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Editorial: Patterns and trends of time–space evolution of volcanism, from local to global

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Editorial on the Research Topic
Patterns and trends of time–space evolution of volcanism, from local to global

Volcanism is one of the most obvious Earth surface manifestations of the deep-seated geodynamic processes driving global tectonics and shaping our planet's topographic surface. It has accompanied Earth's evolution and history over millions to billions of years of its geological past. Thus, understanding the evolution of volcanism in space and time helps the comprehension of geodynamic processes at all scales of time and space. For instance, revealing the time–space evolution pattern of volcanic activity over a given territory—either locally (e.g., the East Carpathians in Romania, Szakács et al., 2018, or Burgenland in Austria; Neubauer and Cao, 2021), regionally (e.g., the Andes, Norini et al., 2013), in a sub-continental (e.g., Mexico, Bellotti et al., 2006) or continental area (e.g., along the East African Volcanic System, Hassan et al., 2020; Biggs et al., 2021), or even at a global scale—may offer important clues for the reconstruction of the past geodynamic/tectonic evolution of those areas. Similarly, time-dependent trends of migration of volcanic centers and trends of magma composition variations in time and space, along with other quantizable volcanism-related parameters (such as magma output volumes and rates through volcanic activity), may help to gain a deeper insight into deep Earth processes. The refinement and unprecedented accuracy of the dating methodology of volcanic products acquired over the past few decades along with the concurrent accumulation of a significant wealth of information on the timing and evolution of volcanic activity worldwide allows us today to consider data synthesis and interpretation in terms of time–space evolution patterns and trends of volcanism at all possible scales, from the local to global. Frontiers in Earth Science intended to collect papers addressing this Research Topic and answering questions such as "How has volcanic activity evolved in space and time within a given territory?", "To what extent do local patterns and trends of volcanic evolution fit within regional trends?", or, just the opposite, "How are regional trends of volcanism reflected in local ones?", "How is the geodynamic evolution of a territory is reflected in its volcanism?", and, *vice versa*, "How does volcanism eventually feedback to local regional tectonic evolution?".

The interest for such a Research Topic, as demonstrated by the submitted contributions, was less than expected by the initiators and co-editors of the thematic Research Topic. Of the five proposed contributing manuscripts, four were accepted and one rejected. Of the four accepted contributions, three were authored by Japanese scientists addressing time–space evolution patterns of Japanese volcanic systems.

Hasegawa et al. examined the time–space evolution of the large, complex multi-stage Akan caldera (Hokkaido, Japan) using geological, geophysical, and geochemical constraints. Of the 17 eruptive phases identified for the 1.4–0.1 Ma life span of this volcanic system, the authors focused on the large-volume "younger eruptive group" in the 0.8–0.2 Ma time interval. Lithic clast composition along with the whole-rock composition of juvenile components allowed the authors to distinguish three different "magma systems," also supported by mapped gravity minima anomalies, corresponding to three spatially distinct vent sources within a caldera complex including several smaller nested calderas.

Nakagawa et al. re-investigated the sector collapse event of Usu volcano using a rather unusual tephrochronological approach since direct dating of the event is impossible because of the lack of related juvenile material to be dated. Starting from the observation that the collapse-generated debris avalanche deformed, fragmented, and incorporated a particular pyroclastic flow deposit, correlation of a glass shards-bearing reworked tephra and radiocarbon dating of paleosoil horizons below and above the reworked ash deposits helped the researchers to indirectly constrain the debris avalanche event at Usu at ca. 8 ka, a much younger age than previously proposed.

Nishihara et al. addressed the long-term changes in the eruptive activity of Sakurajima volcano by studying its pyroclastic fallout deposits by a combined analysis of the distribution, stratigraphy, and age of the pumice fall layers with other products of the same volcanic edifice based on an original field survey, compilation of geological and archeological data, and new radiocarbon dating. The authors determined three eruption stages (30–24 ka, 12.8–4.8 ka, and 4. 5 ka–present), with the most recent two stages being further subdivided, concluding that the volcano "peaked in magma discharge during stage 2a (2.9 km^3/kyr) and then decreased rapidly toward Stage 2b (8–4.8 ka; 0.07 km^3/kyr)," an evolution accompanied by a shift "from explosive pumice eruption to ash-producing Vulcanian activity." In contrast, the most recent stage of evolution was characterized by a shift in activity from vulcanian explosions and lava effusions to predominantly pumice-rich explosive eruptions during the historical period with an increasing magma discharge rate. The total volume of magma erupted as pumice fallout was also revised to 5.8 km^3 (dense rock equivalent), which is much less than the previous estimation.

One article authored by an international team of researchers led by Siegburg et al. investigated fissural eruption patterns at the Boset magmatic segment in the northern Ethiopian rift of the East African Rift system.

Combining radiocarbon dating of charcoal fragments trapped in volcanic products with historically documented eruption dates, and with major and trace element geochemistry of different rift segment-erupted lavas, the authors arrived at the conclusion that each magmatic segment experienced separate rifting episodes clustered during a ca. 150-year time interval from the late XVIII to the early XX century.

Although this Frontiers thematic issue procedure is formally closed, we continue to encourage volcanologists to consider addressing this exciting Research Topic of the discipline, namely, how volcanism evolves and shifts in space and time at various scales, from the local to global.

Author contributions

Concept: AS, Text editing and enhancing: All five authors. All authors contributed to the article and approved the submitted version.

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

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