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Editorial: Volcanism in the Central Volcanic Zone of the Andes

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Editorial on the Research Topic
Volcanism in the Central Volcanic Zone of the Andes

This Research Topic was born out of the 1st Symposium on the Central Volcanic Zone of the Andes (CVZA; carried out in virtual mode during 2021) which counted for the presence of geoscientists working in the volcanological, petrological and geochemical fields, among the others. Our objective was to bring together contributions focused on the evolution and impact of volcanism in the CVZA from its formation (Late Oligocene) up to present times, including specific and multidisciplinary studies, with both detailed and regional approaches. The CVZA is located in the western part of South America, as a consequence of the subduction of the Nazca plate under South American plate, and covers the northern Chile, northwestern Argentina, western Bolivia and southern Peru. The CVZA is characterized by the occurrence of massive explosive events, dominated by andesitic-to-dacitic products, and strongly influenced by the presence of a thick continental crust, which favors several processes as long-lasting magma storage, magma assimilation by crustal contamination, among others. One of the main scientific problems related to this volcanic area is to define what are the main processes that control the size and frequency of the major explosive eruptions. The nine articles published in this Research Topic cover a spectrum of topics applied in different areas of the CVZA, including poly- and monogenetic volcanism, the influence of the crust in magmatic processes, fluid geochemistry, volcano seismicity, petrology, geochronology, hazards assessment, relationships between volcanoes and archeology/anthropology/sociology.

Barry et al. compare the degassing processes between the Central and Southern volcanic zones of the Andes using He and carbon isotopes, and CO2/3He ratios obtained from gas and water samples related to fumaroles and thermal springs. They conclude that crustal thickness exerts a primary control on the extent of fluid-crust interaction, as helium and other volatiles rise through the upper plate in the Andean convergent margin, with more significant crustal inputs in the CVZA due its thicker crust. Additionally, CO2 removal related to calcite precipitation (probably associated with biological processes) and gas dissolution was observed in shallow hydrothermal systems of both volcanic zones.

Burns and de Silva present a regional study along the CVZA. They show that during the past 10 Myr, the CVZA records two distinct types of intermediate magmas: 1) Andesitic magmas

generated/fractionated in the lower crust associated with major composite cones and small centers of the Quaternary arc, or 2) andesitic magmas resulting from hybridization of mantle-derived basalts and upper crustal lithologies related to 6–1 Ma ignimbrites and lava domes.

Salisbury et al. present new geochemical (major/trace elements and radiogenic isotopes) and geochronological data of a transect along the Bolivian Intersalar Range. They identify two distinct pulses of rear-arc magmatism: 1) a 20–14 Ma phase that corresponds to local compressional shortening, and 2) a 5–1 Ma phase that postdates structural deformation in the region. Additionally, they suggest melting in the region is triggered by the breakdown of Nb-rich hydrous minerals within foundering (delaminating) mantle lithosphere.

Aguilar et al. study the evolution of the previously poorly known Yura monogenetic field (Southern Perú) using geological mapping, stratigraphic logs, petrography, geochemistry and geochronology. They find that volcanic activity was concentrated during the Middle-Upper Pleistocene (*ca.* 195–54 ka) and was characterized by phreatomagmatic, Strombolian and effusive eruptions, which produced small scoria cones, maars, and lava flows/coulées.

McFarlin et al., determined the distribution and classified seismic data recorded at the Lazufre Volcanic System (northern Chile). Most of the events occur beneath Lastarria volcano with almost no activity observed beneath the Cordón del Azufre volcano. Five classes of seismic events were recognized: volcano-tectonic, two types of long-period, hybrid, and others whose origin remains unknown. Based on their spatial distribution and b-values, it was inferred that seismic activity is driven mainly by movement of fluids and gases associated with the regional magma zones and inflation centers.

Two articles deal with volcanic hazards assessment. Bertin et al. investigated new approaches to quantify the hazards of long-term active and complex settings at a regional scale (22.5–28°S), being one of the few hazard assessments carried out at a regional scale worldwide. The study was based on the estimation of 1) spatial probability of future volcanic activity (based on kernel density estimation using a new volcanic geospatial database), 2) temporal probability of future volcanic events, and 3) areas susceptible to volcanic flow and fall processes (based on computer modeling), from which several hazard maps were produced. Alcozer et al. carried out a local GIS-based multi-hazard assessment of the San Pedro volcano (northern Chile). They considered the size of eruptions to co-parameterize the size of the accompanying phenomena (e.g., mass flows) in a given eruptive scenario. The novelty of the study is the use of intra-scenarios (i.e., subdivisions of eruptive scenarios) to explore the size variability of explosive volcanic phenomena. The size of intra-scenarios was extrapolated from the largest-size deposits of each type of phenomenon from the geologic record. This work produced several single-event hazard maps, and an integrated hazard map.

The last two articles explore the relationship between volcanism and the ancient-to-present indigenous societies. Loyola et al., using petrographical techniques and archaeological knowledge, studied rocks used for stone tools and other artifacts in the Salar de Atacama basin area (22–24°S/67–68°W), to classify lithic assemblages and their sources. A diversity of volcanic and subvolcanic rocks were identified (e.g. pumice, micro-diorites, obsidians) from several sites including craters, maars, caldera-domes, lava flows, hydrothermal deposits, and ignimbrites. Ramos Chocobar and Tironi examine the volcanological understandings of the Lickanantay people in the Salar de Atacama Basin, called by the authors as "Atacameño volcanology". They describe the volcanological notions arising from the Lickanantay ancestral knowledge-volcanic formation, functions, and behavior. Finally, they present a delineation of some relevant elements of human–volcano interactions and volcanic risk management from an Atacameño perspective.

This Research Topic is a first effort to put together contributions that increase the knowledge of the CVZA, which is still limited, and we expect that the local/regional and international volcanological community looks to this area, which could provide several answers for critical volcanic processes, especially considering the very good preservation of their volcanic deposits as a consequence of the presence of arid-to-hyper arid environment.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

Conflict of interest

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