RESEARCH FIELD:
Geophysics

RESEARCH TOPIC:
Paleomagnetism applied to volcanology

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RESEARCH DESCRIPTION

This research is subdivided into more applications, all addressed to better define the emplacement mechanisms of volcanic products, providing physical parameter for eruptive scenarios modelling.
The first application, currently direct to Vesuvius, Phlegrean Fields, Santorini island, Colima and El Chichón volcanoes, concerns the emplacement temperature estimate of the pyroclastic deposits from Recent eruptions, by progressive thermal demagnetization of both lava framents and archaeological artefacts (tiles, pottery) embedded during pyroclastic flow (Fig. 1).
The second application deals with the study of the magnetic fabric of the Vesuvius and Phlegrean Field's pyroclastic deposit matrix and of the Central Anatolian ignimbrites. Magnetic fabric provides pyroclastic flow direction indications, which can be used to locate the eruptive vent and to evaluate the paletopographic effect on the emplacement (Fig. 2).
The pre-eruptive morphology is a main constrain factor on the lava emplacement dynamics. The city of Clermont-Ferrand is an example. Here, lava flows may have formed a natural barrier in the valley which may have entrapped subsequent flows.

The last application is classical in paleomagnetism and it bases on the paleomagnetic directions recorded by volcanic propducts during their emplacement. These directions may be used to build the Earth's magnetic field paleosecular variation curves, which is a tool at the regional scale for temporal correlations (Fig. 3).
In favorable anthropic settings, as in the archaeological excavations in volcanic area (Pompeii and Herculaneoum, the Bronze age village in the Campanian plain), but also in town and villages next to active volcanoes, paleomagnetism is employed in multidisciplinary studies to unravel the interactions between anthopic structures and pyroclastic or lava flows and to provide constrain for the volcanic risk evaluation.

LABORATORIES OF THE DST IN USE:

Rock preparation laboratory
Alpine Laboratory of Paleomagnetism (Peveragno)

RESEARCH PRODUCTS:

Singer B.S, Guillou H., Jicha B.R., Zanella E., Camps P., 2014, Refining the quaternary Geomagnetic Instability Time Scale (GITS): lava flow recordings of the Blake and post-Blake excursions. Quaternary Geochronology, 21, 16-28, doi:10.1016/j.quageo.2012.12.005

Airoldi G., Muirhead J.D., Zanella E., White J.D.L., 2012, Emplacement process of Ferrar Dolerite sheets at Allan Hills (South Victoria Land, Antarctica) inferred from magnetic fabric. Geophysical Journal International, 188, 1046-1060, doi9:10.1111/j.1365-246X.2011.05334.x

Zanella E., Cicchino A., Lanza R., 2012. Composite detrital and thermal remanent magnetization in tuffs from Aeolian Islands (southern Tyrrhenian Sea) revealed by magnetic anisotropy. Int. J. Earth Sci., 101, 841-848, DOI 10.1007/s00531-011-0651-5.

Cicchino A., Zanella E., De Astis G., Lanza R, Lucchi F., Tranne C.A., Airoldi G., Mana S., 2011. Rock magnetism and compositional investigation of Brown Tuffs deposits at Lipari and Vulcano (Aeolian Islands – Italy). J. Volcanol. Geotherm. Res., DOI 10.1016/j.volgeores.2011.08.007, 208, 23-38.

Di Vito M., Zanella E., Gurioli L., Lanza R., Sulpizio R., Bishop J., Tema E., Boenzi G., Laforgia E., 2009. The Afragola settlement near Vesuvius, Italy: The destruction and abandonment of a Bronze Age village revealed by archaeology, volcanology and rock magnetism. Earth Planet. Sci. Lett., doi:10.1016/j.epsl.2008.11.006

Sulpizio R., Zanella E., Macias J.L. 2008. Deposition temperature of some PDC deposits from the 1982 eruption of El Chichón (Chiapas, Mexico) inferred from rock-magnetic data. J. Volcanol. Geotherm. Res., 2008, doi:10.1016/j.volgeores.2008.02.024

Zanella E., Gurioli L., Lanza R., Sulpizio R., Bontempi M., 2008. Deposition temperature of the AD 472 Pollena pyroclastic density current deposits, Somma-Vesuvius, Italy. Bull. Volcanol., DOI 10.1007/s00445-008-0199-9

Gurioli L., Zanella E., Pareschi MT, Lanza R., 2007. Influences of urban fabric on pyroclastic density currents at Pompeii (Italy): 1. flow direction and deposition. J. Geophys. Res., B05213,
doi: :10.1029/2006JB004444

Zanella E., Gurioli L., Pareschi M.T., Lanza R., 2007. Influences of urban fabric on pyroclastic density currents at Pompeii (Italy): 2. Temperature of the deposits and hazard implications. J. Geophys. Res., 112, B05214, doi:10.1029/2006JB004775

Gurioli L., Pareschi M.T., Zanella E., Lanza R., Deluca E., Bisson M., 2005. Interaction of pyroclastic density currents with human settlements: evidence from ancient Pompeii. Geology, 33, 6, 441-444.

