

A seafloor observatory for the Kolumbo volcano: an informed modelling system

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Submarine hydrothermal systems that are located along active volcanic ridges and arcs are highly dynamic. Their restless state and puzzling evolution require state-of-the-art, long-term, and continuous in situ observation in order to perform the high-resolution monitoring that can ascertain their part in the evolution of ocean chemistry and volcanic change over time. Shallow-water hydrothermal systems in the subduction-related submarine arc volcanoes, like those along the active Hellenic Volcanic Arc in the Aegean Sea, are of particular interest because of their vicinity to highly populated/touristic areas (e.g., Santorini Island). There currently is limited knowledge of this type of hydrothermal activity, which is a source of volcanic heat, toxic metals/minerals, and greenhouse gases such as CO₂, that can be a serious risk for marine biota, including pelagic calcifiers (e.g., coccolithophores). Currently, there is no strategy for monitoring and identifying the sudden and potentially disastrous changes that often accompany these activities.

To confront these challenges, it is essential to establish a hybrid seafloor and water column observatory with fixed seafloor monitoring platforms that contain innovative sensors, an integrated onboard hybrid glider, and hover-capable autonomous underwater vehicles (AUV) that will enable large-scale/high-resolution visualization of spatial and temporal hydrothermal variability. The Kolumbo submarine volcano, located 7km NE of Santorini, and its hydrothermal vents at 500m bsl are known to discharge pure gaseous CO₂ and fluids at 220°C and could serve as a natural laboratory. The vents are enriched in critical metals (e.g., antimony) and support a thriving microbial activity, the speciation and diversity of which have not been fully evaluated. Such a shallow observatory will shed light on the processes that control local hydrothermal activity and the linkages to mantle processes, the crust, the oceans, and dark ecosystem function. This seafloor observatory will act as a proof of concept towards developing effective strategies for hazard mitigation in underwater volcanic systems worldwide.