ID: 46

Inyección atmosférica de sales marinas durante la erupción submarina del 15 de enero de 2022 en el volcán Hunga, Tonga

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La erupción submarina del 15 de enero de 2022 en el volcán Hunga fue el episodio volcánico más explosivo observado en los últimos 140 años. Esta erupción, que desencadenó el colapso de la caldera, involucró una interacción excepcional de magma y agua de mar. La pluma volcánica submarina irrumpió la superficie del mar y formó una pluma eruptiva subárea que transportó cenizas volcánicas, gas, sales marinas y agua de mar hasta una altura de ~57 km, alcanzando la mesósfera. Documentamos altas concentraciones de sales marinas en la tefra (ceniza volcánica) recogida poco después de su depositación. Discutimos las posibles consecuencias climáticas de la inyección a gran escala de sales en la atmósfera superior durante las erupciones submarinas. Sales como el cloruro de sodio, pueden alcanzar concentraciones extremas en estas plumas volcánicas, y la deshalogenación de cloruros y bromuros plantea el riesgo de un impacto atmosférico y meteorológico a largo plazo. El contenido de sal en las muestras de tefra recogidas rápidamente después de su depositación, puede utilizarse como indicador de la proporción *magma:agua* que entró en contacto durante la erupción, con implicaciones para la cuantificación de la eficiencia de fragmentación en erupciones submarinas. El balance entre la carga de sal en la atmósfera y la depositada con los agregados de ceniza es un factor clave para comprender las consecuencias atmosféricas y climáticas de las erupciones submarinas.

ID: 238

Scientific drilling reveals hazardous explosive eruptions of the Kameni Volcano inside the Santorini Caldera

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Santorini lies at the center of the South Aegean Volcanic Arc and attracts over 2 million tourists a year. Its dramatic landscape is the result of a major caldera collapse associated with the Minoan eruption ~1600 BC. Since then, Santorini is considered to be in a rejuvenating stage and a new volcano emerged in the center of the flooded caldera, forming the islands of Palea and Nea Kameni. Historically described eruptions date back to 197 BCE and have generally been considered effusive to mildly explosive. At the beginning of 2023, IODP Expedition 398 drilled four sites within the Santorini Caldera, offering the unique opportunity to sample the intra-caldera sediments, which reach up to 300 m in thickness. We will present a shoreline crossing analysis using core-seismic integration to spatially extrapolate the drilled lithologies throughout the caldera and link them to the evolution of the Kameni Volcano. At all four drilling sites, we made a significant discovery—a major pumice deposit up to 40 m thick. Our integrated analysis indicates that the identified pumice layer corresponds to a historically mentioned eruption in 726 CE. We estimate a VEI 5 magnitude of this eruption, significantly exceeding previously considered worst-case eruptive scenarios for Santorini. Our study highlights how incomplete onshore eruption archives surrounding oceanic volcanoes are, which necessitate deep-sea sampling for comprehensive understanding.

ID: 239

Discovery of a major normal fault along the Kolumbo Volcanic Chain reveals fundamental volcano-tectonic feedback mechanisms

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Many hazardous volcanic systems worldwide are located in extensional back-arc systems with complex volcano-tectonic feedback mechanisms. However, our knowledge about the structural and temporal relationships of volcanism and tectonics remains immature due to the lack of long-term records. The Christiana-Santorini-Kolumbo volcanic field lies in an active continental rift zone in the southern Aegean Sea and represents an ideal natural laboratory to study the interaction between volcanism and tectonism. Recently, IODP Expedition 398 drilled 12 sites across the volcanic rift system. We will present the results of core-seismic integration at two sites west of Kolumbo Volcano. These sites lie on both sides of the Kolumbo Fault, which strikes parallel to the Kolumbo Volcanic Chain and was previously considered a fault with little vertical offset. However, biostratigraphic markers on both sides of the fault indicate that it represents a major normal fault with an offset of several hundred meters. Seismic data reveal that major subsidence along this fault preceded the onset of major activity of the Kolumbo Volcanic Chain. Rapid sedimentation of volcanoclastic material subsequently buried this fault. Our study shows a fundamental tectonic control of the Christiana-Santorini-Kolumbo volcanic field, a process that might be present at other back-arc systems.

