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Discovery of products from an explosive submarine eruption in Santorini Caldera implies more hazardous behavior of the Kameni Volcano

Scientist Jonas Preine and colleagues from the International Ocean Discovery Program (IODP) Expedition 398 Hellenic Arc Volcanic Field have found evidence of a historical submarine explosive eruption of Kameni Volcano, Santorini. Their paper in **Nature Geoscience (March 25th)** details newly discovered submarine pumice and ash deposits that support historical writings about a submarine eruption in 726 CE which produced pumice rafts that covered the sea over an immense area reaching the coasts of Asia Minor, over 400 km away. The study suggests a greater volcanic hazard exists than previously thought, which has important implications for hazard assessments of recharging volcanic systems locally and globally.

BACKGROUND:

Santorini is one of the best-studied island-arc volcanoes in the world. Yet the presence of vast amounts of pumice within the caldera from a historical submarine eruption of Kameni, the volcano in the center of the caldera, has remained unrecognized until now. The latest findings challenge established views on the volcanic activity in this region, with this discovery adding a new layer to the complex volcanic history of Santorini.

Santorini has been active for approximately 650,000 years and is classified a multi-cyclic volcano. Caldera cycles typically comprise phases of rejuvenation and recharge through new magma injections after caldera collapse with small but frequent eruptions. This is succeeded by a build-up stage with few eruptions over many thousands of years before a climatic eruption triggers caldera collapse, with the last one being the Late Bronze Age Minoan eruption of around 1600 BCE. This eruption is a pivotal event not only in volcanology but also in archaeology, potentially contributing to the decline of the Minoan civilization that populated the island of Crete.

Following that caldera-collapsing eruption, a new volcano, the Kameni Volcano emerged in the center of the caldera. Today, the summits of this largely submarine Kameni Volcano form the islands of Nea and Palea Kameni within Santorini caldera.

Recent findings from IODP Expedition 398 challenge the prevailing understanding of Santorini's volcanic phases. Previously, scientists assumed that the intra-caldera Kameni Volcano had been in a typical recharging

(lava-forming) phase since the Late Bronze Age Minoan eruption with 11 historically recorded effusive to mildly explosive eruptions since 197 BCE. However, IODP drilling inside of Santorini caldera suggests otherwise. Notably, the discovery of a 40-meter-thick pumice layer inside the caldera shows that the historical Kameni Volcano has been not only capable of small lava-forming eruptions but also larger explosive eruptions during the early stages of the caldera cycle. Integration of the core stratigraphy with a dense array of seismic profiles inside the caldera allows the pumice layer to be attributed to a historically recorded eruption in 726 BCE. The explosive eruption must have occurred largely under the water inside the flooded caldera, because almost no deposits from the eruption are found on land.

The shift in understanding Santorini's volcanic behavior has important implications for hazard assessment. It is noticeable that the 726 CE eruption was 30 times smaller than the Late Bronze Age Minoan eruption and there is no indication that an eruption even like that of 726 CE will happen again in the near future. However, it offers a worse-case eruptive scenario at Santorini caldera that must be taken into account in risk assessments. These findings also show that our global eruption records are largely blind to comparable submarine eruptions. Recognizing the potential for hazardous explosive eruptions in the early stages of the caldera building cycle is crucial for developing comprehensive risk mitigation strategies both locally and globally.

SCIENTIFIC OPERATIONS:

The expedition was conducted by the *JOIDES Resolution* Science Operator (JRSO) as part of the IODP. The IODP is a multidecadal, international research program supported by 22 nations, with the goal of exploring Earth's history and structure recorded in seafloor sediments and rocks and monitoring sub-seafloor environments. Expedition 398 sailed with 32 scientists from 9 countries, with expertise in a range of geoscience disciplines.

MORE INFORMATION:

About the expedition - [IODP JRSO • Expeditions • Hellenic Arc Volcanic Field \(tamu.edu\)](#)

About the research program - www.iodp.org

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Image: Credit Thomas Ronge, JRSO IODP. The JOIDES Resolution working in the Santorini caldera with Nea Kameni Volcano in the background.