frontiers | Frontiers in Earth Science

TYPE Editorial
PUBLISHED 22 July 2022
DOI 10.3389/feart.2022.982459

Check for updates

OPEN ACCESS

EDITED AND REVIEWED BY
Michel Grégoire,
UMR5563 Géosciences Environnement Toulouse (GET), France

*CORRESPONDENCE
Rosa Anna Corsaro,
rosanna.corsaro@ingv.it

SPECIALTY SECTION
This article was submitted to Petrology, a section of the journal Frontiers in Earth Science

RECEIVED 30 June 2022
ACCEPTED 30 June 2022
PUBLISHED 22 July 2022

CITATION
Corsaro RA, Petrone CM, Pietruska A and Peltier A (2022), Editorial: Basaltic volcanism: From magmatic processes to eruptive styles.
Front. Earth Sci. 10:982459.
doi: 10.3389/feart.2022.982459

COPYRIGHT
© 2022 Corsaro, Petrone, Pietruska and Peltier. This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.

Editorial: Basaltic volcanism: From magmatic processes to eruptive styles

Rosa Anna Corsaro[1]*, Chiara Maria Petrone[2], Aaron Pietruska[3] and Aline Peltier[4,5]

[1]National Institute of Geophysics and Volcanology, Section of Catania, Catania, Italy, [2]Natural History Museum, London, United Kingdom, [3]SOEST, University of Hawaii, Honolulu, HI, United States, [4]Université Paris Cité, Institut de Physique du Globe de Paris, CNRS, Paris, France, [5]Observatoire Volcanologique du Piton de la Fournaise, Institut de Physique du Globe de Paris, Paris, France

KEYWORDS

basaltic volcanism, magmatic processes, eruptive styles, real-time monitoring, volcanic hazards

Editorial on the Research Topic
Basaltic volcanism: From magmatic processes to eruptive styles

Basaltic volcanoes are characterized by periods of activity ranging from effusive to explosive eruptions with variable intensity, posing threats to the population. Understanding the links between volcanic phenomena (e.g., type, intensity, location), real-time monitoring data (i.e., gas fluxes, lava or tephra chemistry, seismicity, ground deformation), and the magmatic processes in depth is crucial to progress in volcanic hazard assessment and mitigation. The contributions in this Research Topic looked at various aspects of basaltic magmatism, discussing fundamental processes concerning flood basalt provinces, and the relationship between pre-eruptive magmatic processes and eruptive style, with the aim to provide a better understanding of the state of the art at basaltic volcanoes.

A wide range of magmatic and eruptive processes are controlled by the amount of water dissolved in magmas. Barth and Plank examined the fidelity of the water record of melt inclusions hosted in olivine. The fast diffusion of H^+ from the melt inclusion to the host olivine determines water loss on timescales of hours and can compromise the water record of the melt inclusion (e.g., Gaetani et al., 2012; Lloyd et al., 2013). This study outlines the principal factors controlling water loss. They developed diagnostic tools to recognise when and where the water loss occurred, showing that useful information on magma decompression rate can still be extracted even when the melt inclusion is partly re-equilibrated.

Lava flow morphology and volumetric features are used with petrological and geochronological data to link magmatic processes in the plumbing system and their surficial manifestation. Self et al. constrained the eruption rates of flood basalt lava flows in the Deccan Province (India) *via* measurements of the thickness of lava-flow lobes. These thickness were used to evaluate the changes in eruption style during the ~1 Ma lifetime of the Deccan and quantitatively test previous suggestions of geographical distribution of eruptive styles. They also suggested that lava lobe thickness distribution can be used to reveal flow emplacement dynamics.

Monogenetic tholeiitic basalts can erupt over decades from multiple, migrating vent systems. Downs et al. focused on the Pleistocene volcanic activity of the Brushy Butte flow field (Cascades volcanic arc). The study showed that the Brushy Butte flow field comprised at least 28 vents, which erupted lava flows during four continuous pulses, with little or no crustal storage time. The extents and large volumes of lava flows had the potential to impact populations and infrastructure. Therefore, investigations of past monogenetic, tholeiitic back-arc eruptions are a powerful tool for forecasting the behaviour of potential future eruptions in these regions.

Gravitational instability leading to lateral collapse in mafic arc volcanoes was investigated by Romero et al. Despite the relatively simple structure and the homogeneous compositions of mafic volcanic cones, their lateral collapse may encompass a broad range of volumes, causing extensive long-term modification of the volcanic system and of the environment. Several case studies were reviewed to clarify the link between mafic arc magmatism and the main factors of volcano instability, offering an overview of typology, impact and post-collapse reactivation of volcanic activity. They recognised six internal to external factors of volcano instability.