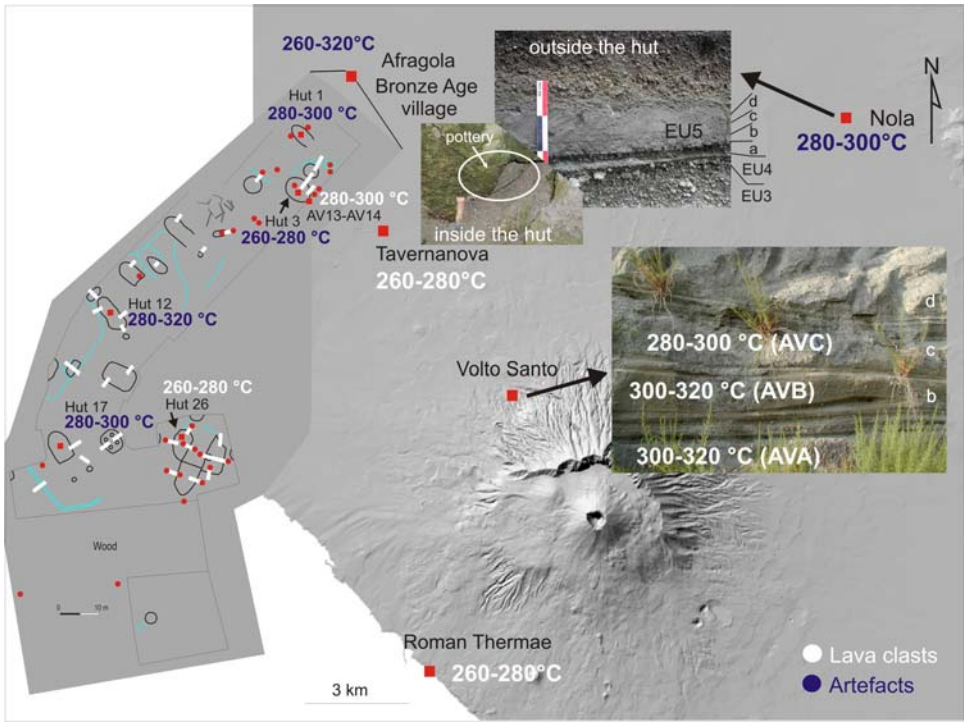

Fig. 1. Emplacement temperature estimate of the Avellino eruption deposits (Somma-Vesuvius) recorded by pottery and lava fragments in the Afragola Bronze Age village and in the circumvesuvian area (from DeVito et al., 2009, *Earth Planet. Sci. Lett*.)

