Goldschmidt 2024 Abstract
https://doi.org/10.46247/gold2024.23810

Structural controls on the explosive volcanism of Hunga Volcano, Tonga

SUNG-HYUN PARK[1], SEUNG-SEP KIM, PHD[2], SHANE CRONIN[3], SEUNG-GOO KANG[1], HAKKYUM CHOI[1], JIN YOUNG JUNG[1], KYU-CHEUL YOO[1] AND JIHYUK KIM[4]

[1]Korea Polar Research Institute
[2]Chungnam National University
[3]University of Auckland
[4]Seoul National University

Presenting Author: shpark314@kopri.re.kr

Hunga volcano erupted on January 15, 2022, producing the largest volcanic plume since Pinatubo in 1991. The plume injected water into the mesosphere and caused exceptionally large tsunamis in Tonga and across the Pacific Ocean, reaching Japan and Peru. It may be the most powerful volcanic eruption of the 20th century. The Korea Polar Research Institute (KOPRI) conducted the world's first expedition to Hunga Volcano between the 8th and 17th of April 2022 to determine what caused the powerful eruption and Tsunami. The expedition included multibeam, geomagnetic surveys, CTD cast, and sediment sampling. The geomorphology revealed a dramatic change in the width and depth of the Hunga caldera. Initially ranging between 140 m above sea level to 200 meters below sea level at the deepest point, the post-eruption caldera is now 850 meters deep. Sparker surveys show flat-lying deposits inside the caldera are ~100 meters thick, which we interpret as syn- and post-eruptive pyroclastic and epiclastic deposits. This suggests the overall caldera collapse could have been >1000 meters. The geomagnetic survey confirmed the loss of magnetism between Hunga-Tonga (HT) and Hunga-Happai (HH) Islands, suggesting that the primary eruptive vent was located here. CTD surveys of the caldera interior showed little change in depth, and the seawater inside the caldera has characteristics similar to local surface waters. There is also little temperature increase at the bottom of the caldera, suggesting that the center is a collapsed block surrounded by ring-faults. CTD profile indicates that the pre-eruption rim is structurally sound and intact, with only localized channel erosion and deposition. We found many signs of life returning to the vent area already, meaning that ecology is recovering quickly. Because the seawater inside the caldera is isolated, the ecosystem is likely to decay rapidly. We surmise that the explosivity of Hunga Volcano was promoted by a narrow, confined conduit located at depth below the positions of HT and HH islands. The caldera collapse might be the leading cause of the strongest Tsunami.