ID: 260

A giant shallow-marine pyroclastic-flow-eruption from ancestral Santorini discovered by IODP Expedition 398 - Objectives, challenges and results of deep drilling into Christiana-Santorini-Kolumbo volcanic field deposits

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IODP Expedition 398 'Hellenic-Arc-Volcanic-Field' took place with the overarching goal to study the links and feedbacks between volcanism/magmatism, crustal tectonics and sea level using the volcanic record of the central Hellenic Volcanic Arc. During our expedition around the Christiana-Santorini-Kolumbo-Volcanic-Field (CSKVF) we experienced very challenging drilling conditions giving us time to drill twelve sites. In total we drilled 7345 meter in 28 holes, retrieved 780 cores with a total recovery of 3356 meters. Outside of Santorini caldera, drilling penetrated the thick basin fills of the crustal rift system hosting the CSKVF, identifying more than 1000 tephra layers, some known from onland and others formerly unknown. Deposits from inside Santorini caldera and close to submarine Kolumbo volcano indicate unknown smaller and larger explosive silicic submarine eruptions.

One of the expeditions objectives also included investigation of processes and products of these shallow submarine eruptions and to groundtruth the seismic stratigraphy of Santorini caldera. In this regard one of the

first results, constrained by a multidisciplinary approach and highlighting the hazards of submarine explosive eruptions, includes the discovery of a giant rhyolitic pumice deposit emplaced 520±10 ky ago at water depths of 200 to 1000 m during a high-intensity, shallow marine eruption of ancestral Santorini Volcano. Pyroclastic currents discharged into the sea, transformed into water-saturated gravity flows, forming a >88 ± 8 km^3 volcaniclastic megaturbidite up to 150 m thick in the surrounding marine basins, while breaching of the sea surface by the eruption column laid down veneers of ignimbrite on three islands.

ID: 287

Explosive volcanism at Santorini - new insights into the timing and frequency using marine tephra from IODP Expedition 398

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Santorini, located in the southern Aegean Sea, belongs to the Christiana-Santorini-Kolumbo Volcanic Field (CSKVF) as part of the Hellenic Volcanic Arc. The CSKVF is characterised by highly explosive eruptions, some are associated with caldera collapses.

The earliest volcanic activity from Santorini is dated at ~650-550 ka and was characterised by phreatomagmatic and effusive eruptions. For the last 360 kyr its volcanic activity was assigned to two explosive cycles (~360 - 170 ka and ~170 - 3.6 ka). Since the most recent caldera collapse at ~3.6 ka, eruptions at Santorini formed the Kameni islands within the present-day caldera. From onland and preceding marine tephra studies, particularly the last ~200 kyr are well-constrained, whereas the early volcanic history lacks a continuous record.

IODP Expedition 398 drilled the marine sediments in the basins around the CSKVF and recovered more than 1000 discrete tephra layers and >300 horizons with tuffaceous sediments.

We present a revised tephrochronostratigraphy based on these marine sediments extending the onset of explosive eruptions at Santorini further back in time (>500 ka).

Geochemical fingerprinting enabled the identification of most major eruptive units of both explosive cycles (radiometrically dated) and in combination with the high-resolution onboard biostratigraphy, we estimate ages for the newly identified eruption deposits. We identified and geochemically characterised ~180 “new” volcanic deposits of which ~130 are dated at >200 ka. These preliminary results indicate that explosive volcanism at the CSKVF has been ongoing for >300 kyr longer than preceding studies showed, and clearly show the importance of marine tephrostratigraphy.