The relationship between pre-eruptive magma processes and eruptive style is investigated by Lormand et al. for the 1974 activity of Etna. The eruption consisted of two phases fed by the same source magma, but different rheology that influenced distinct flow dynamics and eruption style. The authors focused on a type of eruption that is uncommon at Etna (Guest et al., 1974; Andronico and Lodato 2005), i.e., low effusion rate eruptions at low altitude, which could impact the population. The thick flows, high lava viscosity, and lack of tube formation characteristic of this eruption type may lower the efficiency of mitigation measures to deviate the lava flows (cf. Macdonald 1962; Colombrita 1984; Barberi et al., 1993).

D'Oriano et al. focused on the relationship between magmatic processes and the eruptive style of the 2019 summit activity of Etna. A study of the deposit was combined with a time-series investigation of the textural and chemical properties of ash fragments, and linked to the magmatic processes occurring in different portions of the eruptive conduits. In particular, the pulsating ash emissions resulted from the episodic fast ascent of small batches of gas-rich magma travelling as a slow rising magma column subject to crystallization. This activity can represent the final long-lasting stage of high intensity eruptions. Despite its low energetic character, it can pose several problems from airport closure to ash dispersal for prolonged periods.

Changes in the eruptive style of an active volcano are explored by monitoring networks. Bonaccorso et al. studied the pre-eruptive magmatic processes governing the strong explosive activity of Etna that produced 23 lava fountains from December 2020 to March 2021. The explosive activity was investigated with high-precision borehole dilatometers (Bonaccorso et al., 2016) measuring ultra-small strain ($<10^{-6}$). The study demonstrates that strain signals provide useful constrains on the timing and the intensity of a single lava fountain. Strain modelling proves also useful to estimate the source depth and the erupted volumes.

Magma degassing at open conduit volcanoes is one of the fundamental processes controlling eruption dynamics (Sparks et al., 2003). However, conduit degassing is largely invisible to monitoring systems. Thivet et al. used an experimental multiparametric approach to set up a monitoring network at Stromboli during July 2016 and synchronously measure several parameters to understand magma ascent and fragmentation condition driving Strombolian explosive activity. The experiments indicated an activity characterised by periods with prevalent gas-dominated explosions alternating with periods of prevalent particle-loaded explosions. Persistent degassing allows tracking of deeper magmatic processes and the volume of gas involved in explosion; whereas particle-loaded explosion charged with bombs are indicative of a degassed cap.

The contributions in this Research Topic demonstrated the importance of multidisciplinary approaches to study on-going eruptive events, but also the need to better understand past activities widening our approach to include textural studies, lava morphology and volumetric features that are often overlooked. At the same time the significant threat posed by gravitational instability leading to flank collapse should not be ignored.

Author contributions

All the authors contributed to the conception of the work; RAC and CMP wrote a draft of the manuscript that has been revised by AP and ALP.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

References

Andronico, D., and Lodato, L. (2005). Effusive activity at mount Etna volcano (Italy) during the 20th century: A contribution to volcanic hazard assessment. *Nat. Hazards* 36, 407–443. doi:10.1007/s11069-005-1938-2

Barberi, F., Carapezza, M. L., Valenza, M., and Villari, L. (1993). The control of lava flow during the 1991-1992 eruption of Mt. Etna. *J. Volcanol. Geotherm. Res.* 56, 1–34. doi:10.1016/0377-0273(93)90048-V

Bonaccorso, A., Linde, A., Currenti, G., Sacks, S., and Sicali, A. (2016). The borehole dilatometer network of mount Etna: A powerful tool to detect and infer volcano dynamics. *J. Geophys. Res. Solid Earth* 121, 4655–4669. doi:10.1002/2016JB012914

Colombrita, R. (1984). Methodology for the construction of Earth barriers to divert lava flows: The Mt Etna 1983 eruption. *Bull. Volcanol.* 47 (4), 1009–1038. doi:10.1007/BF01952358

Gaetani, G. A., O'Leary, J. A., Shimizu, N., Bucholz, C. E., and Newville, M. (2012). Rapid reequilibration of H_2O and oxygen fugacity in olivine-hosted melt inclusions. *Geology* 40, 915–918. doi:10.1130/G32992.1

Guest, J. E., Huntingdon, A. T., Wadge, G., Brander, J. L., Booth, B., Carter, S., et al. (1974). Recent eruption of mount Etna. *Nature* 250, 385–387. doi:10.1038/250385a0

Lloyd, A. S., Plan, T., Ruprect, P., Hauri, E. H., and Rose, W. (2013). Volatile loss form melt inclusions in pyroclasts of different sizes. *Contrib. Mineral. Petrol.* 165, 129–153. doi:10.1007/s00410-012-0800-2

Macdonald, G. A. (1962). The 1959 and 1960 eruptions of Kilauea volcano, Hawaii, and the construction of walls to restrict the spread of the lava flows. *Bull. Volcanol.* 24, 249–294. doi:10.1007/BF02599351

Sparks, R. S. J., Pyle, D. M., and Barclay, J. (2003). *Volcanic Degassing, Oppenheimer, C.*, 213, 5–22. Dynamics of magma degassing. *J. Geol. Soc. Spec. Pubb.*