Research activity

The study of tephra layers from marine and terrestrial environments is a very powerful tool in volcanology for studying past eruptive events, reconstructing long-term eruption histories and constraining the timing and dynamics of explosive eruptions (Lowe, 2011). Near-vent volcanic successions commonly provide fragmentary records of past eruptions, due to volcanic and sedimentary processes they experience (Albert et al., 2019). In this context, tephrochronology can be used to acquire a better knowledge of past explosive activity, through the correlation of distal and proximal deposits to volcanic source areas. Campanian volcanoes have widespread distal records in the Mediterranean area (e.g. Y-3 and Neapolitan Yellow Tuff eruptions). In particular, the Campi Flegrei, a Holocene caldera west of Naples, is one of the most productive volcanoes, with a volcanic history including large-magnitude eruptions (e.g. Campanian Ignimbrite, 39 ka; Neapolitan Yellow Tuff, 15 ka). A lot of research has been done on the large-magnitude eruptions and on the history of the last 15 ka (Di Vito et al., 1999; Smith et al., 2011).

However, volcanic record of the eruptions occurred before Neapolitan Yellow Tuff and Campanian Ignimbrite eruptions is largely incomplete. In fact, recent studies (Albert et al., 2019; Donato et al., 2016; Giaccio et al., 2012; Monaco et al., submitted) revealed the presence of widespread ash layers in distal tephrostratigraphic record (i.e., up to hundreds of thousands of km^2 of ash covering, tens of km^3 dense rock equivalent of the magma erupted and VEI>6; Albert et al., 2019) which reduces drastically the reoccurrence interval of large-magnitude events at Campi Flegrei caldera. However, a full reconstruction of eruptive dynamics and modeling of these large-magnitude eruptions still lacks.

In summary, the recent literature on tephrostratigraphic records of large-magnitude eruptions demonstrates that the knowledge of the Campi Flegrei volcanic record is largely incomplete. This has important implications in the estimate of recurrence times of explosive activity and volcanic hazard assessment, due to the increase of the probability of large-magnitude events.

Thus, a better understanding of these events in the volcanic activity appears to be essential to provide future eruptive scenarios. Moreover, the genesis and ash dispersal modeling of these poorly known eruptions are still lacking. Further studies to model their dispersal, eruption parameters and dynamics must be carried out to know their scale and the hazard of similar eruptions in the future.

General objectives of the research:

- Improving the knowledge of large-magnitude eruptions occurred in the central Mediterranean area from proximal to distal tephrostratigraphic records;
- Providing a deeper knowledge of the dynamics and dispersal of past large-magnitude eruptions in the central Mediterranean area.

Specific objectives:

- Tephrochronological study and correlation of distal and proximal deposits from large-magnitude eruptions;
- Reconstruction of the volume, magnitude and eruption dynamics through 2D or 3D ash-dispersal Eulerian models (HAZMAP or FALL3D);

- Evaluation of the hazard associated to ash fall dispersal and of potential hazard by inhalation exposure (e.g., by determining the hydroxyl radical production and iron release).

The research includes a suite of field activities, laboratory analyses and numerical modellings to reconstruct the eruption dynamics and to model ash fall and ash dispersal mechanisms.
The results obtained in this project will help the scientific community to reconstruct the eruptive history of the Campi Flegrei volcano with greater details and completeness. This study will improve current research in tephrochronology and provide new constraints on recurrence times of large-magnitude eruptions in the central Mediterranean area. The research will provide the basis to model future eruptive scenarios and to assess the hazard of high-magnitude events in proximal and distal settings.

References

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