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Editorial: Volcanic Islands—A Challenge for Volcanology

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Editorial on the Research Topic

Volcanic Islands - A Challenge for Volcanology

Most volcanoes on the Earth rise from the bottom of seas and oceans. Most of them do not reach the surface of sea and remain hidden to all conventional observations from surface and space. Only some of them rise above the sea level, forming islands and passing from submarine to subaerial volcanism. Volcanic islands develop in virtually all the geodynamic contexts on Earth, from mid-ocean ridges (Iceland), to intraplate (Hawaii), to volcanic arcs (Aeolian Islands). All the liquid-descent evolutive degrees of magma are finally represented, from primitive compositions up to strongly evolved rhyolite, trachyte and phonolite lavas. So, the eruptive styles of these volcanoes range consequently from mild effusions to plinian eruptions.

The interface with the sea poses some particular conditions due to the interaction with seawater, both at surface and below. Large hydrothermal activity easily develops due to the circulation of seawater at depth, and consequent interaction with magmatic gases and hot country rocks. The presence of the water and sea erosion also triggers particular instability conditions of the slopes of these volcanic edifices, so that the effects by seismicity and ground deformations can become disastrous. Volcanic island are by far the most vulnerable environments on Earth, not only because of their high exposure to the impact of multi-hazards, where several hazardous phenomena may interact in a simultaneous or consecutive way, but also due to their isolation from the main land, which makes external supply chains and help during a crisis difficult. A large number of volcanic islands are in fact intensively inhabited, despite the limited available lands, thus the common volcanic phenomenologies pose severe hazardous scenarios and submarine eruptions and landslides triggering catastrophic tsunami waves have to be considered.

One of the most important Research Topics to be considered when investigating and monitoring island volcanoes, is that most of the edifice is submerged and the emerging part only constitutes the summit of the volcano. This poses enormous difficulties to scientists, both from a scientific and technological point of view, because the development of monitoring systems at seafloor is still in its infancy. On this ground, such edifices represent one of the most important and interesting challenges for volcanologists and Earth scientists in general.

This Research Topic collected 10 contributions, covering a very wide range of disciplines, from petrology to submarine geophysics, all aimed at understanding and characterizing the activity, dynamics and hazards of volcanoes developing at the interface between land and sea, not only forming islands but also raising above the sea along a continental coastline. This latter is the case of Mt. Etna, whose submerged eastern flank has been investigated in one of the contributions (Urlaub et al.), describing and analyzing a wide series of geophysical imaging and seafloor geodetic surveys

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that unveil some volcano-tectonic structures probably representing the link between flank dynamics and tectonic triggering of the instability.

Arc volcanic islands have also been investigated in this Research Topic, that is the case of the Aleutian Arc segment (Fischer et al.). Geochemical data show that all these volcanoes host high-temperature magmatic-hydrothermal systems and have gas discharges typical of volcanoes in oceanic arcs. Volcanic CO_2 fluxes from this arc segment are small, probably due to the lower sediment flux delivered to the trench in this part of the arc.

In volcanic islands, stratigraphy and sedimentary records can be particularly useful to reconstruct past volcanic activity. One of the contributions (Andrade et al.) focused on Flores island (Azores) shows in fact that the volcano experienced vigorous volcanic activity during the Late Holocene; therefore, contrary to what is assumed, the possibility of future eruptions should be properly considered, and the volcanic hazard here should not be underestimated.

The Hazard aspects have been investigated also for remote islands, in a contribution (Gjerløw et al.) focused on Jan Mayen Island, in the North-Atlantic. The eruptive history of this island, showing variable activity styles, has been exploited for evaluating the different vent opening probabilities, exposure to different volcanic phenomena and recurrence times for depicting different scenarios and qualitative hazard maps.

A similar hazard evaluation come from tha PDCs deposits on Terceira island (Pimentel et al.). Studies on the geometry and structure of two ignimbrite deposits on the island reveal interesting details on the eruptions that produced them. Even if ignimbrite-forming eruptions are not frequent on that volcano, this kind of hazard is significant, since its effect can be dramatic for the population.

Geochronological and isotopes analyses, as well as field surveys and petrological analysis were used for reconstructing the eruptive history of Weizhou island in the Guangxi Province (China), for evaluating the risk to inhabitants (Yu et al.). A very variable eruptive style has been found on the four volcanoes discovered, spanning from explosive, PDC-forming eruptions to effusive ones, also with some evidences of magma-water interaction.

The Canary Islands are a classical site locality for alkaline, SiO_2-undersaturated intraplate magmas (Klügel et al.). Products from one eruption of the now active Cumbre Vieja volcano of La Palma contain abundant inclusions from different levels of the plumbing system, mantle rocks, oceanic gabbros and cumulates. Phonolites form beneath oceanic island volcanoes by combined differentiation and periodic recharge by mantle magmas. They require a balance between rates and volumes of magma recharge pulses and of eruptive events.

In small islands such as Martinique (Lesser Antilles), the history of the volcanic activity is generally better preserved in submarine deposits than on-land (Villemant et al.). Cores of marine sediments reconstitute the chronostratigraphy of tephra, volcaniclastic turbidites, and mass-wasting events over 1.5 Ma. Results provide a framework for further petrological studies of Mt Pelée and Pitons du Carbet and for the timing of flank collapses and submarine landslides.

The very recent eruptive history of a newborn and growing island has been analyzed and correlated with the variations of the chemical composition of erupted magma (Maeno et al.). Results of this analysis have been used to infer the minimum eruption rates and durations required for forming volcanic islands able to survive to the erosion.

Volcanism on ocean island can also serve as windows into the composition and behavior of mantle plumes (Wilson et al.). Santa Cruz volcano (Galapagos) followed a distinct geochemical evolution from the present-day western shields, having been constructed under the influence of the Galápagos Spreading Center. Ocean island evolution can change dramatically depending on the plume's tectonic setting.

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

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