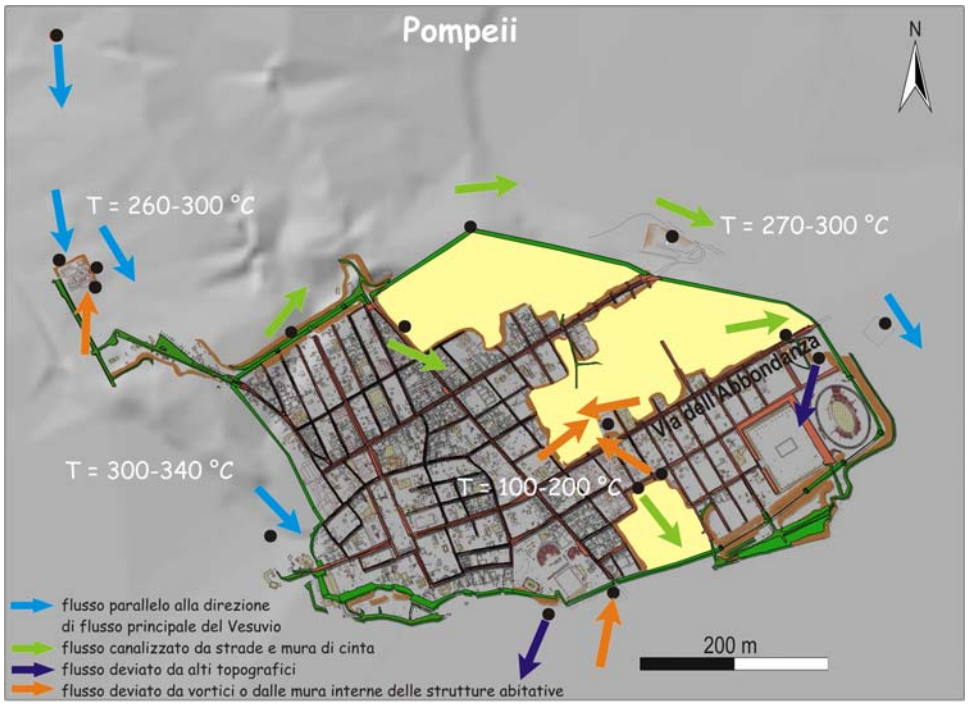

Fig. 2. Flow directions recorded by the magnetic fabric of the AD 79 Pompeii eruption deposit matrix (Somma-Vesuvius) (modified by Gurioli et al., 2005, *Geology*)

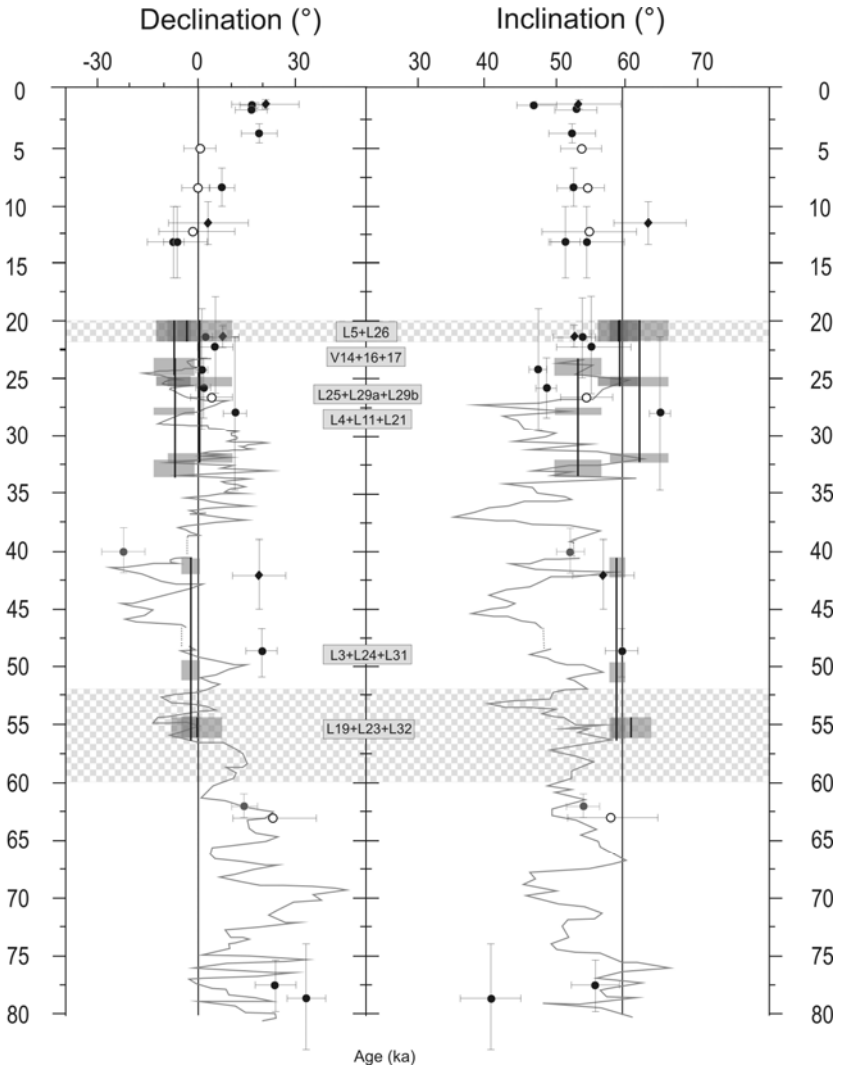

Fig. 3. Paleomagnetic directions recorded by the Brown Tuffs pyroclastic deposits successions at the Aeolian Islands reported on the paleosecular variation curves of the Tyrrhenian area (Cicchino et al., 2011, *J. Volcanol. Geotherm. Res*.)

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