ID: 379

Analysis of 2021 Fukutoku-Oka-no-Ba hydroacoustic, lightning, plume width, and infrasound data

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The August 2021 eruption of Fukutoku-Oka-no-Ba (FOB) volcano, Japan was remarkable in part because of its generation of a 16-km water-rich atmospheric plume, new islands, and large pumice raft. Recent studies provide complementary summaries of the 2021 FOB eruption that include infrasound analysis and analysis of Himawari-8 satellite data. As the vent of FOB is at ~25 m depth there is an associated hydroacoustic record from this eruption which was recently published. A central question that has yet to be addressed is: to what extent did the processes occurring beneath the sea surface correlate with the intensity of the atmospheric portion of the 2021 FOB eruption? Alternatively, does the intensity of the hydroacoustic signal correlate with the intensity of the atmospheric plume, infrasound, and lightning, thereby demonstrating a coupling between submarine and subaerial processes? Here we compare multiple data sets from the FOB eruption, specifically the hydroacoustic data in context of lightning (GLD360), infrasound (regional and IMS array IS39), and plume height/width data (Himawari-8). We also examine the volume flow rate derived from plume observations with respect to the acoustic and lightning characteristics. The goal is to understand the extent to which the submarine and subaerial portions of the eruption correlate and thus are coupled.

ID: 410

SANTORY: Preliminary results of monitoring Kolumbo volcano (Santorini, Greece)

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SANTORY is an innovative seafloor observatory deployed in Kolumbo submarine volcano, 7km NE of Santorini (Greece). Its sensors monitor Kolumbo's active hydrothermal field to comprehend the links between deep-seated geological processes that have associated risks and their expression in hydrothermal activity. Our international research team monitors Kolumbo by developing and integrating state-of-the-art technology for in situ monitoring along with discrete sampling and measurements. So far, we conducted two oceanographic expeditions in December 2022 and June 2023 to a) deploy and maintain the seafloor observatory, which is a new generation automated multiparametric geochemical recording module that collects data of passive acoustics, dissolved gases (CO_2, O_2 and CH_4), temperature, hydrostatic pressure, EC, pH, and turbidity; b) conduct various measurements on Kolumbo's crater with multiple innovative sensors (T-sensors, Inclinometers, Pressure gauges), c) continuously record the active hydrothermal vent field with stand-alone optical cameras, multispectra and the "THEIA'' stereo camera and d) make for the first time, real-time measurements for radioactivity using gSniffer and γ-radiation imager "SUGI".

Here, we present our preliminary results from the whole operative period of SANTORY where it acquired a discrete 6 month-long data series including temperature, conductivity, hydrostatic pressure, turbidity, dissolved CH_4, pH, passive acoustics and radioactivity that attests to a highly active hydrothermal system.

ID: 416

Managing the hazard risks posed by Kolumbo submarine volcano (Santorini, Greece)

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Volcanic eruptions present significant threats to nearby communities due to the array of associated dangers, including earthquakes, tsunamis, pyroclastic flows, and toxic gases. The proactive management of volcanic risks is imperative to mitigate these threats in densely populated areas. Kolumbo, an active submerged volcano situated 7 km NE of Santorini Island, serves as a pertinent case. Its most recent eruption in 1650 triggered a devastating tsunami, leading to damage on neighboring islands and casualties from noxious gases in Santorini. Eyewitness accounts reported maximum run-up heights of 20m on the southern coast of Ios, 240m inundation on Sikinos, and flooding of up to 2km² of land on the eastern coast of Santorini. Recent studies indicate that a potential future explosive eruption of Kolumbo poses a substantial hazard to the northern and eastern coasts of Santorini. Unfortunately, there is currently no established management protocol in place to address this looming threat. Therefore, it is recommended that a comprehensive approach be adopted, involving scientific research (active monitoring, hazard maps), community engagement, preparedness planning with government agencies, and the development of timely response strategies to reduce the associated risks, prevent casualties, and mitigate the consequences on the region's economy and infrastructure.

In the current context, advanced sensors have been deployed to monitor Kolumbo's active hydrothermal field as part of the SANTORY project. The SANTORY project aims to create innovative communication tools and establish interregional monitoring protocols, providing the scientific community, policymakers, and stakeholders with the means to assess hazard warning codes effectively.

ID: 443

REVISIÓN DE ISLA SAN BENEDICTO A 71 AÑOS DE LA FORMACIÓN DEL CONO BÁRCENA 1952-1953, ARCHIPIÉLAGO DE REVILLAGIGEDO, MÉXICO.

