frontiers | Frontiers in Earth Science

TYPE Editorial
PUBLISHED 21 February 2023
DOI 10.3389/feart.2023.1155137

OPEN ACCESS

EDITED AND REVIEWED BY
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SPECIALTY SECTION
This article was submitted to Volcanology, a section of the journal Frontiers in Earth Science

RECEIVED 31 January 2023
ACCEPTED 03 February 2023
PUBLISHED 21 February 2023

CITATION
Barde-Cabusson S, Bolós X, Graettinger AH and Nemeth K (2023), Editorial: From magma generation to surface processes in monogenetic volcanism. *Front. Earth Sci.* 11:1155137. doi: 10.3389/feart.2023.1155137

Editorial: From magma generation to surface processes in monogenetic volcanism

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KEYWORDS

monogenetic volcanism, maar, volcanic field, magma generation, magma ascent, magma water interaction, volcanic landforms

Editorial on the Research Topic
From magma generation to surface processes in monogenetic volcanism

This Research Topic was born out of the wish to share the many facets of monogenetic volcanism and to reunite experts from various volcanic regions around this fascinating topic. On polygenetic volcanoes, the main question remains "When will the next eruption take place?" whereas monogenetic volcanic fields raise additional key questions such as "Where will the eruption take place?" and "Which type of eruption should we expect?". From those questions, more unsolved problems arise as we intent understanding how such a relatively little amount of magma can sometimes rise from the mantle in record time, or how interactions with the top layers of the crust are so important to explain the spatial distribution of volcanic vents in a volcanic field and why those interactions are also probably the main factor underlying the observed variety of eruptive dynamics despite a common magmatic source. In order to answer part of those questions, our objective was to bring together original studies on monogenetic volcanism taking place in volcanic fields, on adventive cones associated with stratovolcanoes and with rift zones, using field and laboratory methods, analog experiments, numerical simulations, and remote sensing.

Our article Research Topic presents seven articles in a variety of disciplines, observing processes and identifying key characteristics from this volcanism from the deep feeding system to the surface deposits and landforms.

With the first dating of their maar deposits and detailed stratigraphic study on the Clear Lake Volcanic Field (California), Ball proposes a first important step toward the

FIGURE 1
A recent example of monogenetic eruption at Cumbre Vieja, in La Palma island (Canary Islands, Spain). The eruption lasted 85 days (19/09/2021 to 13/12/2021) and built the Tajogaite volcano in an inhabited area (picture: Xavier Bolós).

characterization of this volcanic field. In particular, it allows a constraint of the age of this volcanism and to show that part of the activity may have been witnessed by local indigenous peoples. The author highlights an interesting point, suggesting that multidisciplinary studies led by volcanologists and Knowledge Keepers[1] may add valuable information to the eruptive history and serve future volcanic hazard assessment for this field.

Despite the relatively low volume (usually much less than 1 km^3) of their eruptions, monogenetic volcanoes complexity is increasingly recognized, justifying the variety of the research technics applied in this field, and the growing publication list available on this topic. Monogenetic volcanoes interact with their environment in many ways. On one hand, their activity can have a great impact on humans as in the case described by Le Moigne et al. with the ~1700 CE Eruption of Tseax Volcano (British Columbia, Canada). Even of small volume, this eruption was the deadliest eruption in Canada with up to 2000 members of Nisga'a First Nation killed in the area, which demonstrate the importance of studying eruptive dynamics and risks associated to monogenetic volcanoes not only from probabilistic but deterministic such as eruption scenario-based perspectives. On the other hand, the environment has a great impact on monogenetic volcanic activity. Sanchez-Torres et al. study on the Samanà volcanic field shows the complex history of a small monogenetic field with evidence of magma differentiation, mixing, recharge, assimilation, and storage in deep and shallow reservoirs. However, as in the case of the Acıgöl (Nevşehir) caldera (Central Anatolia, Turkey), the influence of the geological context can come from much shallower levels, e.g., from the contrasts in the lithology and presence or absence of groundwater in the eruptive process. These deep and shallow factors impacting the monogenetic volcanic activity are also well demonstrated by the work of Harris and Russell at Cracked Mountain (Canadian Cascades), where both polymagmatic plumbing system and glacial loading and unloading are responsible of the complexity of the magmatic crustal dynamics. Those are small volcanoes with a high impact on their environment and a high impact on our knowledge in volcanology (Figure 1). In this context, Nolan and Graettinger present an original tool for the remote identification of landforms through morphometric statistic (SMILES). With this new methodology they demonstrate how a growing catalog of volcanic landforms helps enhancing this tool and they suggest applications beyond monogenetic volcanism and beyond volcanology itself.

Finally, our Research Topic presents a geochemical review article on one of the greatest and most studied volcanic fields. Torres-Sanchez et al. propose a new model for the evolution of the mafic and intermediate magmas from the Michoacán–Guanajuato volcanic field (Western Mexico). The authors use an extended geological and geochemical database from data published for 429 samples. This regional scale study demonstrates how such large-scale investigations are meaningful to monogenetic volcanism showing that geodynamics and tectonics strongly influence the evolution of a volcanic field.

These works highlight the role that studies of monogenetic volcanoes have on geoscience broadly, volcanic and magma genesis processes, as well as specific events and communities. New technologies and techniques enable high resolution detection of changes in chemistry, morphology, and chronology providing opportunities for greater insight into volcanic processes and their impacts. Although the volume of erupted material monogenetic volcanism can be relatively small, this Research Topic highlights that the impacts of such eruptions should not

1 As defined by the Office of Indigenous Initiatives at Queen's University, "the term "Knowledge Keeper" or "Traditional Knowledge Keeper" refers to someone who has been taught by an Elder or a senior Knowledge Keeper within their community. This person holds traditional knowledge and teachings, they have been taught how to care for these teachings and when it is and is not appropriate to share this knowledge with others".

be underestimated as they generate unpredictable and significant local impacts that can leave very little evidence in the geologic record. At the same time these studies, building on a recent renaissance of monogenetic volcano research, provide insights on individual volcanic processes including eruption, transport and deposition that can be muddled or buried at longer lived volcanic systems. This focused perspective provides information on volcanic process that can be applied to any volcanic type.

Author contributions

SB-C took the lead in writing the Editorial, XB, AHG, and KN contributed to writing. All the authors discussed the content of the Editorial.

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