Geophysical Research Abstracts
Vol. 20, EGU2018-8988, 2018
EGU General Assembly 2018

Thermal behavior of pyroclastic density currents by means of charcoal reflectance proxy: application to present and past eruptions at Vesuvius, Fogo, Colima and Merapi volcanoes

Sveva Corrado (1), Chiara Caricchi (2), Guido Giordano (1), Alessandra Pensa (3), Claudia Romano (1), Matteo Trolese (1), and Alessandro Vona (1)

(1) Roma Tre University, Dept. of Sciences, Roma, Italy (sveva.corrado@uniroma3.it), (2) Istituto di Geofisica e Vulcanologia, Roma, Italy, (3) Centro de Geociencias, Universidad Autónoma de México, Ciudad de México, Mexico

Knowing the thermal state of pyroclastic density currents (PDCs) is crucial for hazard assessment and provides important clues about their eruptive, transport and emplacement histories. The emplacement temperature of PDCs can be strongly influenced by the initial eruptive temperature, the size and provenance of PDC constituents, the extent of air ingestion, cooling during transport,
sedimentation rate and magma-water interaction.
We investigated the temperature distribution of PDCs produced during two recent and two past eruptions, well known for their destructive power at volcanoes developed in different geodynamic settings. They are: 1. the ca.4.6 ka Fogo A plinian eruption sequence at Sao Miguel Island (Portugal); 2. the 79 AD eruption at Vesuvius (Italy), renown for the destruction of Roman villas; 3. the explosive outburst at Merapi (Indonesia) on 5th November 2010; 4. the eruption at Volcàn de Colima (Mexico) on the 10th -11th July 2015.
We performed optical analyses on charcoal fragments embedded into PDCs deposits, derived from trees and woody human artifacts. Samples were collected at varying distances from the vent in different paleo-topographic settings to study the changes in emplacement temperature as a function of the distance from the source, verifying the feedback between topography and thermal history.
The main results are:
1. For the Fogo A plinian eruption, two successive ignimbrites composing the sequence (an intraplinian pink ignimbrite, partially filling narrow paleo-valleys and the climactic dark brown ignimbrite, more widespread as paleo-valleys were already filled) were analysed. The first ignimbrite displayed an emplacement temperature between 380°-460°C, while the final ignimbrite inferred temperatures of 330-350°C, suggesting higher temperature for deposits emplaced in more confined environment.
2. For the 79AD Vesuvius eruption, wooden beams from the Villa dei Papyri at Herculaneum archeological site have been analysed. Temperatures range between 240°C and 370°C. Variations in such a limited area can be interpreted as due to the interaction of the PDCs with local environments (i.e. the impacted buildings of the villa and the sea shoreline).
3. For Merapi event, minimum temperatures are of 240 - 320°C. Charring temperatures show no major differences between proximal and distal deposits, suggesting that PDCs interaction with topography and the effects of air entrainment may have not played the main role in the thermal dissipation of particles along the flow path.
4. For the Colima eruption, the study of the block-and-ash deposit suggests temperature from ca. 345 -385°C in valley-confined area (from 3.5 to 8.5 km from the vent) and to ca. 170-220°C (from 8.0 to 10.5 km from the vent) in unconfined distal area. The assessment of emplacement temperature variation along the 10.5 km-long deposit highlights the strong influence of topography confinement on flow dynamics and heat dispersion.
Charcoal reflectance turned out to be an excellent proxy for temperature assessment: it is generally consistent with estimations determined from independent field, lab, and medical proxies based on more traditional approaches and, in some cases, it provides higher resolution in temperature ranges. Furthermore, charcoal reflectance provides constraints at various scales, vital for hazard assessment.