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El Cono Bárcena en Isla San Benedicto representa la erupción subaérea más reciente de las 4 islas volcánicas que comprenden el Archipiélago de Revillagigedo en el Pacífico Mexicano. San Benedicto, la más joven, es un monte submarino que se alza desde el suelo marino, a más de 3 km de profundidad, hasta los 400 m.s.n.m. A 71 años de la actividad que duró de agosto de 1952 a febrero de 1953, únicamente se reconocen los trabajos de Richards (1959, 1965 y 1966), una expedición por el Nautilus (Raineault, N. et al, 2017) y un estudio sobre la formación y morfología de las cárcavas del Bárcena (Kieffer, S. et al, 2021). Sin embargo, la estratigrafía subaérea dista de ser definida en detalle.

El volcán isla San Benedicto, donde afloran principalmente flujos de lava, conos y domos erosionados, está compuesto por rocas alcalino-cálcicas, siendo las más abundantes las unidades de composición traquita alcalina (Richards 1959). Se presenta una actualización volcano-estratigráfica, granulométrica y de componentes, así como petrografía y geoquímica de roca total de la fase subaérea de la isla. El Cono de Toba Bárcena fue resultado de una erupción explosiva con distintas etapas de hidrovolcanismo (Vulcaniana/Surtseyana) lo cual generó corrientes piroclásticas diluidas, algunas con abundantes agregados de ceniza y pómez con corteza de pan. La erupción finalizó con actividad efusiva formando primero un domo en el cráter y posteriormente un delta de lava. El trabajo en proceso incluye química mineral, análisis de inclusiones y exploración de procesos petrogenéticos.

ID: 471

Investigating the marine tephrostratigraphy of the Azores Archipelago to test possible volcanism-climate interactions in a non-glaciated ocean island setting

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Volcanic activity shows cyclic behaviour on different timescales, ranging from a few hours to thousands of years. Long-term variations have been related to orbital cycles, which control the glacial-interglacial cyclicity on Earth. Several studies have demonstrated that isostatic unloading due to ice cap melting during interglacial periods or drawdowns of sea level during glacial periods correlate to an increase in the volcanic activity of individual volcanoes and volcanic systems worldwide. However, a good understanding of how climate change can trigger volcanism is still lacking, because data on the timing and periodicity of volcanic cycles are sometimes contradictory and the possible underlying processes not fully understood. To bring new insights into this question, we investigate the long-term climatic and tephrostratigraphic records of the Azores Archipelago, representing a non-glaciated ocean island setting in the central North Atlantic. The Azorean islands are known to have produced many explosive (Plinian and sub-Plinian) eruptions during the Holocene and upper-Pleistocene, but detailed eruption chronology is still incomplete. Based on 77 marine gravity cores collected during two RV Meteor Cruises, M141 (2017) and M186 (2022), we aim to reconstruct a detailed eruptive time series for the central and eastern islands of the Azores. Preliminary results show that marine records extend back to >350,000 years, covering at least three glacial cycles. Major and trace element analyses of glass shards of >500 marine and subaerial tephra samples are used to distinguish primary from secondary deposits, as well as to establish correlations between cores and between marine and subaerial deposits.

ID: 476

The magma system of Santorini volcano after the Late Bronze Age eruption: into a new caldera cycle

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From December 2022 to February 2023, IODP Expedition 398 to the Hellenic Arc Volcanic Field, Greece, drilled twelve sites in and around Santorini volcano, penetrating the thick basin fills of the rift system that hosts the Christiana-Santorini-Kolumbo volcanic field as well as the volcano-sedimentary sequence inside Santorini caldera. Within the latter, four sites were drilled in the southern (U1594, U1595) and northern (U1596, U1597) caldera basin, respectively, retrieving predominantly volcaniclastic sediment with minor amounts of tuffaceous sediment and mud. The five main lithological units identified at these sites provide the hitherto most complete record of explosive eruptive activity and the associated evolution of Santorini's magma system following the caldera-forming Late Bronze Age (LBA) eruption ~1600 BCE, complementing the well-established, predominantly effusive eruptive and petrological record of the intra-caldera Kameni volcano exposed on land.

