

Distal tephra layers from Campania volcanic sources as markers within Late-Middle Pleistocene stratigraphic successions

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Accurate and precise chronologies are fundamental requirements for understanding how the climate system works at different time scales and for providing reliable natural benchmarks for modelling future projections. However, achieving robust time-frames in natural archives remains a challenging task. Lacustrine successions hosted in tectonic basins of central Italy have demonstrated to be precious archives of paleoclimate histories, possessing high quality proxy series anchored to independent time-scales based on high-precision $^{40}\text{Ar}/^{39}\text{Ar}$ dating of tephra. These successions can also offer the opportunity to “spread out” chronology over and beyond the Mediterranean, via direct tephrostratigraphic synchronizations.

Following the increasing need to find chronostratigraphic markers that allow land-sea and large-scale correlations based on palinspastic reconstructions, in the last two decades many papers have been aimed at improving the level of tephrostratigraphic knowledge concerning mainly the Middle Pleistocene. Among these, we can quote the results of the researches that constrained the age of sedimentation in the intramountain basins of Vallo di Diano (Marine Isotope Stage - MIS 15-14, Karner et al., 1999), Acerno (MIS 14-13, Petrosino et al., 2014a), Mercure (MIS 14, Petrosino et al., 2014b; Giaccio et al., 2014), Sessano (MIS13-12, Russo Ermolli et al., 2010), and Boiano (MIS 13-2, Amato et al., 2014) and in the marine succession of Montalbano Ionico (MIS 30-16, Petrosino et al., 2015). The main spillover effect of these works was the need to acquire new stratigraphic and chemical data on the glasses extracted from the products of the main explosive eruptions that occurred in the Middle Pleistocene at the single sources active at the time, in order to update and enrich the database of the terrestrial counterparts used for comparison. This need becomes particularly pressing for the volcanism of the Campania area before the eruption of Campanian Ignimbrite (40 ka - Giaccio et al., 2017a), about which the knowledge is scarce and very fragmentary because, being volcanism still active, older products in the proximal areas are buried by those of more recent activity, and outcrop only to a limited extent in the intermediate sites. At the same time, the need has arisen to find new analytical techniques that allow to characterize in a complete and univocal way an unknown level of tephra. Among these, the determination of isotopic compositions can be a new and powerful tool to support traditional geochemical identification or even be a correlation tool itself in those cases

where geochemistry alone cannot discriminate among the possible volcanic sources (e.g., Giaccio et al., 2013, 2014, 2017b; D'Antonio et al., 2016).

The present research project, which is part of the PRIN 2017 FUCINO Tephrochronology Unites Quaternary REcords - FUTURE project (national principal investigator Giovanni Zanchetta, local principal investigator Massimo D'Antonio) aims, therefore, to study in detail the chemistry of distal products older than Campanian Ignimbrite sourced at Campania volcanoes and embedded in the lacustrine sequences of Fucino and other Middle Pleistocene basins, as well as to find and characterize with the same approach the possible proximal to medial counterparts. Through the systematic study of tephra layers (chemical composition of major and trace elements, isotopic ratios $^{87}\text{Sr}/^{86}\text{Sr}$ and $^{143}\text{Nd}/^{144}\text{Nd}$, $^{40}\text{Ar}/^{39}\text{Ar}$ dating) occurring in the lacustrine successions of the Upper- Middle Pleistocene of the Apennine basins - supplemented by studies on the primary deposits older than Campanian Ignimbrite outcropping in the proximal to intermediate areas of the Campania volcanoes, in this project we intend to contribute to assemble a high-resolution and independently dated record for the Middle Pleistocene. For the purposes of paleoclimate studies this could represent a very important result, because it would allow to better circumscribe periods such as the so called Mid-Brunhes Event (ca. 450 ka), which represents the culmination of a series of modifications of the Earth's climate system started ca. 1.4 Ma that resulted in a progressive increase of the length of the climatic cycles (from ~41 ka to ~100 ka) and of the amplitude and asymmetry of the interglacial-glacial climatic excursions.

Proposal for a PhD position

The PhD proposal plans to carry out a systematic investigation of the Campania volcanic products older than Campanian Ignimbrite (40 ka) cropping out in proximal-intermediate areas with respect to the possible sources (Campi Flegrei, Somma-Vesuvius), aimed at identifying the possible terrestrial counterparts of the distal tephra layer sourced at Campania volcanoes. In the first phase of the research the PhD student will carry out a field survey devoted at finding and describing in detail the outcropping stratigraphic successions. These will be then sampled throughout, and the glass fraction of juvenile fragments will be analyzed by the same methodologies used for distal tephtras (es. Electron Microanalysis EDS and WDS for major elements, Laser Ablation-ICP-MS for trace elements). Trace element analyses will be carried out at the Dipartimento di Fisica e Geologia of University of Perugia, in collaboration with dr. Maurizio Petrelli. The PhD student will further perform isotopic analyses on juvenile glass and minerals extracted from tephra levels to complete the chemical characterization and contribute to define the sources, using the

analytical facility (Multi-Collector Thermal Ionization Mass Spectrometer Triton Plus) recently acquired by DiSTAR. New $^{40}\text{Ar}/^{39}\text{Ar}$ dating will be carried out in collaboration with dr. Brian Jicha at the Department of Geoscience of the University of Madison, Wisconsin (USA) on the investigated eruptive products whose age is still unknown. The results obtained will be integrated with those on the distal tephra to identify which outcropping deposits can be the terrestrial counterparts of main tephrostratigraphic markers and provide new constraints to refine the construction of a tephrostratotype for the Middle-Upper Pleistocene.

Progetti

PRIN 2017 FUCINO Tephrochronology Unites Quaternary REcords - FUTURE project (responsabile nazionale prof. Giovanni Zanchetta, responsabile locale prof. Massimo D'Antonio)