Fe(II). These results agree with medium to low sintering inferred from the microstructures of the ceramic body, as well as the bulk mineral content (XRD). Although the Curie point of the samples falls between 500 and 580 °C (TRM), this cannot be ascribed to magnetite of volcanic or of firing origin (T > 800 °C and reducing atmosphere required). It follows that the magnetization of the potsherds was mainly due to maghemite as a phase newly formed during firing. The demagnetization path of each sample obtained by TRM analysis revealed more or less complex thermal histories, ranging from samples carrying only primary TRM (thermal insulation during PDC deposition) to samples showing both primary and secondary TRM due to reheating during PDC deposition and/or pottery use.
In conclusion, the heterogeneous magnetic behavior of the potsherds was a consequence of both their technological characteristics and their position in the stratigraphic succession. Care should be exercised in the use of pottery to infer the deposition temperature of PDCs by TRM analysis, since its magnetic behavior is not only determined by the raw materials, but also by their processing and firing. Moreover, the original function of the pottery vessels may complicate the thermal history of the samples and lead to a misleading interpretation of the data.