In this contribution, we lithologically characterise Santorini's intra-caldera volcano-sedimentary sequence and explosive eruption record, as established at IODP Expedition 398 Sites U1594 to U1597, and attempt to link the marine tephra record to the subaerially exposed eruption record of the Kameni volcano. We present new

data on the geochemical composition of the magmas that fed the post-LBA eruptions of Santorini and explore the crystal cargo of these magmas to determine the magma storage conditions, magmatic processes and the timescales of magma dynamics at the onset and during the early stages of a new caldera cycle at Santorini's multi-cyclic caldera.

ID: 614

Volcanogenic turbidites in marine sediment successions off Stromboli island

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Volcaniclastic turbidites provide a unique opportunity to investigate the recurrence, dynamics and magnitude of past sector collapses in coastal volcanic areas. Twenty-two sediment cores were recovered in the area facing the Sciara del Fuoco scar, off Stromboli, during the 2018 GEOMAR POS-522 cruise aboard R/V Poseidon. The cruise was aimed at gravity coring sediment sequences containing turbidity current deposits co-genetic to potential landslides associated with flank collapses of Stromboli volcano. The cores contain hemipelagic sediments with intercalated multiple, variably thick volcaniclastic layers, possibly emplaced by turbidity currents co-genetic to volcanic landslides of Stromboli, and tephra layers crucial for the correlation and synchronization of the sequence. We studied four cores covering a distance from the island between 29 and 47 km. Fifty-two samples were analyzed for grain-size, textural and geochemical characteristics. Grain-size analyses indicate that the volcaniclastic deposits of more distal (>40 km) cores comprise a higher mud/sand ratio and bear clasts characterized by low angularity with respect to more proximal (<30 km) samples. The volcaniclastic components of the silty-clay layers increase progressively from the distal to the more proximal samples reaching 100% in proximal cores. Component analyses and geochemical compositions suggest a dual source area for the volcanic component: highly-vesicular, light pumices and shards suggest an origin from Lipari island, whereas mineral grains, porphyritic tachylite and sideromelane fragments are indicative of provenance from Stromboli.

ID: 351

Foraminiferal response to volcanic eruptions in the Hellenic Volcanic Arc, Aegean Sea

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Foraminiferal fauna ability to tolerate major catastrophic events in their environment and to recover and recolonize is both admirable and extremely useful, as a tool to interpret biostratigraphic correlations and paleoenvironmental conditions. The effects of such extreme events as volcanic eruptions in foraminiferal microfauna were investigated in the drilled cores by IODP Expedition 398 in the Christiana-Santorini-Kolumbo volcanic field in the southern Aegean Sea. A pyroclastic flow took place in the uppermost to upper bathyal paleowater depths, where hemipelagic sediments were deposited prior and after the volcanic activity at Middle Pleistocene, as suggested by foraminifera and calcareous nannoplankton biostratigraphic markers. The intervals before, during and after this pyroclastic flow were studied in six cores along the different basins, and here we present our preliminary results on its impacts on foraminiferal community structure. During the volcanic deposits benthic foraminifera species were severely affected both in terms of density and diversity, with survivor infaunal species, shelf species and damaged specimens likely representing downslope reworking. Some samples were barren even from accompanying ostracods, molluscs and pteropods, while planktonic foraminifera were also rarely present. Subsequent to the deposition of volcanic layers, a relatively quick foraminiferal repopulation took place, with high numbers and diversity values, suggesting the recovery of the stressed environment and the restoration of the oligotrophic and well-oxygenated conditions.

ID: 374

Instalación de la Primera Red Argentina de Monitoreo Volcánico Permanente en la Isla Decepción

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La Isla Decepción, situada en el archipiélago de las Shetland del Sur, a unos 100 kilómetros de la Península Antártica, es uno de los volcanes más activos del continente antártico, con varias decenas de erupciones en los últimos 10.000 años.

Desde el siglo XIX, este volcán ha tenido períodos de alta actividad, seguidos de décadas de inactividad. Sus últimas erupciones, ocurridas en 1967, 1969 y 1970, generaron importantes impactos dentro de la isla, incluyendo la destrucción de las bases británica y chilena, y la evacuación de la base argentina en la isla. A su vez, los episodios de reactivación registrados en 1992, 1999 y 2014-2015 demostraron que la potencial ocurrencia de erupciones volcánicas en la isla es una importante preocupación para científicos, personal técnico y logístico, así como turistas que se encuentren en ella o en sus proximidades. Actualmente, Isla Decepción muestra actividad fumarólica, anomalías térmicas, procesos activos de deformación y actividad sísmica, siendo objeto de estudio para numerosas disciplinas científicas y destino privilegiado para el turismo antártico.

Esta contribución busca mostrar los esfuerzos realizados por el Observatorio Argentino de Vigilancia Volcánica (OAVV) del SEGEMAR para la instalación de la primera red argentina de monitoreo volcánico permanente en la Isla Decepción. Esta nueva red, desplegada en marzo de 2023, no solo permitirá mejorar el conocimiento que se tiene sobre este sistema volcánico, sino que contribuirá al pronóstico de futuros eventos volcánicos en la isla y la gestión del riesgo volcánico en la región antártica.

ID: 589

The terrestrial and marine tephra record of the 1650 AD marine-emergent eruption of Kolumbo volcano, Greece: Challenges in eruptive stratigraphy and chronology.

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Understanding of explosive eruptions are heavily embedded in accurate interpretation of volcanic stratigraphy. However, the environment of deposition can play a major factor in the preservation of loose, fine volcanic material. Arid, windy environments with poor soil development, complex terrain, and mass wasting, are not conducive for tephra preservation. This potential loss of thin, fine terrestrial deposits from small, but impactful, eruptions is of great detriment to assessing the frequency of past eruptions, and thereby, a volcano's hazardous potential. The marine tephra record provides stratigraphy that can better preserve tephra deposition, albeit with some assumptions, and of course, greater challenges in sampling and acquisition. In locations where both terrestrial and marine sampling are available, both datasets should be analysed in tandem for a more comprehensive assessment of stratigraphy and eruptive processes. The 1650AD eruption of Kolumbo volcano, 7km NE offshore of Santorini, Greece, is of great interest due to the historic impacts of this eruption across the southern Aegean, and current hazard monitoring efforts of its active hydrothermal system. This study combines sampling from marine sediment cores that may contain ashfall from the 1650AD eruption, with new terrestrial sampling of tsunami deposits on islands impacted by 1650AD tsunami. Using a combination of particle density and size distribution analysis, SEM imagery and componentry, and field measurements, we will discuss the challenges and differences in both sampling environments. Nonetheless, the combination of these datasets permits a more in-detail perspective into the eruption dynamics, and timeline, of events for the 1650AD eruption.

ID: 779

Erupciones volcánicas recientes en Canarias: asesoramiento científico del Instituto Español de Oceanografía (IEO-CSIC) durante las crisis volcánicas de El Hierro (2011) y La Palma (2021)

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Canarias es un archipiélago volcánico activo. El Instituto Español de Oceanografía (IEO-CSIC) lleva más de una década monitorizando los efectos de la actividad volcánica del archipiélago sobre el medio marino, especialmente de las dos erupciones volcánicas más recientes. En 2011 tuvo lugar una erupción submarina al sur de la isla de El Hierro que duró 6 meses, afectando a todos los parámetros físico-químicos y biológicos en un área extensa alrededor de la isla, y ocasionando la destrucción casi total del ecosistema marino de la zona. Sin embargo, en los años siguientes el volcán evolucionó hacia un sistema hidrotermal con emisiones difusas que han sido clave para la recuperación del ecosistema, el cual hoy en día presenta una riqueza singular. El IEO-CSIC ha realizado más de 30 campañas oceanográficas para el monitoreo de este volcán submarino. Una década más tarde ocurrió otra erupción en el archipiélago, esta vez subaérea, en la isla de La Palma. Las coladas de lava de este volcán alcanzaron el mar generando deltas de lava. Este proceso también afectó al medio marino en todos sus ámbitos, especialmente generando una gran cantidad de turbidez en el medio. El ecosistema también se vio severamente afectado, con enterramiento de especies bentónicas, ausencia de especies pelágicas, y una gran disminución del fitoplancton. Durante estas dos crisis, el IEO-CSIC puso todos sus medios y su flota oceanográfica a disposición de la gestión de la crisis. La colaboración entre instituciones fue clave a la hora de ofrecer el mejor asesoramiento científico posible.